



THE MADURA COLLEGE (AUTONOMOUS)

(Affiliated to Madurai Kamaraj University, Reaccredited (3rd cycle) with “A” Grade by NAAC)

TPK Road, Madurai – 625 011, Tamil Nadu

www.maduracollege.edu.in

ACADEMIC COUNCIL

17.06.2021



ESTD : 1889

Learning Shines with Righteousness

BOOK 2 of 3

(Corrected Copy)

(Syllabi Pages: 804-1572)



THE MADURA COLLEGE (AUTONOMOUS)

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Ordinary Meeting of the Academic Council

Venue : **Online at Google Meet** 
(<https://meet.google.com/igp-iops-gsm>)

Date : **17.06.2021**

Time : **10.30 a.m.**

Members are requested to bring with them this soft copy as well as the copy of the appendices.

Dr.R.Eswaran
Member Secretary

Dr.J.Suresh
Principal & Chairman



THE MADURA COLLEGE (AUTONOMOUS)
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ACADEMIC COUNCIL

MEMBERS IN THE ACADEMIC COUNCIL

Dr.J.Suresh

The Principal & Chairman

Dr.R.Eswaran

Member Secretary

EXTERNAL MEMBERS

Er.N.S.Krishnan,

President,
Madura College Board,
Madurai.

C.A.S.Natanagopal,

Secretary,
Madura College Board,
Madurai.

Sri.N.Anand Srinivasan,

Treasurer,
Madura College Board,
Madurai.

Dr.V.Chinniah,

Professor & Head, Department of Management Studies,
School of Business studies,
Madurai Kamaraj University,
Madurai -625 021.

Dr.R.Sudha,

Professor & Head, Department of French,
School of English and Foreign Languages,
Madurai Kamaraj University,
Madurai -625 021.

Dr.H.Shakila,

Professor & Head
Department of Molecular Microbiology,
School of Biotechnology,
Madurai Kamaraj University,
Madurai -625 021.

Dr.S.Vaidhya Subramanian,

Dean, (Member representing Education)
SASTRA University,
Tirumalai Samudiram,
Thanjavur – 613 401.

Sri.S.Sankaran,

(Member representing Profession)
Director – Madura College Board,
Madurai.

Sri.R.Sridharan,

(Member representing Profession)
Director – Madura College Board,
Madurai.

Sri.K.K.Raman,

(Member representing Industry)
President,
Sundaram Industries (TVS Rubber)
Madurai.

INTERNAL MEMBERS

Boards of Studies Chairmen	-	All Heads/Coordinators of the Department
Members of Academic Council	-	All Permanent Faculty Members
Special invitees	-	Nominated by Chairman
(Teachers on probation/Senior Faculties of SF stream)		



THE MADURA COLLEGE (AUTONOMOUS)

(Reaccredited with “A” Grade by NAAC)

ACADEMIC COUNCIL

AGENDA FOR THE MEETING ON 17.06.2021

1. Prayer
2. Welcome Address : The Chairman, Academic Council
3. Confirmation of the Minutes of the previous Academic Council Meeting held on 26.08.2020 & Resolutions passed by circulation on 22.10.2020
4. Resolutions of Boards of Studies from various Departments
5. Any other subjects brought forward by the Chairman
6. Observation & Remarks by the External Members
7. Vote of Thanks : Member Secretary

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I. CONFORMATION OF MINUTES OF THE PREVIOUS ACADEMIC COUNCIL MEETING HELD ON 26.08.2020.



THE MADURA COLLEGE
(Autonomous, Affiliated to Madurai Kamaraj University, Re-accredited (3rd Cycle) with 'A' Grade by NAAC)
MADUARI -625 011
MEETING OF THE ACADEMIC COUNCIL

Date: 26.08.2020 (Wednesday)

Venue: Online at Google Meet
(<https://meet.google.com/kgj-rjft-pzg>)

Time: 10:00 a.m.

MINUTES OF THE ACADEMIC COUNCIL MEETING

A meeting of the Academic council was held through online mode at Google meet (<https://meet.google.com/kgj-rjft-pzg>) on Wednesday, 26th August 2020.

1. The meeting was called to order by the Principal-cum-Chairman of the Academic council, Dr. J. Suresh and the meeting started with the college prayer. The Chairman, Academic council (here after Chairman) welcomed Sri. N.S. Krishnan, President, Madura College Board (MCB), Sri. S. Natanagopal, Secretary, MCB, Sri. N. Anand Srinivasan, Treasurer, MCB, Sri. S. Sankaran, Director, MCB, Sri. R. Sridharan, Director, MCB, Dr. R. Sudha, Professor and Head, Department of French, School of English and Foreign Languages & University Nominee, Dr. H. Shakila, Professor and Head, School of Biotechnology & University Nominee and all other members of the Academic council to the first meeting of Academic council of the academic year 2020-21. He also gave a prelude about Outcome Based Education (OBE) and its importance in the current scenario of paradigm shift in Higher education. He necessitated the need of OBE adoption by quoting from Darwin's words, "It is not the strongest who survive but the one most response to change". Also highlighted about the want of transparency in Higher education, outcome based shift in curriculum design and excellence of student centric model. He appreciated the sincere efforts taken by the members of OBE committee in the design and implementation of OBE.
2. The Minutes of the previous Academic council meeting, held on 10.07.2019, was confirmed and passed.
3. Resolutions No. **1.1 to 1.4** were moved by **Dr. S. Dhanasamy**, Chairman, Board of Studies (BoS) in Tamil and seconded by **Dr. A. Atheeswari**. Prof. S. Chellapandian suggested to change the title of a certificate course, "Art of Elocution" into "பேச்சுக்கலை". The Chairman, BoS in Tamil agreed to change the title. Then, the motion was put to vote and CARRIED.
4. Resolutions No. **2.1 and 2.2** were moved by **Prof. S. Murali**, Chairman, BoS in Hindi and seconded by **Dr. S. Dinakaran**. Dr. N. Sriman Narayanan, Controller of Examination (CoE) pointed out the unmatched nature of question pattern proposed. He emphasized four sections of questions such as Sections A, B, C & D that is followed in the curriculum of almost all the departments. Prof. S. Murali explained the difficulty in following such uniform question pattern by elucidating the factors such as very fundamental nature of the syllabi, tutoring the subject from very basic level, students' difficulty to cope up with higher objective questions. Sri. S. Natanagopal, Secretary, MCB, queried about the question pattern followed in the other language departments. Members deliberated about the different facets of following uniformity in question pattern for the language courses. The Chairman concluded and emphasized the need of uniformity in curriculum design and implementation. Prof. S. Murali assented to change the question pattern. Then, the motion was put to vote and CARRIED.
5. Resolutions No. **3.1 and 3.2** were moved by **Prof. P. Manikandan**, Chairman, BoS in Sanskrit and seconded by **Prof. S. Murali**. Sri. S. Natanagopal, Secretary, MCB, queried about the difficulty if any in following the uniform question pattern in Sanskrit language courses. Prof. P. Manikandan ascertained that no difficulty in following uniform question pattern. Then, the motion was put to vote and CARRIED.
6. Resolutions No. **4.1 to 4.5** were moved by **Dr. R. Subramony**, Chairman, BoS in English and seconded by **Dr. Sheela P. Karthick**. Sri. S. Natanagopal, Secretary, MCB, highlighted the question pattern with only three sections such as A, B & C in Page number 101. Dr. R. Subramony explained that the consensus arrived at

the BoS meeting after a long discussion. The Chairman intervened and clarified that the syllabi for the Part-II language should be as per Tamil Nadu State Council for Higher Education (TANSCHÉ) norms. Chairman added, "It is mandatory for the colleges of Tamil Nadu to follow the syllabi proposed by TANSCHÉ for Part-II languages, as per recent communication received from TANSCHÉ". He further recapitulated that the syllabi proposed in this meeting was a substitute for the TANSCHÉ syllabi and we may need to follow standard TANSCHÉ syllabi once the orders passed by TANSCHÉ.

Then, the motion was put to vote and CARRIED.

7. Resolutions No. **5.1 to 5.5** were moved by **Dr. S. Theenathayalan**, Chairman, BoS in Economics and seconded by **Dr. S. Karthikeyan**. Dr. S. Theenathayalan requested to read the resolution 5.3 as "*Resolved to introduce common syllabi for Business Economics and International Economics courses for the I year B.Com. Aided and I B.Com. Self-financing (General / Professional Accounting / Banking & Insurance / Capital Markets) for the students to be admitted from the academic year 2020-2021 onwards (pp 204-208; 247-253)*". Sri. S. Natanagopal, Secretary, MCB, suggested to include NITI Aayog in the syllabus. Dr. S. Theenathayalan accepted to incorporate it.

Then, the motion was put to vote and CARRIED.

8. Resolutions No. **6.1 to 6.7** were moved by **Dr. A. Mayilmurugan**, Chairman, BoS in Commerce and seconded by **Dr. S. Selvakumar**. Sri. S. Natanagopal, Secretary, MCB, recommended to add group discussion skills as a part in Unit-V of the course, 17U6KSM6-Soft Skills, in Page number 226. Dr. A. Mayilmurugan agreed for the inclusion.

Then, the motion was put to vote and CARRIED.

9. Resolutions No. **7.1 to 7.3** were moved by **Dr. S. Muthukumar**, Chairman, BoS in Mathematics and seconded by **Dr. I. Sahul Hamid**. Dr. S. Muthukumar requested the members to refer to Page number 321 and read Part I as Part II and vice versa in references column. In resolution 7.2, he asked the members to read "rectification" as "ratification". Dr. S. Karuppasamy, Deputy Controller of Examination (DCoE) questioned whether the syllabi for the certificate courses included in the Academic council book. Dr. S. Muthukumar emphasized that the syllabi would be included in the revised copy of the Academic council book.

Then, the motion was put to vote and CARRIED.

10. Resolutions No. **8.1 to 8.4** were moved by **Dr. S. Muthukumar**, Chairman, BoS in Statistics and seconded by **Dr. I. Sahul Hamid**. Dr. S. Muthukumar requested the members to read resolution 8.1. as "*Resolved to approve the syllabi along with question paper pattern for internal and external examinations for I B.Sc., Statistics from the academic year 2020-2021 onwards*". Dr. N. Sriman Narayanan, CoE, pointed out the discrepancy in credits in overall programme structure and in syllabus of the course in Page numbers 355, 356 and 363. Dr. S. Muthukumar accepted to modify as per the programme structure table in the corrected copy of the Academic council book. He also requested the members to read resolution 8.2. as "*Resolved to approve the syllabus for II M.Sc., Statistics major students who joined the course in July, 2019 onwards with aided stream*". In addition, he requested the members to read the word "rectify" in Resolution 8.3. as "ratify". Dr. S. Karuppasamy, DCoE, pointed out the inclusion of syllabi for the certificate courses in the revised copy of Academic council book. Dr. S. Muthukumar agreed to add the syllabus in the revised copy.

Dr. R. Sudha, University nominee queried the duration of the certificate course and suggested to rename the certificate course as the value added course. The chairman explained that the teaching duration of the certificate course per semester as 30 hours and also agreed to consider the renaming of the certificate courses as value added courses after consulting with Heads of the Departments. Er. J. Rajendran questioned the facilities and the skilled human resources for conducting more specialized certificate courses on computer science such as Visual basic. He opined that the specialized certificate courses on a subject should be run by the department of subjects concerned and not by other departments. Dr. S. Muthukumar highlighted about the need for the mathematics and statistics students to develop skills on computer programs. Further, he added that the choice for the joining of a certificate course was open for the students;

they have a freedom to choose certificate course(s) offered by any department. The chairman recapitulated that the objectives of offering certificate courses are to enrich the students' skill in the applied branches of Science/Arts. Hence, a department can bring certificate courses in related disciplines by considering the need of their students. He also requested the departments to reconcile in bringing the certificate courses. Then, the motion was put to vote and CARRIED.

11. Resolutions No. **9.1 to 9.4** were moved by **Dr. M. Prema Rani**, Chairman, BoS in Physics and seconded by **Prof. V. Meenakshi Sundaram**. Dr. M. Prema Rani requested the members to refer resolutions 9.2. & 9.3 and read "June 2020 onwards" as "academic year 2020-2021 onwards". Then, the motion was put to vote and CARRIED.

12. Resolutions No. **10.1 to 10.3** were moved by **Dr. A. Xavier**, Chairman, BoS in Chemistry and seconded by **Dr. P.S. Harikrishnan**. Dr. A. Xavier asked permission to change the resolution 10.2. The chairman suggested to give it in addendum. Dr. A. Xavier agreed and presented the Addendum as follows:
"Resolved to implement the syllabi for Ancillary Chemistry, evaluation components and question paper pattern for those who join B.Sc. Maths, Physics, Microbiology and Biotechnology in SF stream from the academic year 2020-2021 onwards. The students of Biotechnology and Microbiology will study the Ancillary Chemistry in their first year and the students of Mathematics and Physics will study the Ancillary Chemistry in their second year (pp478; 501-512)".
 Then, the motion was put to vote and CARRIED.

13. Resolutions No. **11.1 to 11.2** were moved by **Prof. S. Chellapandian**, Chairman, BoS in Botany and seconded by **Dr. P. Kannan**. Dr. H. Shakila, University nominee suggested to start certificate course in Horticulture and Herbal Technology. Dr. G. Sivasubramanian also suggested take up green campus initiations. Prof. S. Chellapandian appreciated the suggestions given by members and agreed to start certificate courses in the coming years. He also narrated the steps taken by the department towards Green Campus mission. Then, the motion was put to vote and CARRIED.

14. Resolutions No. **12.1 to 12.3** were moved by **Dr. S. Dinakaran**, Chairman, BoS in Zoology and seconded by **Dr. L.D. Devasree**. Dr. H. Shakila suggested to start Certificate courses in Sericulture, Vermitechnology, Dairy Technology, Animal disease and Health. Dr. S. Dinakaran elucidated the meager facility and space as a constraint for the running a certificate courses. He elated and registered the successful conduct of Certificate and Diploma Course in Medical Lab Technology by the department under the UGC funded programme. The chairman intervened and apprised the approval given by management for the erection of Vermibed in our college campus. Dr. S. Karuppasamy, DCoE, doubted about Resolution 12.3. as the department offer ancillary only to Chemistry students. Dr. S. Dinakaran clarified that Department offers Ancillary papers also to II B.Sc. Botany students. Then, the motion was put to vote and CARRIED.

15. Resolutions No. **13.1 and 13.2** were moved by **Er. J. Rajendran**, Chairman, BoS in Computer Science and seconded by **Prof. R. Umasankari**. Members unanimously agreed the resolutions. Then, the motion was put to vote and CARRIED.

16. Resolutions No. **14.1 and 14.2** were moved by **Prof. K.Rajasaravankumar**, Chairman, BoS in Information Technology and seconded by **Dr. N. Paneerselvam**. Members unanimously agreed the resolutions. Then, the motion was put to vote and CARRIED.

17. Resolutions No. **15.1 and 15.4** were moved by **Dr. N. Paneerselvam**, Chairman, BoS in Microbiology and seconded by **Prof. K.Rajasaravankumar**. Members unanimously agreed the resolutions. Then, the motion was put to vote and CARRIED.

18. Resolutions No. **16.1 and 16.3** were moved by **Dr. N. Paneerselvam**, Chairman, BoS in Microbiology and seconded by **Prof. K.Rajasaravanakumar**. Dr. S. Dinakaran interrogated that the conduct of the certificate course in Medical Lab Technology as it requires following guidelines from medical board and needing of skilled professionals. He recalled the collaboration made with professionals from Rajaji Government Hospitals, Madurai during the conduct of the course in Zoology department. The Chairman requested the department to strictly follow guidelines from government. Then, the motion was put to vote and CARRIED.
19. Resolutions No. **17.1** was moved by **Prof. S. Sivaramakrishnan**, Dean (Academic) and seconded by **Dr. I. Sahul Hamid**, Dean (Planning & Development). Members unanimously agreed the resolution. Then, the motion was put to vote and CARRIED.
20. Resolutions No. **18.1** was moved by **Prof. S. Chella Pandian**, and seconded by **Dr. S. Dinakaran**. Dr. S. Theenathayalan suggested to change the title as Environmental studies instead of Environmental Science. Prof. S. Chellapandian clarified that Environmental Science is a more focused term than Environmental studies. Dr. S. Muthukumar, Dean (Administration) also suggested to change the title as "Environmental studies" as this paper is a common paper to be taught in the Under-graduate courses as per UGC guidelines. Dr. S. Theenathayalan also added that the title, Environmental studies, is followed in many of the colleges under Madurai Kamaraj University (MKU) as per TANSCH to meet UGC standard. Tracing the history and factors for inclusion of this paper, Prof. S. Chellapandian highlighted the importance of scientific approach to the Environment instead of a mere study and thus he insisted to retain it as "Environmental science". Only then, students will have the attitude to preserve and sustain the components of different ecosystems. The chairman cautioned that the title must be relevant with content and he suggested to keep the title as Environmental Science and if needed to change the title then we may have to change the syllabus too. Dr. S. Dinakaran also reiterated that the contents should be more relevant than a use of specific technical jargon. Finally, the Chairman recapitulated that the title of the course can be "Environmental Science". Then, the motion was put to vote and CARRIED.
21. Resolutions No. **19.1** was moved by **Dr. S. Theenathayalan** and seconded by **Dr. A. Mayilmurugan**. Members unanimously agreed the resolution. Then, the motion was put to vote and CARRIED.
22. The chairman requested the Secretary, MCB and University nominees to give their observations and remarks. Dr. R. Sudha appreciated the Academic council for the healthy deliberations. She also suggested to add more practical components in the certificate course. Dr. H. Shakila also praised the college as the first college under MKU conducted the Academic council meeting in online mode and appreciated the entire team for the successful conduct of the academic council meeting. She also suggested to start more value added courses. The chairman agreed to the suggestions and also envisioned that two certificate courses from a department per year now will result to have 5 or 6 certificate courses in each department after three years.

The member Secretary, Dr. R. Eswaran proposed vote of Thanks.

The Chairman adjourned the meeting of the Academic council after singing of the National Anthem by all.



Dr.R.Eswaran
Member Secretary



Dr.J.Suresh
Principal & Chairman

I. CONFORMATION OF RESOLUTIONS PASSED BY CIRCULATION ON 22.10.2020

1) FROM BOTANY DEPARTMENT

Prof.S.Chellapandian, Chairman, Board of Studies in Botany, brought the resolution and seconded by **Dr.P.Kannan**.

- Resolved to ratify the syllabi for the certificate course “ETIQUETTE” for the UG students of The Madura College.

2) FROM CONTROLLER OF EXAMINATIONS

Dr.V.Sriman Narayanan, Controller of Examination (CoE), brought the resolution and seconded by **Dr.S.Karuppusamy**, Deputy Controller of Examination (DCoE).

- Resolved to ratify the conduct of final semester UG and PG April 2020 examinations in online mode, from 21-09-2020 to 28-09-2020, as per UGC-Guidelines and State Government order vide no: 111 and 125 dated 27-07-2020 and 26-08-2020.
- Resolved to ratify the procedure for processing the results of students in the 2nd Semester and 4th semester as per UGC-Guidelines and the orders of Department of Higher Education, Government of Tamilnadu, for April 2020 semester examinations.

Dr.R.Eswaran
Member Secretary

Dr.J.Suresh
Principal & Chairman

II. BUSINESS BROUGHT FORWARD BY THE CHAIRMAN

- Resolved that students of B.Sc. Physics who join the programme from the Academic year 2021-22 will study Chemistry as their first Ancillary subject and Mathematics as their second ancillary subject.

III. RESOLUTIONS BROUGHT FORWARD BY HEAD OF VARIOUS DEPARTMENTS

1) FROM THE BOARD OF STUDIES OF TAMIL DEPARTMENT

Dr.S.Dhanasamy, Chairman, Board of Studies in Tamil, shall move and **Dr.A.Atheeswari** shall second the following resolutions, passed in the Board of Studies meeting held on 22.04.2021.

- 1.1. Resolved to pass the revised syllabi for Part -I Tamil, for the II year B.A./ B.Sc. of Semesters III & IV, offered to students who joined in the Academic year 2020-21 and onwards **(pp 1-11, 25-32)**.
- 1.2. Resolved to pass the syllabi for II year B.A. Tamil to be offered to students who joined B.A. Tamil in the Academic year 2020-21 and onwards **(pp 46-115)**.
- 1.3. Resolved to pass the Programme structure of M.A. Tamil and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards **(pp 150-244)**.
- 1.4. Resolved to introduce add-on courses in the II year of B.A. Tamil programme students who joined in the Academic year 2020-21 and onwards **(pp 116-120)**.
- 1.5. Resolved to introduce self-study course for Advanced Learners in B.A. Tamil programme students who joined in the Academic year 2020-21 and onwards **(pp 121-122)**.
- 1.6. Resolved to ratify and approve the syllabi for the following papers offered to students who joined in the Academic year 2020– 21 and onwards **(pp 130-145)**.

20U2TMC3 - அற இலக்கியம்

20U2TAC2 - சிற்றிலக்கியம்

- 1.7. Resolved to ratify and approve the K-levels, blue print for Internal and external examinations, for courses offered in I year B.A. Tamil programme, for students who joined in the Academic year 2020-21 and onwards **(pp 146-148)**.

- 1.8. Resolved to pass the syllabi of the certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**pp 127-129**).
- 1.9. Resolved to ratify the syllabi of Certificate courses for students who admitted in the Academic year 2020-21 and onwards (**pp 123-126**).
- 1.10. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.A. Tamil course, for students who joined in the Academic year 2020-21 and onwards (**P 149**).
- 1.11 Resolved to introduce the revised syllabus for the following NME courses offered to those students who did not study Tamil as Part-I subject in the School education (**pp 12-17, 33-37**).

20U3TNMB1 - அடிப்படைத் தமிழ் - 1

20U4TNMB2 - அடிப்படைத் தமிழ் - 2

- 1.12. Resolved to introduce the revised syllabus for the following NME courses offered to those students who did not study Tamil as Part-I subject during collegiate Education (**pp 18-24, 38-45**).

20U3TNMA1 - சிறப்புத் தமிழ் - 1

20U4TNMA2 - சிறப்புத் தமிழ் - 2

2) FROM THE BOARD OF STUDIES OF HINDI DEPARTMENT

Prof.S.Murali, Chairman, Board of Studies in Hindi, shall move and **Dr.S.Dinakaran** shall second the following resolutions, passed in the Board of Studies meeting held on 22.04.2021.

- 2.1. Resolved to pass the revised syllabi for Part –I HINDI for II year B.A./B.Sc. of Semesters III &IV for students who joined the programme in the Academic year 2020-21 and onwards (**pp 245-253**).
- 2.2. Resolved to pass the syllabi of certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**P 254**).

3) FROM THE BOARD OF STUDIES OF SANSKRIT DEPARTMENT

Prof.P.Manikandan, Chairman, Board of Studies in Sanskrit, shall move and **Prof.S.Murali** shall second the following resolutions, passed in the Board of Studies meeting held on 22.04.2021.

- 3.1. Resolved to pass the revised syllabi for Part –I SANSKRIT for II year B.A/ B.Sc. of Semesters III & IV for students who joined the programme in the Academic year 2020-21 and onwards (**pp 255-270**).
- 3.2. Resolved to pass the syllabus of certificate course for students to be admitted in the Academic year 2021-22 and onwards (**pp 271-272**).

4) FROM THE BOARD OF STUDIES OF ENGLISH DEPARTMENT

Dr.R.Subramony, Chairman, Board of Studies in English, shall move and **Dr.Sheela P.Karthick** shall second the following resolutions, passed in the Board of Studies meeting held on 22.04.2021.

- 4.1. Resolved to ratify the syllabi for part -II English for students who joined the B.A. /B.Sc. of Semesters I & II and B.Com. of Semester I Programme in the Academic year 2020-21 and onwards (**pp 273-293**).
- 4.2. Resolved to pass the revised syllabi for Part -II English for students who joined II year B.A/ B.Sc. of Semesters III & IV and B.Com. of Semester IV programme in the Academic year 2020-21 and onwards (**pp 294-309**).
- 4.3. Resolved to pass the Programme structure of M.A. English and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 389-442**).
- 4.4. Resolved to pass the syllabi for II year B.A. English to be offered to students who joined B.A. English in the Academic year 2020-21 and onwards (**pp 310-375**).
- 4.5. Resolved to introduce add-on courses in the II year of B.A. English programme students in the Academic year 2020-21 and onwards (**pp 378-380**).
- 4.6. Resolved to ratify add-on course in the III year of B.Sc. / B.A./B.Com. programme for students in the Academic year 2020-21 and onwards (**pp 376-377**).
- 4.7. Resolved to introduce Self-Study course for Advanced Learners in B.A. programme for students who joined the programme in the Academic year 2020-21 and onwards (**P 381**).
- 4.8. Resolved to pass the syllabus of certificate course for students to be admitted in the Academic year 2021-22 and onwards (**P 382**).

- 4.9. Resolved to ratify the syllabi of Certificate courses for students admitted in the Academic year 2020-21 and onwards (**pp 383-387**).
- 4.10. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.A. English course for students who joined in the Academic year 2020-21 and onwards (**P 388**).

5) FROM THE BOARD OF STUDIES OF ECONOMICS DEPARTMENT

Dr.S.Theenathayalan, Chairman, Board of Studies in Economics, shall move and **Dr.P.Kannan** shall second the following resolutions, passed in the Board of Studies meeting held on 22.04.2021.

- 5.1. Resolved to pass the syllabi for II year B.A. Economics Programme for students who joined in the Academic year 2020-21 and onwards (**pp 446-492**).
- 5.2. Resolved to introduce add-on courses in the II year B.A. Economics Programme for students who joined in the Academic year 2020-21 and onwards (**pp 493-495**).
- 5.3. Resolved to introduce Self-Study courses for Advanced Learners in II B.A. Economics programme for the students who joined the programme in the Academic year 2020-21 and onwards (**pp 495-496**).
- 5.4. Resolved to pass the syllabus for the certificate course in Salesmanship for the students to be admitted in the Academic year 2020-21 and onwards (**P 497**).
- 5.5. Resolved to Ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.A. Economics courses for the students who joined the programmes in the Academic year 2020-21 and onwards (**pp 498-499**).
- 5.6. Resolved to pass the Programme structure of M.A. Economics and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 500-568**).

6) FROM THE BOARD OF STUDIES OF COMMERCE DEPARTMENT

Dr.A.Mayil Murugan, Chairman, Board of Studies in Commerce, shall move and **Dr.S.Selvakumar** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 6.1. Resolved to replace the course on ‘Business Mathematics and Statistics’ offered in II semester of B.com. “(General, PA, B&I, CM) with ‘Business Statistics’, for those who join in the Academic year 2021-22 onwards (**pp 569-573**).
- 6.2. Resolved to pass revised syllabi for II Year B.Com (General) for the students who joined in the Academic year 2020– 21 and onwards (**pp 574-688**).

- 6.3. Resolved to pass revised syllabi for II Year B Com., (Professional Accounting) for the students who joined in the Academic year 2020– 21 and onwards (**pp 574-688**).
- 6.4. Resolved to pass revised syllabi for II Year B .Com (Banking and Insurance) for the students who joined in the Academic year 2020– 21 and onwards (**pp 574-688**).
- 6.5. Resolved to pass revised syllabi for II Year B.Com (Capital Markets) for the students who joined in the Academic year 2020– 21 and onwards (**pp 574-688**).
- 6.6. Resolved to pass revised syllabi on ‘Basics of Accounting’ and ‘Marketing and Salesmanship’ as NME papers during the III and IV semesters for the students who joined in the Academic year 2020– 21 and onwards (**pp 628-632, 681-685**).
- 6.7. As suggested by subject experts, resolved to introduce Add-on course on ‘Principles of Co-operation’ for B.Com (General, PA, B&I, CM) in the III semester for students who joined in the Academic year 2020-21 and onwards (**P 687**).
- 6.8. Resolved to introduce Add-on course on ‘Business Mathematics’ during the II semester for B.Com (General, PA, B&I, CM) I year students who join in the Academic year 2021-22 and onwards, further this course enable the students to appear in the competitive exams and professional courses viz., CA & CMA (**P 686**).
- 6.9. Resolved to introduce self-learning course for advanced learners on ‘Indian Constitution’ during the IV semester for B.Com (General, PA, B&I, CM) II year students who joined in the Academic year 2020-21 and onwards (**P 688**).
- 6.10. Resolved to pass the Programme Structure of M.Com and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 709-803**).
- 6.11. Resolved to approve inter-disciplinary course ‘Financial Accounting’ in III Semester and ‘Business Statistics’ in IV semester for II Year B.Sc. (Information Technology) students who joined in the Academic year 2020– 21 and onwards (**pp 694-703**).
- 6.12. Resolved to approve inter-disciplinary course ‘Financial and Management Accounting’ in III semester for II Year B.A (Economics) students who joined in the Academic year 2020– 21 and onwards (**pp 704-708**).
- 6.13. Resolved to ratify and approve syllabi for the certificate courses offered during the academic year 2020-21 and onwards for students of all disciplines (**pp 689-693**).
- 6.14. Resolved to pass, two online certificate courses on ‘Derivative Market’ and ‘Foreign Exchange and Currency Markets’ in III semester. Further four certificate courses on ‘Capital

Market Operations', 'Back Office' , 'Depository Operations & Clearing' and 'Settlement & Risk Management' in the IV semester offered by National Stock Exchange (NSE) Academy for the B.Com (Capitam Marketing) students who joined in the Academic year 2020– 21 and onwards

- 6.15. Resolved to have two certificate courses on '**Fundamental Analysis and Technical Analysis**' at the end of II year. This course is offered as workshop outside the syllabi at the end of II Year B.Com (CM) for the students who joined in the Academic year 2020– 21 and onwards.
- 6.16. Resolved to follow the eligibility norms for admission into B.Com (Professional Accounting), B.Com (Banking & Insurance) and B.Com (Capital Markets) programmes, as prescribed by Government of Tamil Nadu for admission into B.Com.

7) FROM THE BOARD OF STUDIES OF MATHEMATICS DEPARTMENT

Dr.S.Muthukumar, Chairman, Board of Studies in Mathematics, shall move and **Dr.C.Thangapandi** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 7.1. Resolved to pass the revised syllabi for II year B.Sc. Mathematics Programme for students who joined the programme in the Academic year 2020-21 and onwards (**pp 804-859**).
- 7.2. Resolved to pass the Programme structure of M.Sc. Mathematics and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 885-956**).
- 7.3. Resolved to pass the revised syllabi for Allied Courses to be offered to students who joined B.Sc. (chemistry) in the Academic year 2020-21 and onwards (**pp 864-877**).
- 7.4. Resolved to introduce add-on courses in the II year of B.Sc. Mathematics programme for the Students who joined in the Academic year 2020-21 and onwards (**pp 860-862**).
- 7.5. Resolved to introduce Self-Study courses for Advanced Learners in B.Sc. Mathematics Programme for the students who joined in the Academic year 2020-21 and onwards (**pp 862-863**).
- 7.6. Resolved to approve the syllabi of certificate courses for the students to be admitted in the Academic year 2021-22 and onwards (**pp 878-881**).
- 7.7. Resolved to ratify the syllabi of Certificate courses offered to the students who joined in the Academic year 2020-21 and onwards (**P 882**).

- 7.8. Resolved to ratify the nature of course, rationale and activities having direct bearing on Nature of course offered to I year B.Sc. students who joined in the Academic year 2020-21 (**pp 883-884**).

8) FROM THE BOARD OF STUDIES OF STATISTICS DEPARTMENT

Dr.S.Muthukumar, Chairman, Board of Studies in Statistics, shall move and **Dr.C.Thangapandi** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 8.1. Resolved to pass the Programme structure of M.Sc. Statistics and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 957-1045**).
- 8.2. Resolved to pass the syllabi of certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**pp 1046-1047**).
- 8.3. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.Sc. Statistics course for students who joined in the Academic year 2020-21 and onwards (**pp 1048-1049**).

9) FROM THE BOARD OF STUDIES OF PHYSICS DEPARTMENT

Dr.R.Saravanan, Chairman, Board of Studies in Physics, shall move and **Dr.M.Prema Rani** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 9.1. Resolved to ratify the revised programme structure for B.Sc. programme for students who joined in the academic year 2020-2021 onwards (**pp 1050-1052**).
- 9.2. Resolved to pass the revised syllabi for II year B.Sc. Physics programme for students who joined in the academic year 2020-2021 onwards (**pp 1053-1086**).
- 9.3. Resolved to pass the Programme structure of M.Sc. Physics and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 1098-1169**).
- 9.4. Resolved to introduce Add-on courses in the II year of B.Sc. Physics programme for students who joined in the academic year 2020-21 and onwards (**pp 1087-1090**).
- 9.5. Resolved to introduce Self-Study courses for Advanced Learners in B.Sc. Physics programme for students who joined in the academic year 2020-21 and onwards (**pp 1090-1091**).

- 9.6. Resolved to pass the syllabi of Certificate courses for students to be admitted in the academic year 2021-22 and onwards (**pp 1092-1094**).
- 9.7. Resolved to ratify the syllabi of Certificate Courses for students offered in the Academic year 2020-21 and onwards (**P 1095**).
- 9.8. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.Sc. Physics programme for students who joined in the Academic year 2020-21 and onwards (**pp 1096-1097**).

10) FROM THE BOARD OF STUDIES OF CHEMISTRY DEPARTMENT

Dr.A.Xavier, Chairman, Board of Studies in Chemistry, shall move and **Dr.P.S.Harikrishnan** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 10.1. Resolved to ratify the revised programme structure for students who joined the B.Sc. Chemistry programme in the Academic year 2020-21 and onwards (**pp 1170-1181**).
- 10.2. Resolved to pass the revised syllabi for II year B.Sc. Chemistry programme for students who joined the programme in the Academic year 2020-21 and onwards (**pp 1182-1222**).
- 10.3. Resolved to pass the Programme structure of M.Sc. Chemistry and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 1252-1335**).
- 10.4. Resolved to pass the revised syllabi for allied courses to be offered to students who joined B.Sc. Mathematics & B.Sc. Physics programme in the Academic year 2020-21 and onwards (**pp 1223-1241**).
- 10.5. Resolved to introduce add-on courses in II year of B.Sc. Chemistry programme for students who joined in the Academic year 2020-21 and onwards (**pp 1242-1244**).
- 10.6. Resolved to introduce self-study course for advanced learners in B.Sc. Chemistry programme for students who joined the programme in the Academic year 2020-21 and onwards (**pp 1242, 1245**).
- 10.7. Resolved to pass the syllabi of certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**pp 1246-1247**).
- 10.8. Resolved to ratify the syllabi of Certificate courses for students admitted from the academic year 2019-20 (**pp 1248**).

- 10.9. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B. Sc. Chemistry for students who joined in the Academic year 2020-21 and onwards (**pp 1249-1251**).

11) FROM THE BOARD OF STUDIES OF BOTANY DEPARTMENT

Prof.S.Chellapandian, Chairman, Board of Studies in Botany, shall move and **Dr.P.Kannan** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 11.1. Resolved to ratify the revised programme structure for students who joined the B.Sc. Botany Programme in the Academic year 2020-21 and onwards (**pp 1336-1342**).
- 11.2. Resolved to pass the revised syllabi for II year B.Sc. Botany Programme for students who joined the programme in the Academic year 2020-21 and onwards (**pp 1343-1390**).
- 11.3. Resolved to pass the Programme structure of M.Sc. Botany and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 1418-1485**).
- 11.4. Resolved to introduce add-on courses, Crop varieties and Industrial Botany, in the II year of B.Sc. Botany programme for students who joined in the Academic year 2020-21 and onwards (**pp 1391-1392**).
- 11.5. Resolved to introduce Self-Study paper on ‘Secondary metabolites’ for Advanced Learners in B.Sc. Botany programme for students who joined the programme in the Academic year 2020-21 and onwards (**P 1393**).
- 11.6. Resolved to pass the syllabi of Diploma course on “Gardening” for students to be admitted in the Academic year 2021-22 and onwards (**pp 1394-1403**).
- 11.7. Resolved to pass the syllabi of certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**pp 1404-1408**).
- 11.8. Resolved to ratify the nature of course, Course Learning Outcomes (CLOs), rationale and activities having direct bearing on nature of course offered to I year B.Sc. Botany courses for students who joined in the Academic year 2020-21 and onwards (**pp 1409-1417**).

12) FROM THE BOARD OF STUDIES OF ZOOLOGY DEPARTMENT

Dr.S.Dinakaran, Chairman, Board of Studies in Zoology, shall move and **Dr.L.D.Devasree** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 12.1. Resolved to ratify the revised programme structure for students who joined the B.Sc. Zoology Programme in the Academic year 2020-21 and onwards (**pp 1486-1489**).
- 12.2. Resolved to pass the revised syllabi for II year B.Sc. Zoology Programme for students who joined the programme in the Academic year 2020-21 and onwards (**pp 1490-1523, 1544-1555**).
- 12.3. Resolved to pass the revised syllabi for Allied Courses to be offered to students who Joined B.Sc. Botany in the Academic year 2020-21 and onwards (**pp 1524-1543**).
- 12.4. Resolved to introduce add-on courses in the II year of B.Sc. Zoology programme for students who joined in the Academic year 2020-21 and onwards (**pp 1556-1558**).
- 12.5. Resolved to introduce Self-Study courses for Advanced Learners in B.Sc. Zoology programme for students who joined the programme in the Academic year 2020-21 and onwards (**P 1559**).
- 12.6. Resolved to pass the syllabi of certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**pp 1560-1561**).
- 12.7. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.Sc. Zoology courses for students who joined in the Academic year 2020-21 and onwards (**pp 1562-1572**).

13) FROM THE BOARD OF STUDIES OF COMPUTER SCIENCE DEPARTMENT

Er.J.Rajendran, Chairman, Board of Studies in Computer Science, shall move and **Prof.R.Umasankari** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 13.1. Resolved to Ratify the revised programme structure for the students those who joined in B.Sc. Computer Science Programme of both Aided and self-finance stream in the Academic year 2020-21 and onwards (**pp 1573-1580**).
- 13.2. Resolved to pass the revised syllabi of II year B.Sc. Computer Science Programme (III and IV semesters) for students who joined the programme in both aided and self-finance stream in the Academic year 2020-21 and onwards (**pp 1581-1632**).
- 13.3. Resolved to pass the revised syllabi for Allied Courses to be offered to students who joined in B.Sc. Computer Science in the Academic year 2020-21 and onwards (**pp 1592-1597**).

- 13.4. Resolved to introduce add-on courses in the II year of B.Sc. Computer science programme for the students those who joined in the Academic year 2020-21 and onwards (**pp 1604-1605, 1631-1632**).
- 13.5. Resolved to introduce Self-Study courses for Advanced Learners in B.Sc. Computer science programme for the students who joined in the programme in the Academic year 2020-21 and onwards (**P 1606**).
- 13.6. Resolved to Ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.Sc. Computer science course for students who joined in the Academic year 2020-21 and onwards (**pp 1633-1634**).

14) FROM THE BOARD OF STUDIES OF INFORMATION TECHNOLOGY DEPARTMENT

Prof.K.Rajasaravanakumar, Chairman, Board of Studies in Information Technology, shall move and **Dr.N.Paneerselvam** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 14.1. Resolved to ratify the revised programme structure for students who joined the B.Sc. Information Technology (I.T) Programme in the Academic year 2020-21 and onwards (**pp 1635-1637**).
- 14.2. Resolved to pass the revised syllabi for II year B.Sc. (I.T) Programme for students who joined the programme in the Academic year 2020-21 and onwards (**pp 1638-1679**).
- 14.3. Resolved to pass the Programme structure of M.Sc. Computer Science and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021– 22 and onwards (**pp 1690-1784**).
- 14.4. Resolved to introduce add-on courses in the II year of B.Sc. (I.T) programme for students who join in the Academic year 2020-21 and onwards (**pp 1680-1683**).
- 14.5. Resolved to introduce Self-study Courses for Advanced Learners in B.Sc. (I.T) programme for students who join the programme in the Academic year 2020-21 and onwards (**pp 1684-1685**).
- 14.6. Resolved to pass the syllabi of certificate courses for students to be admitted in the Academic year 2021-22 and onwards (**pp 1686-1689**).
- 14.7. Resolved to ratify the programme structure, nature of course, rationale, activities having direct bearing on nature of course, and K-levels in course content, Formative & Summative Question Patterns, offered to I year B.Sc. (I.T) programme for students who joined in the Academic year 2020-21 and onwards (**pp 1785-1833**).

15) FROM THE BOARD OF STUDIES OF MICROBIOLOGY DEPARTMENT

Dr.N.Paneerselvam, Chairman, Board of Studies in Microbiology, shall move and **Prof.K.Rajasaravanakumar** shall second the following resolutions, passed in the Board of studies meeting held on 22.04.2021.

- 15.1. Resolved to ratify the revised programme structure for students who joined the B.Sc. Microbiology Programme in the Academic year 2020-21 and onwards **(pp 1834-1842)**.
- 15.2. Resolved to introduce the revised syllabi for II year B.Sc. Microbiology Programme (semester III and IV) for students who joined the programme in the Academic year 2020-21 and onwards **(pp 1843-1882)**.
- 15.3. Resolved to ratify the revised syllabi for Allied Courses for students who joined B.Sc. Biotechnology in the Academic year 2020-21 and onwards **(pp 1897-1916)**.
- 15.4. Resolved to pass the Programme structure of M.Sc. Microbiology and syllabi of I year i.e., I and II Semesters, for students who join the programme in the Academic year 2021–22 and onwards **(pp 1921-2003)**.
- 15.5. Resolved to introduce syllabi and the evaluation pattern for add-on courses in the II year of B.Sc. Microbiology programme for students who joined in the Academic year 2020-21 and onwards **(pp 1883-1886)**.
- 15.6. Resolved to introduce syllabus and the evaluation pattern for Self-Study courses for Advanced Learners in the B.Sc. Microbiology programme for students who joined the programme in the Academic year 2020-21 and onwards **(pp 1889-1890)**.
- 15.7. Resolved to introduce the certificate courses for students of Under-graduate science programmes admitted from the Academic year 2020-21 and onwards **(pp 1887-1888)**.
- 15.8. Resolved to ratify the evaluation component and question pattern for Certificate courses conducted during the Academic year 2020-2021.
- 15.9. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.Sc. Microbiology course for students who joined in the Academic Year 2020-21 and onwards **(pp 1891-1896, 1917-1920)**.

16) FROM THE BOARD OF STUDIES OF BIOTECHNOLOGY DEPARTMENT

Dr.N.Panneerselvam, Chairman, Board of studies of Biotechnology, shall move and **Prof. K.Rajasaravanakumar**, shall second the following resolutions, passed in the meeting of the Board of studies in Biotechnology held on 22.04.2021.

- 16.1. Resolved to ratify the revised programme structure for students who joined the B.Sc. Biotechnology Programme in the Academic year 2020-21 and onwards **(pp 2004-2010)**.
- 16.2. Resolved to introduce the revised syllabi for II year B.Sc., Biotechnology Programme (Semester III and IV) for students who joined the programme in the Academic year 2020-21 and onwards **(pp 2011-2048)**.
- 16.3. Resolved to introduce new syllabi for Allied Courses to be offered to students who join B.Sc. Microbiology in the Academic year 2020-21 and onwards **(pp 2049-2064)**.
- 16.4. Resolved to introduce syllabi and the evaluation pattern for add-on courses in the II year of B.Sc. Biotechnology programme for students who join in the Academic year 2020-21 and onwards **(pp 2067-2069)**.
- 16.5. Resolved to introduce syllabi and the evaluation pattern for Self-Study courses for Advanced Learners in the B.Sc. Biotechnology programme for students who join the programme in the Academic year 2020-21 and onwards **(pp 2067, 2070-2071)**.
- 16.6. Resolved to introduce the syllabi for certificate courses for students to be admitted in the Academic year 2020-21 and onwards **(pp 2065-2066)**.
- 16.7. Resolved to ratify the evaluation component and question pattern for Certificate courses for all UG/PG students admitted in the Academic year 2020-2021 and onwards.
- 16.8. Resolved to ratify the nature of course, rationale and activities having direct bearing on nature of course offered to I year B.Sc. Biotechnology programme for students who joined in the Academic year 2020-21 and onwards **(pp 2072-2076)**.

FROM THE BOARD OF STUDIES OF PART V ACTIVITIES

17) FROM THE BOARD OF STUDIES IN NATIONAL CADET CORPS (NCC)

Dr.S.V.Karthikeyan, Chairman, Board of studies in NCC, shall move and **Dr.K.Kathirvelpandian**, shall second the following resolution passed in the meeting of the Board of studies in NCC held on 06.05.2021.

- 17.1. Resolved to ratify and approve the syllabi for Part-V NCC for students who joined in the academic year 2020-21 and onwards **(pp 2077-2085)**.

18) FROM THE BOARD OF STUDIES IN NATIONAL SERVICE SCHEME (NSS)

Dr.M.Malarvizhi, Chairman, Board of studies in NSS, shall move and **Dr.Y.Natarajan**, shall second the following resolution passed in the meeting of the Board of studies in NSS held on 06.05.2021.

- 18.1. Resolved to ratify and approve the syllabi for Part-V NSS for students who joined in the academic year 2020–21 and onwards (**pp 2086-2093**).

19) FROM THE BOARD OF STUDIES IN YOUTH RED CROSS (YRC)

Dr.S.Selvakumar, Chairman, Board of studies in YRC, shall move and **Dr.D.Gandhimathi**, shall second the following resolution passed in the meeting of the Board of studies in YRC held on 06.05.2021.

- 19.1. Resolved to ratify and approve the syllabi for Part-V YRC for students who joined in the academic year 2020–21 and onwards (**pp 2094-2101**).

20) FROM THE BOARD OF STUDIES IN PHYSICAL EDUCATION

Dr.K. Kathirvelpandian, Chairman, Board of studies in Physical Education, shall move and **Dr.S.V.Karthikeyan**, shall second the following resolution passed in the meeting of the Board of studies in Physical Education held on 06.05.2021.

- 20.1. Resolved to ratify and approve the syllabi for Part-V Physical education for students who joined in the academic year 2020–21 and onwards (**pp 2102-2109**).

21) FROM CONTROLLER OF EXAMINATIONS

Dr.V.Srivan Narayanan, Controller of Examinations (CoE), shall move and **Dr.S.Karuppusamy**, Deputy Controller of Examinations (DCoE), shall second the following resolutions:

- 21.1. Resolved to award “FIRST CLASS WITH DISTINCTION” as a class in all post-graduate programmes for students who joined the PG programmes from the academic year 2021–22 and obtain passing grades in all courses in first attempt and secure at least 75% marks or more.
- 21.2. Resolved to ratify the conduct of November 2020 and April 2021 semester examinations in online mode as per directions of Higher Education Department, Government of Tamilnadu following the guidelines of UGC

22) FROM DEAN (ACDEMICS)

Prof.S.Sivaramakrishnan, Dean (Academics), shall move and **Dr.I. Sahul Hamid**, (Dean (Planning and Development), shall second the following resolution:

22.1. Resolved that students may be allowed to transfer credits earned from Swayam against elective courses following the guidelines of UGC from the Academic year 2020-21.

IV. Any Other Subjects



Dr. R. Eswaran
Member Secretary



Dr. J. Suresh
Principal & Chairman

Department of Mathematics

Revised Curriculum

(Choice Based Credit system with Outcome Based Education)

Academic Year 2020-2021 onwards

III and IV semesters (B.Sc. Mathematics)

I and II semesters (M.Sc. Mathematics)

Certificate Courses

THE MADURA COLLEGE
Department of Mathematics

VISION

To train the students so that they are strong in logic, which enables them to approach, analyze and solve any problem, both scientific and sociological, in an unbiased manner and to enhance the quantitative and analytical skill.

MISSION

- ❖ To provide an environment where students can learn and become an efficient and accurate problem solver of Mathematics and Mathematical applications.
- ❖ To make the students as Mathematical thinkers and enable them to become a long time learners of Mathematics.
- ❖ To make the students to have core knowledge and able to correlate this core mathematical knowledge with other disciplines

PROGRAMME OUTCOMES FOR B.Sc. GRADUATES:

At the end of the program the graduates will be able to

PO 1: Integrate learned skills and knowledge derived from the study of the science and other related disciplines, acquiring the necessary depth and breadth required for a disciplinary perspective.

PO2: Demonstrate proficiency in using disciplinary-appropriate methods for research, critical analysis or creative work and provide scientific solutions to the problems of the society.

PO3: Communicate conclusions, interpretations, and implications clearly, concisely, and effectively, both orally and in writing for different types of audiences.

PO4: Articulate and apply values, principles, ethics and ideals derived from an integrated understanding of their areas of study and demonstrate awareness of current societal and environmental challenges and ways of mitigating them.

PO5: Use modern tools, resources and software and be abreast with the emerging trends in their disciplinary area and practice lifelong learning.

PROGRAM EDUCATIONAL OBJECTIVES

After completion of the course the student will

- ❖ Understand the situation, make a mathematical model and find a solution.
- ❖ Obtain the proficiency of mathematical and computational skills to model and solve real life problems.
- ❖ Acquire thorough knowledge on pure, applied and advanced area of Mathematics.
- ❖ Have the ability to face competitive examinations.
- ❖ Think independently in constructing rigorous mathematical proof.
- ❖ Articulate mathematical ideas both oral and writing reasoning.

GRADUATE ATTRIBUTES

- a. Knowledge in core Competency
- b. Problem Analysis
- c. Design and development of solution for complex problems
- d. Conduct investigation of solution for complex problems
- e. Modern tool usage
- f. Environment and sustainability
- g. Ethics
- h. Individual and team work
- i. Communication
- j. Project management and finance
- k. Life-long learning

S.No.	PROGRAM SPECIFIC OUTCOMES	GRADUATE ATTRIBUTES
PSO-1	Develop the skills to systematically solve the problems on Calculus, Classical Algebra and Trigonometry, Analytical Geometry of three dimensions and Vector Calculus, Discrete Mathematics, Mathematical Statistics, Abstract Algebra, Sequence and series, Differential Equations, Real Analysis, Mechanics, Graph theory, Complex Analysis, Operations Research, Linear Algebra, Allied Mathematics for Physics, Allied Mathematics for Chemistry and Skill oriented Mathematical papers.	a,c
PSO-2	Relate and apply Mathematical concepts / parameters in solving real life problems.	b,e
PSO-3	Attain a strong foundation on the mathematical logic and capability of developing mathematical concepts.	a,c
PSO-4	Analyze critically and interpret numerical and graphical data, develop Mathematical solution.	b,c,d
PSO-5	Face competitive examinations by gaining knowledge of solving problems on quantitative methods, reasoning skills.	a,b
PSO-6	Acquire proficiency in developing proofs for mathematical theories independently.	h,k
PSO-7	Obtain knowledge on topics in Pure and Applied Mathematics to pursue higher studies.	a
PSO-8	Apply ethical principles and commit to legal professional ethics, responsibilities, good practices and norms established.	f,g



The Madura College (Autonomous), Madurai – 625 011

Department of Mathematics

B.Sc. Mathematics Major – Course Structure

Sem.	Sub. Code	Title of the paper	Hours	Credits
I		Language-I(Tamil/Hindi/Sanskrit)	6	3
		English –I	6	3
		VE and PE	3	3
	20U1MAC1	Allied Mathematics – I	6	5
	20U1MMC1	Calculus	5	4
	20U1MMC2	Classical Algebra And Trigonometry	4	4
		Total	30	22
II		Language-II(Tamil/Hindi/Sanskrit)	6	3
		English-II	6	3
		EVS and Gender Studies	3	3
	20U2MAC2	Allied Mathematics - II	6	5
	20U2MMC3	Analytical Geometry Of Three Dimension And Vector Calculus	4	4
	20U2MMC4	Discrete Mathematics	5	4
		Extension	-	1
		Total	30	23
III		Language-III(Tamil/Hindi/Sanskrit)	6	3
		English-III	6	3
	20U3MAC3	Allied Mathematics-III	6	5
	20U3MNM1	NME-I	2	2
	20U3MSBE1	Skill based elective-I	2	2
	20U3MMC5	Mathematical Statistics	4	3
	20U3MMC6	Graph theory	4	3
		Total	30	21
IV		Language-IV(Tamil/Hindi/Sanskrit)	6	3
		English-IV	6	3
	20U4MAC4	Allied Mathematics-IV	6	5
	20U4MNM2	NME-II	2	2
	20U4MSBE2	Skill based elective-II	2	2
	20U4MMC7	Sequence and series	4	3
	20U4MMC8	Differential Equations	4	3
		Total	30	21
V	20U5MSBE3	Skill based elective-III	2	2
	20U5MMC9	Real Analysis	6	5
	20U5MMC10	Mechanics	6	5
	20U5MMC11	Abstract Algebra	6	5
	20U5MME1	Major Elective – I	4	4
	20U5MMEL1	Major Elective – I Practical	2	2
	20U5MME2	Major Elective- II	4	4
		Total	30	27

VI	20U6MSBE4	Skill based elective-IV	2	2
	20U6MMC12	Complex Analysis	6	5
	20U6MMC13	Operations Research	6	5
	20U6MMC14	Linear Algebra	6	5
	20U6MME3	Major Elective-III	4	4
	20U6MME3L	Major Elective –III Practical	2	2
	20U6MME4	Major Elective-IV	4	4
		Total	30	27

DEPARTMENT OF MATHEMATICS				CLASS: II UG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Non-Major Elective 1	20U3MNM1	Numerical Aptitude	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Objectives:

1. To learn simplest tricks to find hcf, lcm, average, percentage and Profit & loss problems.
2. To apply numerical techniques in solving quantitative aptitude.
3. To understand the shortcuts for the problems.

Unit	Description	Hours	K-level	CLO
I	HCF & LCM: Find HCF by Factorization Method , Division Method – find LCM by Factorization Method , Common Division Method – product of 2 numbers – co-prime – HCF & LCM of fractions – largest four digit number or smallest five digit number exactly divisible by some numbers – least number which divided by some numbers	6	Up to K2	CLO1
II	Square roots and cube root : Find square root by Factorization Method, Division Method – square root of numbers – square root of decimal numbers – find cube root by Factorization Method. Average: Average of N natural numbers – 4 consecutive even integers – class – scores in innings – find a result from given average – expenditure of mess	6	Up to K2	CLO2
III	Problems on ages: finding present age. Surds and Indices: law of indices, Surds and Law of surds and its related problems.	6	Up to K2	CLO3
IV	Percentage: Express percent as fraction – express fraction as percent – problems on populations – problems on Depreciation.	6	Up to K2	CLO4
V	Profit and loss: Gain and Loss – Gain% and Loss% – find SP from given CP and gain% or loss% – find CP from given SP and gain% or loss%.	6	Up to K2	CLO5

Book for Study:

1. **R.S. Aggarwal, Quantitative Aptitude**, Reprint 2016, S.Chand & Company Limited.
Sections : 2 , 5, 6, 8, 9, 10, 11

Books for Reference:

1. **G. K. Ranganath, C. S. Sampangiram and Y. Rajaram, A text book of business Mathematics**, 2008, Himalaya Publishing House.
2. **R.V. Praveen, Quantitative Aptitude and Reasoning**, 2nd revised edition, 2013, Prentice – Hall of India Pvt. Ltd.

Web Resources:

1. <https://www.math-shortcut-tricks.com/>
2. <https://www.ibpsguide.com/numerical-ability/>
3. <https://www.youtube.com/watch?v=PYPkIFMb6E>
4. <https://www.youtube.com/watch?v=Xe3cDAP-GIg>

Rationale for Nature of the course:

Thinking critically and applying basic mathematics skills to interpret data, conclusions and solve problems; developing proficiency in numerical aptitude.

Activities having direct bearing on Employability:

This course imparts problem solving skills in the students and is crafted to help the students in identifying the best solution for a given problem. This course helps in strengthen the students in their “Numerical Aptitude knowledge” with the essentials such as short techniques, quiz to help increase their curiosity and also help them to become expert with knowledge of peripheral concepts.

Pedagogy :

Chalk and Talk, Problem Solving, Tutorial, Group Discussion, Quiz,.

Course Learning Outcomes

On the successful completion of the course, students will be able to

Number	Course outcome	knowledge level
CLO1	Learn mathematical tricks to find LCM and HCF	Up to K2
CLO2	Learn shortcuts in finding square root, cube root and average	Up to K2
CLO3	Understand the idea of solving problems on ages, surds and indices	Up to K2
CLO4	Acquire the knowledge of percentage	Up to K2
CLO5	Solve the problems on profit and loss	Up to K2

K1- Recall, K2 – Understanding

Mapping with Course Learning Outcomes(CLOs)

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	-	1	2	1	3	3	1	-	3	-	1
CLO2	3	-	1	2	1	3	3	1	-	3	-	1
CLO3	2	-	1	2	1	3	3	1	-	3	-	1
CLO4	3	-	1	2	1	3	3	1	-	3	-	1
CLO5	3	-	1	2	1	3	3	1	-	3	-	1

1. Basic level

2. Intermediate level

3. Advance level

BLUE PRINT – External Exam

Articulation Mapping K-level with Course Learning Outcomes(CLOs)

units	CLOs	K-level	Section A Short Answer	Section B Either/or Choice	Section C Open Choice
1	CLO 1	Up to K2	1(K1)	2(K2 & K2)	1(K1)
2	CLO 2	Up to K2	1(K1)	2(K2 & K2)	1(K1)
3	CLO 3	Up to K2	1(K1)	2(K2 & K2)	1(K1)
4	CLO 4	Up to K2	1(K1)	2(K2 & K2)	1(K1)
5	CLO 5	Up to K2	1(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	-	70	-	70	53.85	53%
Total marks	10	50	50	130	100	100%

The Components of assessment shall be

S.No	CLO	Test Component	Marks	K Level
1	5	Assignment	5 Marks	K2
2	5	Seminar	5 Marks	K1
3	5	Quiz	5 Marks	K1

Blue Print – CIA – I**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

Sl. No	CLOs	K. Level	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO1	Up to K2	3(K1)	2(K2 & K2)	2(K1&K1)
2	CLO2	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels*

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100	100%

Blue Print – CIA – II**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

Sl. No	CLOs	K. Level	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO3	Up to K2	3(K1)	2(K2 & K2)	2(K1&K1)
2	CLO4	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels*

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

Lesson Plan

UNIT	DESCRIPTION	HOURS	PEDAGOGY
I	HCF by Factorization method, division method	2	Chalk and Talk, problem solving, Tutorials
	LCM by Factorization method , common division method	1	
	Co-primes and HCF and LCM of Fraction	1	
	largest four digit number or smallest five digit number exactly divisible by some numbers	2	
	least number which divided by some numbers	2	
II	Square roots of a number and decimal number	1	Chalk and Talk, Problem Solving
	cube root of a number	1	
	Average of N natural numbers – 4 consecutive even integers – class – scores in innings	2	
	find a result from given average – expenditure of mess	2	
III	Problems on ages	3	Chalk and Talk, quiz
	Law of surds	1	
	Law of indices	1	
IV	Express percent as fraction – express fraction as percent	1	Chalk and Talk, quiz, group discussion
	problems on populations	2	
	Problems on Depreciation.	2	
V	Gain and Loss – Gain% and Loss%	2	Chalk and Talk, quiz
	Find SP from given CP and gain% or loss%	2	
	find CP from given SP and gain% or loss%	2	
Total Hours		30	

Course Designer:

Dr. I. Padmavathi, Assistant Professor of Mathematics, The Madura College(Autonomous), Madurai.

DEPARTMENT OF MATHEMATICS				CLASS: I B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Skill Based Elective	20U3MSBE1	Mathematics For Competitive Examinations – I	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Objectives:

- To provide the students with an overview of Aptitude view in Mathematics.
- To learn about topics such as logic and proofs and easy calculations ways.
- To give clear idea about competitive exams.

Unit	Description	Hours	K-level	CLO
I	Introduction– Important facts – Present ages – Age ratio – Some related problems –Definition in Percentage – Important facts and Formulae – Results on populations – Results on depreciation – Difference percentage – Some other related problems.	6	Up to K3	CLO1
II	Introduction - Important facts and Formulae – Calculate cost and selling price – Calculate Gain and Loss – Problems - Ratio - Proportion - Important facts and Formulae – Types of Proportional – Comparison and Compound ratio – Variation – Related problems.	6	Up to K3	CLO2
III	Time and work - Important facts and Formulae – Days and hours calculations – problems - Pipes and Cistern - Important facts and Formulae – Two or more pipe calculations - Problems.	6	Up to K3	CLO3
IV	Time and Distance - Important facts and Formulae –Calculation Speed and Distance – Related problems- Problems on Trains - Important facts and Formulae – Calculate train speed and distance - Problems.	6	Up to K4	CLO4
V	Simple interest - Important facts and Formulae – Principal – Interest calculation - Compound interest - Important facts and Formulae – Calculate Compound interest annually, half-yearly and quarterly – Some related problems.	6	Up to K3	CLO5

Text Book:

1. R.S. Aggarwal, Quantitative Aptitude, Reprint 2016, S.Chand& Company Limited.

Sections: 8, 10, 11, 12, 15, 16, 17, 18, 21, 22.

Reference Books:

1. G. K. Ranganath, C. S. Sampangiram and Y. Rajaram, A text book of business Mathematics, 2008, Himalaya Publishing House.
2. R.V. Praveen, Quantitative Aptitude and Reasoning by, 2nd revised edition, 2013, Prentice – Hall of India Pvt. Ltd.

Web Resources

1. <https://affairsccloud.com/aptitude-questions/age.html>
2. <https://affairsccloud.com/aptitude-questions-profit-and-loss-set-23.html>
3. <https://www.youtube.com/watch?v=0Hqd1M0UuAQ>
4. <https://www.bankexamstoday.com/2013/10/time-and-distance-problems-solutions.html>
5. <https://www.bankexamstoday.com/2015/07/simple-interest-and-compound-interest.html>

Rationale and Activities having direct bearing on nature of the course:

Thinking critically and applying basic mathematics skills to interpret data, draw conclusions, and solve problems; developing proficiency in numerical reasoning; Application of quantitative reasoning in aptitude tests. Aptitude is considered to be an important characteristic of an individual which can predict success in a course of career. This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.

Pedagogy:

Lecture, power point Presentation, Group Discussion, Quiz, Seminar, Problem solving, Tutorial and LMS (CANVAS, FLICKERS).

Course Outcome

On the successful completion of the course, students will be able to

CLO1	Important facts – Present ages – Age ratio – Some related problems – Definition in Percentage – Important facts and Formulae – Results on populations – Results on depreciation – Difference percentage – Some other related problems.	Up to K3
CLO2	Important facts and Formulae – Calculate cost and selling price – Calculate Gain and Loss – Problems - Ratio - Proportion - Important facts and Formulae – Types of Proportional – Comparison and Compound ratio – Variation – Related problems.	Up to K3
CLO3	Time and work - Important facts and Formulae – Days and hours calculations – problems - Pipes and Cistern - Important facts and Formulae – Two or more pipe calculations - Problems.	Up to K3
CLO4	Time and Distance - Important facts and Formulae – Calculation Speed and Distance – Related problems- Problems on Trains - Important facts and Formulae – Calculate train speed and distance - Problems.	Up to K4
CLO5	Simple interest - Important facts and Formulae – Principal – Interest calculation - Compound interest - Important facts and Formulae – Calculate Compound interest annually, half-yearly and quarterly – Some related problems.	Up to K3

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Mapping of Course Learning Outcomes (CLOs) with Program Outcomes (POs) and Program Specified Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	1	1				2
CLO2	3	1				1	
CLO3	3	2	1		1	2	1
CLO4	3		2	1	1	2	
CLO5	3	2	2		1	2	1

Mapping with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CLO1	3				
CLO2	2		2		
CLO3	2	1	3		
CLO4	2				
CLO5	1		2		1

3- Advanced Applications

2- Intermediate Level

1- Basic Level

BLUE PRINT (for External exams)

S.No	CLOs	K- Level	Section A MCQs	Section B Short Answers	Section C (Either/or Choice)	Section D (Open Choice)
1	CLO 1	Up to K2	2 (K1&K2)	1 (K2)	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2 (K1&K2)	1 (K1)	2 (K2&K2)	1(K3)
3	CLO 3	Up to K2	2 (K1&K2)	1 (K1)	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2 (K1&K2)	1 (K2)	2 (K4&K4)	1(K4)
5	CLO 5	Up to K3	2 (K1&K2)	1 (K2)	2 (K3&K3)	1(K3)
No. of Questions to be asked			10	5	10	5
No. of Questions to be answered			10	5	5	3
Marks for each question			1	2	5	10
Total Marks for each Section			10	10	25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.66	41.66%
K4	-	-	10	10	20	16.66	16.66%
Total	10	10	50	50	120	100	100%

BLUE PRINT – CIA - I

S. No.	CLOs	K level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K3	2	K1 &	1	K2	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 &	2	K1 & K1	2(K2 & K2)	2(K3& K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	26.66	30.66%
K2	2	2	10	10	24	4.0	
K3	-	-	-	20	20	33.33	33.33%
K4	-	-	-	-	-	-	-
Total	4	6	20	30	60	100	100%

BLUE PRINT – CIA – II

S.No.	CLOs	K level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 3	Up to K3	2	K1 & K2	1	K1	2(K3 & K3)	2(K3 & K3)
2	CLO 4	Up to K4	2	K1 & K2	2	K2 & K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2	-	-	4	6.67	16.67%
K2	2	4	-	-	6	10	
K3	-	-	10	20	30	50.00	50.00%
K4	-	-	10	10	20	33.33	33.33%
Total marks	4	6	20	30	60	100	100%

Lesson Plan

Unit	Description	Hours	Pedagogy
I	Introduction – Important facts	1	ICT tools
	Present ages – Age ratio – Some related problems	2	Lecture
	Definition in Percentage – Important facts and Formulae – Results on populations.	1	Lecture
	Results on depreciation – Difference percentage – Some other related problems.	3	Lecture
II	Introduction - Important facts and Formulae	1	Lecture
	Calculate cost and selling price – related examples.	2	Lecture
	Calculate Gain and Loss – Problems	1	Lecture
	Ratio - Proportion - Important facts and Formulae	1	Lecture
	Types of Proportional– Comparison and Compound ratio	1	Lecture
	Variation – Related problems.	1	Lecture
III	Time and work - Important facts and Formulae – Days and hours calculations.	1	ICT tools
	Days and hours calculations – problems	1	Lecture
	- Pipes and Cistern - Important facts and Formulae	2	Lecture
	Two or more pipe calculations - Problems.	1	Lecture
IV	Time and Distance - Important facts and Formulae.	1	Lecture
	Calculation Speed and Distance – Related problems.	2	Lecture
	Problems on Trains - Important facts and Formulae.	1	Lecture
	Calculate train speed and distance - Problems.	1	Lecture
V	Simple interest - Important facts and Formulae.	1	Lecture
	Principal – Interest calculation.	1	Lecture
	Compound interest - Important facts and Formulae.	2	Lecture
	Calculate Compound interest annually, half-yearly and quarterly – Some related problems.	2	Lecture
Total Hours		30	

Course Designer

1. Dr. S. USHA
2. Prof. N.SRIVIVEKA SARATHA.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major	20U3MMC5	Mathematical Statistics	3	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

1. To learn the Basic concepts about Axiomatic and Mathematical approach to find Probability, Conditional probability of events and Baye's theorem.
2. To understand Distribution functions of Discrete and Continuous type random variables, and to Calculate Marginal, Conditional distributions, Mathematical Expectations, Variance,, Covariance.
3. To acquire knowledge of Sampling Distributions, Testing Hypothesis, Type I, Type II errors, Evaluate and interpret Powers of Test, Critical region, Level of Significance, One/Two tailed tests Critical Value and large sample test.
4. To study and analyse about the small sample tests based on t, F and χ^2 distributions.

Unit	Description	Hours	K-level	CLO
I	Definitions of various terms – Axiomatic Probability – Random Event – Mathematical Probability – Addition and Multiplication Laws of Probability – Independent Events – Conditional Probability_ Baye's Theorem – Simple applications.	12	Up to K3	CLO1
II	Distribution functions – Discrete random variable – Continuous random variable- Joint Probability mass function Joint Probability distribution function – Marginal distribution function – Joint density function – conditional distribution function.	18	Up to K4	CLO2
III	Mathematical Expectation – Addition and Multiplication theorem – Covariance Expectation and Variance of linear combination of random variables - Moment generating function – Characteristic function – Probability generating function.	20	Up to K4	CLO3
IV	Sampling Distributions – Student's t-distribution, F-distributions - χ^2 - distribution (Definition and derivation only. Testing statistical hypothesis: Null and alternative hypothesis – Type I and Type II errors – Powers of attest – Critical region – Level of Significance – One/Two tailed tests critical value. Large Sample test: Test of Significance for mean and difference of means.	22	Up to K3	CLO4
V	Small Sample Test – Tests based on t, F and χ^2 distributions.	18	Up to K4	CLO5

Text Book:

VITTAL P R Mathematical Statistics -2004-Maragatham Publishers.

Chapters: UNIT I Ch.1,

UNIT II Ch 2,

UNIT III Ch 3,4,5,6 (Relevant Topics only)

UNIT IV Ch 22,24 (Relevant Topics only)

UNIT V Ch 25,26,27 (Relevant Topics only)

Reference Books:

1. Kandasamy, P.K.Thilagavathi and K.Gunavathi, PROBABILITY, STATISTICS,AND QUEUEING THEORY –(2007) S.chand and co. New Delhi.
2. S. C. Gupta , V .K Kapoor FUNDAMENTALS OF MATHEMATICAL STATISTICS-2002 Sultan Chand & Sons, New Delhi – Eleventh thoroughly revised edition.
3. Veerarajan T. FUNDAMENTALS OF MATHEMATICAL STATISTICS, Yesdee Publishing Private Ltd. 2017
4. Arumugam and Thangapandi Issac- STATISTICS ,New Gamma Publishing House,2016.

Web Resources:

1. <http://nptel.ac.in>
2. <http://www.ocw.mit.edu>
3. <https://www.khanacademy.org>
4. <http://onlinestatbook.com/2/introduction/descriptive.html>
5. <https://www.statistichowto.datasciencecentral.com/probability-and-statistics/descriptive-statistics/>

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Seminar, Power Point Presentation.

Rationale for Nature of the course:

Thinking critically and applying basic mathematics skills to interpret data, draw conclusions, and solve problems; developing proficiency in making decisions based on data and make predictions ; Application of reasoning in quality testing.

Course Learning Outcomes

On successful completion of the course, students will be able to

Number	Course Learning Outcome	Knowledge level
CLO1	Learn about Probability, Conditional probability, Bayes's theorem	Up to K3
CLO2	Understand the concepts of discrete and continuous type random variables, distribution/density functions and find variants: joint, marginal, conditional probability distribution/density functions	Up to K4
CLO3	Apply techniques to find Expectation, Variance, Covariance and of random variables and linear combinations of random variables.	Up to K4
CLO4	Know about t-, F, χ^2 -distributions, and find Type I Type II errors, Critical region, level of significance and Large sample test	Up to K3
CLO5	Know how to do small sample test based on t, F, χ^2 distributions	Up to K4

K1 – Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 – Application Oriented- solving problems

K4 - Examining, analyzing, presentation and make inference with evidences.

Mapping of Course Outcomes with Program Outcomes & Program specified outcomes

-CLOs with PSOs

CLOs/ O & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5		PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CLO1	3	3	2	3	2		3	2	3	2	3	3	2
CLO2	3	3	2	3	2		3	3	3	3	3	3	3
CLO3	3	3	2	3	3		3	3	3	3	1	3	3
CLO4	3	3	2	3	2		3	2	3	2	3	3	1
CLO5	3	3	2	3	2		3	2	3	-	1	3	2

1. Basic level

2. Intermediate level

3. Advance level

BLUE PRINT
Mapping with Course Learning Outcomes(CLOs)

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2(K3 & K3)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open Choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	9	7.5	42%
K2	5	6	20	10	41	34.17	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100	100%

BLUE PRINT – CIA – I

Mapping with Course Learning Outcomes(CLOs)

Sl. No	CLOs	K level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K2 & K2)	1(K2)
2	CLO 2	Up to K3	2	K1 & K1	2	K2	2(K3 & K3)	2(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	2	-	-	6	10	50%
K2	-	4	10	10	24	40	
K3	-	-	10	20	30	50	50%
K4	-	-	-	-	-	-	-
Total marks	4	6	20	30	60	100	100%

BLUE PRINT – CIA – II

Mapping with Course Learning Outcomes(CLOs)

Sl.No	CLOs	K level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 3	Up to K4	2	K1 & K2	1	K2	2(K2 & K2)	2(K2&K4)
2	CLO 4	Up to K3	2	K1 & K2	2	K1&K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2	-	-	4	6.67	50%
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33%
K4	-	-	-	10	10	16.67	17%
Total marks	4	6	20	30	60	100	100%

Lesson Plan

Unit	Description	Hours	Pedagogy
I	Definitions-Axiomatic Probability-Random Event-Mathematical Probability-Addition and Multiplication Laws of Probability	6	Lecture, Quiz
	Independent Events-Conditional Probability-Bayes's theorem-applications.	6	Problem Solving
II	Random Variables-Distribution functions	2	Lecture, Quiz
	Discrete random variable-Continuous random variable	3	Quiz
	Joint Probability mass function Joint Probability distribution function	3	Lecture, Problem
	Marginal distribution function, Joint density function	4	Lecture, Group
	Conditional distribution function	6	Problem
III	Mathematical expectation –Addition and Multiplication theorem	4	Lecture
	Covariance Expectation and linear combination of random variables	8	Lecture
	Moment generating function	4	Problem
	Characteristic function, Probability generating function	4	Problem
IV	Sampling distribution, Students t- distribution, F-distribution, χ^2 -distribution,(Definition, Derivation only)	6	Lecture
	Testing statistical hypothesis: Null and alternative hypothesis, Type I and Type II errors	6	Lecture, Seminar
	Powers of test- Critical region-Level of significance-	4	Tutorial
	One/two tailed tests critical value.	2	Problem
	Large sample test: Test of significance for mean and difference of means	4	Problem Solving
V	Tests based on t- distribution	6	Lecture
	Tests based on F- distribution	6	Lecture
	Test based on χ^2 -distribution	6	Lecture
Total Hours		90	

Course Designer:

Dr..R.PANDISELVI,

Associate Professor, Research Centre & PG Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major	20U3MMC5	Graph Theory	3	4	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives:

Graph Theory is one of the most flourishing branches of Mathematics with wide applicability in a variety of areas ranging from Engineering to Molecular Biology. The objective of this course is to introduce basic concepts in the theory of graphs and to develop problem-solving ability and mathematical maturity in this area.

Course content:

Unit	Description	Hours	K-Level	CLO(s)
I	BASICS: Graphs – Pictorial representation – Subgroups – Isomorphism and degrees – Walks and connected graphs – Cycles in graphs – Cut-vertices and cut-edges.	9	K3	1
II	EULERIAN AND HAMILTONIAN GRAPHS: Eulerian graphs – Fleury's algorithm – Hamiltonian graphs – weighted graphs.	9	K4	2
III	BIPARTITE GRAPHS AND MATRICES: Bipartite graphs – Marriage problem – Trees – Connector problem – Matrix representations – Vector spaces associated with graphs – Cycle space – cut-set space.	9	K3	3
IV	PLANAR GRAPHS: Planar Graphs – Euler formula – Platonic solids – Dual of a plane graph – Characterization of planar graphs.	9	K3	4
V	GRAPH COLOURINGS: Vertex colouring – Edge colourings – An algorithm for vertex colouring.	9	K3	5

Book or study:

- S.A.Choudum– A First Course in Graph Theory, Macmillan India Limited, 1987.
UNIT I – 1.1 to 1.7
UNIT II – 2.1 to 2.4
UNIT III – 3.1 to 3.4 and 4.1 to 4.4
UNIT IV – 5.1 to 5.5
UNIT V – 6.1 to 6.3

Books for Reference:

1. S. Arumugam and S. Ramachandran, - *Invitation to Graph Theory*, SCITECH publications (India) Pvt. Ltd, Chennai, 2006.
2. Gary Chartrand and Ping Zhang. *Introduction to Graph Theory*. New Delhi; New York : Tata McGraw-Hill Pub. Co. 2006.
3. Robin J.Wilson, *Introduction to Graph Theory*, Pearson publications, 5th Edition, 2010.

Web Resources

- <https://d3gt.com>
- https://www.brianheinold.net/graph_theory/graph_theory_book.html
- https://www.youtube.com/playlist?list=PLoJC20gNfC2gmT_5WgwYwGMvgCjYVsIQg

Rationale for Nature of the course:

This course namely Graph Theory has applications in various fields. Graph theory has been serving as an elegant tool to easily approach/solve several problems/concepts in other fields ranging from Science to Sociology. This course will enable the students to acquire skills by which they can model certain real-life problems as graph theoretical terms and can make inference.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Modeling certain real-life problems like Scheduling problem, Traffic signal problem, Marriage problem and so on.

Pedagogy: Chalk and Talk, PPT, Group Discussion, Quiz, Seminar, Problem solving, Tutorial, LMS (CANVAS, FLICKERS).

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO #	Description	K -Level
CLO1	Identify various types of sub graphs of a graph, to find degree sequence of a graph, to identify isomorphic graphs, to determine connectedness of a graph, to list out cut-vertices and cut-edges of the given graph	Up to K3
CL02	Determine whether graphs are Hamiltonian and/or Eulerian	Up to K4
CL03	Recognize bipartite graphs, to find various matrices representing a graph, to determine vector spaces associated with a given graph and also to solve problems involving Matchings and trees	Up toK3
CL04	Identify planar graphs, to find dual of a plane graph	Up to K3
CL05	Find minimum vertex and edge coloring of certain families of graphs	Up to K3

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Mapping with Programme Specific Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	1	1				2
CLO2	3	1				1	
CLO3	3	2	1		1	2	1
CLO4	3		2	1	1	2	
CLO5	3	2	2		1	2	1

Mapping with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CLO1	3				
CLO2	2		2		
CLO3	2	1	3		
CLO4	2				
CLO5	1		2		1

1- Basic Level

2- Intermediate Level

3- Advanced Applications

BLUE PRINT (for External Examinations)
Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1/ K2	1	K1	2 (K2/K2)	1(K3)
2	CLO 2	Up to K4	2	K1/ K2	1	K1	2 (K4/K4)	1(K4)
3	CLO 3	Up to K3	2	K1/ K2	1	K2	2 (K3/ K3)	1(K3)
4	CLO 4	Up to K3	2	K1/ K2	1	K2	2 (K3 /K3)	1(K2)
5	CLO 5	Up to K3	2	K1/ K2	1	K2	2 (K1/ K1)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67
K4	-	-	10	10	20	16.67	16.67
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA - I
Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1/ K2	1	K2/K2	2 (K2/K2)	1(K3)
2	CLO 2	Up to K4	2	K1/ K2	2	K1	2 (K3/K3)	1(K3) 1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each section			4		6		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Blue Print for CIA - II
Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 3	Up to K3	2	K1/ K2	2	K1/ K2	2 (K2/K2)	2(K3)
2	CLO 4	Up to K3	2	K1/ K2	1	K2	2 (K3 /K3)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each section			4		6		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

COURSE PLAN

Unit	Description	Hours	Pedagogy
I	Graphs – Pictorial representation	1	Chalk and talk, D3 Graph Theory – ICT tool, Interaction, Group Discussion
	Subgroups	1	
	Degrees	1	
	Isomorphism	1	
	Walks and connected graphs	2	
	Cycles in graphs	1	
	Cut-vertices and cut-edges	1	
	Tutorial	1	
II	Introduction to Eulerian graphs	1	Chalk and talk, PPT, D3 Graph Theory – ICT tool, Interaction, Group Discussion and e - quiz
	Theorems on Eulerian graphs	2	
	Fleury's algorithm to find Eulerian trail	1	
	Hamiltonian graphs	2	
	weighted graphs	2	
	Tutorial	1	
III	Bipartite graphs	1	Chalk and talk, PPT, D3 Graph Theory – ICT tool, Interaction, Assignment and Seminar
	Marriage problem	1	
	Trees	2	
	Connector problem	1	
	Matrix representations	1	
	Vector spaces associated with graphs Cycle space – cut-set space.	2	
	Tutorial	1	
IV	Introduction to Planar Graphs – definition and example	1	Chalk and talk, PPT, D3 Graph Theory – ICT tool, Interaction and e-Quiz
	Properties of planar graphs	2	
	Euler formula for plane graphs and its	1	
	Platonic solids	1	
	Dual of a plane graph	1	
	Characterization of planar graphs	2	
	Tutorial	1	
V	Vertex colouring – definition and examples	1	Chalk and talk, D3 Graph Theory – ICT tool, Assignment and Interaction
	Theorems on vertex colouring	2	
	Algorithm to find a minimum vertex colouring	1	
	Introduction to Edge colouring	1	
	Results on edge colouring	3	
	Tutorial	1	

Course Designer :

Dr.I.SAHUL HAMID, Assistant Professor of Mathematics, The Madura College (Autonomous).

DEPARTMENT OF MATHEMATICS				CLASS: II UG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Non-Major Elective 2	20U4MNM2	Quantitative Aptitude	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Objectives:

1. To learn most simplest tricks in solving problems on time and distance, simple and compound interest, calendar and clock, permutation and combinations and probability.
2. To apply the shortcuts in competitive exams.
3. To understand the numerical techniques in solving quantitative aptitude.

Unit	Description	Hours	K-level	CLO
I	Time and distance: speed in km/hr – speed in m/sec – ratio of speed of two objects – average speed. Problems on Trains: Time taken by a train to pass a signal – time taken by a train to pass a station – relative speed – time taken by the trains to cross each other – time taken by the faster train to cross slower train – ratio of the speed of two trains.	8	Up to K2	CLO1
II	Simple Interest: SI – principal – Interest – rate.	5	Up to K2	CLO2
III	Compound interest: interest compound annually, half-yearly, quarterly, time is in fraction form – Rates are different for different years.	7	Up to K2	CLO3
IV	Calendar: odd day – leap year – ordinary year – counting of odd days. Clocks: angle between hands – hands of a clock together, at right angle, in straight line – correct day.	4	Up to K2	CLO4
V	Permutation & combination: Number of permutation – number of all permutations of n things – number of permutations of these n objects – combinations - number of combinations of n things. Probability: experiment – random experiment – sample space – Event – probability of occurrence of an event – results on probability.	6	Up to K2	CLO5

Book for study:

1. R.S. Aggarwal, Quantitative Aptitude, Reprint 2016, S.Chand & Company Limited.
Sections: 17, 18, 21, 22, 27, 28, 30, 31

Books for Reference:

1. G. K. Ranganath, C. S. Sampangirani and Y. Rajaram, A text book of business Mathematics, 2008, Himalaya Publishing House.
2. R.V. Praveen, Quantitative Aptitude and Reasoning, 2nd revised edition, 2013, Prentice – Hall of India Pvt. Ltd.

Web Resources:

1. <https://www.math-shortcut-tricks.com/>
2. <https://www.careerbless.com/aptitude/ga/home.php>
3. <https://www.indiabix.com/aptitude/questions-and-answers/>

Rationale for Nature of the course:

Understanding and reasoning using concepts framed in words; Critical reasoning; developing proficiency in Quantitative reasoning; Application of techniques in aptitude tests.

Activities having direct bearing on Employability:

It enables the students to acquire skills to do aptitude planning, performing calculation, applying right techniques & managing data. This course provides career opportunities as various categories in employment orientation to the students.

Course Learning Outcomes

On the successful completion of the course, students will be able to

Number	Course outcome	knowledge level
CLO1	Learn tricks for solving problem on time & distance and trains	Up to K2
CLO2	Learn concepts and shortcut to find simple interest	Up to K2
CLO3	Acquire the knowledge of compound interest	Up to K2
CLO4	Understand the idea of calendar and clock problems	Up to K2
CLO5	Apply simple techniques in solving problems on permutation, combination and probability	Up to K2

K1- Recall,

K2 – Understanding

Mapping with Course Learning Outcomes(CLOs)

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	1	1	-	2	3	1	-	3	-	-
CO2	3	-	1	1	-	2	3	1	-	3	-	-
CO3	3	-	1	1	-	2	3	1	-	3	-	-
CO4	3	-	1	1	-	2	3	1	-	3	-	-
CO5	2	2	1	1	-	2	3	2	-	3	-	2

1. Basic level

2. Intermediate level

3. Advance level

Pedagogy :

Chalk and Talk, Problem Solving, Tutorial, Group Discussion, Quiz.

BLUE PRINT – External Exam

Articulation Mapping K-levels with Course Learning Outcomes(CLOs)

units	CLOs	K-level	Section A Short Answer	Section B Either/or Choice	Section C Open Choice
1	CLO 1	Up to K2	1(K1)	2(K2 & K2)	1(K1)
2	CLO 2	Up to K2	1(K1)	2(K2 & K2)	1(K1)
3	CLO 3	Up to K2	1(K1)	2(K2 & K2)	1(K1)
4	CLO 4	Up to K2	1(K1)	2(K2 & K2)	1(K1)
5	CLO 5	Up to K2	1(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	-	70	-	70	53.85	53%
Total marks	10	50	50	130	100	100%

The Components of assessment shall be

S.No	CLO	Test Component	Marks	K Level
1	5	Assignment	5 Marks	K2
2	5	Seminar	5 Marks	K1
3	5	Quiz	5 Marks	K1

Blue Print – CIA – I**Articulation Mapping K-levels with Course Learning Outcomes (CLOs)**

Sl. No	CLOs	K. Level	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO1	Up to K2	3(K1)	2(K2 & K2)	2(K1&K1)
2	CLO2	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels*

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100	100%

Blue Print – CIA – II**Articulation Mapping K-levels with Course Learning Outcomes (CLOs)**

Sl. No	CLOs	K. Level	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO3	Up to K2	3(K1)	2(K2 & K2)	2(K1&K1)
2	CLO4	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels*

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

Lesson Plan

UNIT	DESCRIPTION	HOURS	Pedagogy
I	Speed in km/hr – speed in m/sec – ratio of speed of two objects – average speed	3	Chalk and Talk, Problem Solving, Tutorial
	Time taken by a train to pass a signal – time taken by a train to pass a station	3	
	relative speed – time taken by the trains to cross each other – time taken by the faster train to cross slower train – ratio of the speed of two trains	2	
II	Simple interest – problems	5	Chalk and Talk, Tutorial
III	Interest is compound annually, half-yearly, quarterly, time is in fraction form	4	Chalk and Talk, quiz
	Rates are different for different years	3	
IV	odd day – leap year – ordinary year – counting of odd days	2	Chalk and Talk, Problem Solving
	angle between hands – hands of a clock together, at right angle, in straight line – correct day.	2	
V	Number of permutation – number of all permutations of n things – number of permutations of these n objects – combinations - number of combinations of n things	2	Chalk and Talk, Problem Solving, Group discussion
	experiment – random experiment – sample space – Event – probability of occurrence of an event Probability	2	
	results on probability.	2	
Total Hours		30	

Course Designer:

Dr. I. Padmavathi, Assistant Professor of Mathematics, The Madura College(Autonomous), Madurai.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Skilled based elective	20U4MSBE2	Mathematics for competitive examinations –II	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

COURSE OBJECTIVE

1. To enable the students to have fundamental formulae and fast solving technique of quantitative aptitude for the purpose of preparing for competitive examination.
2. To pioneer the strong foundation of Mathematics for competitive examination.
3. To develop the skill of arithmetical ability for quantitative aptitude.
4. To enhance creative thinking and presence of mind to answer the questions of any competitive examination.

Unit	Description	Hours	K-level	CLO
I	Chain Rule: Direct proportion – Indirect proportion – Solved examples – Logarithms: Logarithm – Properties of Logarithms – Common Logarithms – Characteristic – Mantissa – Solved examples.	7	Up to K2	CLO1
II	Calendar: Odd days – Leap year – Ordinary year – Counting of odd days – Day of the week related to odd days – solved examples – Clocks: Important facts – Too fast and too slow – Solved examples.	7	Up to K4	CLO2
III	Permutations and Combinations: Factorial notation – Permutations – Combinations – Solved examples – Probability: Experiment – Random experiment – Sample space – Event – Probability of occurrence of an event – Results on probability – Solved examples.	5	Up to K3	CLO3
IV	Partnership: Partnership – Ratio of division of gains – Working and Sleeping partners – Solved examples – Stock and Shares: Stock-capital – Shares or Stock – Dividend – Face value – Market value – Brokerage – Solved examples.	5	Up to K4	CLO4
V	True Discount: Important concepts – Important formulae – Solved examples – Banker's Discount: Important concepts – Important formulae – Solved examples.	6	Up to K3	CLO5

Text Book:

1. Dr. R. S. Aggarwal, Quantitative Aptitude for competitive examinations (Fully Solved), 2011 Revised Edition, S. Chand & Company Ltd.

Book for Reference:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, 2020 Seventh Edition, McGraw Hill Publisher.
2. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, 2019 Fourth Edition, Pearson India Publisher.

Web Resources:

1. <https://www.youtube.com/playlist?list=PLXjJ5c4vskp6yidDJs-NttEQwng8tu6Lo>
2. <https://www.careerbless.com/aptitude/qa/home.php>
3. <https://www.indiabix.com/aptitude/questions-and-answers/>

Rationale for Nature of the course:

Understanding and reasoning using concepts framed in words; Critical oral reasoning; Reading Comprehension; Application of oral reasoning in aptitude tests. Aptitude is considered to be an essential attribute of an human being which can guess success in a course of career.

Activities having direct bearing on Skill development/Employability/ Entrepreneurship:

This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.

Pedagogy:

Chalk and Talk, Seminar, Quiz, Group Discussion and PPT

COURSE LEARNING OUTCOMES

CLO1	In solving questions by chain rule, we compare every item with the term to be found out. Exploring the characteristics of the Logarithm and its applications.	Up to K2
CLO2	We are supposed to find the day of the week on a given date. For this, we use the concept of odd days. And we give an idea of how to find the ordinary year and leap year.	Up to K4
CLO3	Giving an essential knowledge of factorial notation, permutation, and combination. Exploring the experiment, sample, and event in probability theory and absorbing its applications.	Up to K3
CLO4	Understanding the concept of partnership, stock, and shares of the business or industry. With this concept, business-oriented problems are analyzed.	Up to K4
CLO5	Exploring real discounts and bankers discounts and applying this concept to various real-life problems.	Up to K3

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences.

Mapping of Course Learning Outcomes (CLOs) with Program Outcomes (POs) and Program Specified Outcomes(PSOs)

CLO\PO- PSO	PO					PSO						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	2	-	-	-	1	2	-	2	-	3	-	1
CLO2	2	-	-	-	1	2	-	2	-	3	-	1
CLO3	2	-	-	-	1	2	-	2	-	3	-	1
CLO4	2	-	-	-	1	2	-	2	-	3	-	1
CLO5	2	-	-	-	1	2	-	2	-	3	-	1

Mapping with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CLO1	3				
CLO2	2		2		
CLO3	2	1	3		
CLO4	2				
CLO5	1		2		1

3- Advance Application

2- Intermediate Level

1- Basic Level

BLUE PRINT (for External exams)

Mapping with Course Learning Outcomes(CLOs)

Sl. No	CLOs	K. Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO1	Up to K2	2	K1 & K2	1	K1	2 (K1 &K1)	1 (K2)
2	CLO2	Up to K4	2	K1 &K2	1	K1	2 (K4& K4)	1 (K3)
3	CLO3	Up to K3	2	K1 &K2	1	K2	2 (K3 &K3)	1 (K3)
4	CLO4	Up to K4	2	K1 &K2	1	K2	2 (K2 &K2)	1 (K4)
5	CLO5	Up to K3	2	K1 &K2	1	K2	2 (K3 &K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

Blue Print – CIA – I

Mapping with Course Learning Outcomes(CLOs)

K1 - Remembering and recalling facts with specific answers

Sl. No	CLOs	K. Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO1	Up to K2	2	K1 & K2	2	K1	2 (K1 &K2)	1 (K2)
2	CLO2	Up to K4	2	K1 &K2	1	K2	2 (K3 &K3)	2 (K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of Section-wise Marks with K levels*

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	5	-	11	18.33	50%
K2	2	2	5	10	19	31.66	
K3	-	-	10	-	10	16.66	17%
K4	-	-	-	20	20	33.33	33%
Total marks	4	6	20	30	60	100.00	100%

Blue Print – CIA – II
Mapping with Course Learning Outcomes(CLOs)

Sl. No	CLOs	K. Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO3	Up to K3	2	K1 & K2	2	K1	2 (K1 &K2)	1 (K2)
2	CLO4	Up to K4	2	K1 &K2	1	K2	2 (K3 &K3)	2 (K4)
No. of Questions to be asked			4		4		3	
No. of Questions to be answered			4		4		3	
Marks for each question			1		1		2	
Total Marks for each Section			4		4		6	

Distribution of Section-wise Marks with K levels*

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	-	-	-	2	3.333	3.333%
K2	2	6	15	-	23	38.333	38.333%
K3	-	-	5	30	35	58.333	58.333%
Total marks	4	6	20	30	60	100.00	100%

LESSON PLAN

UNIT	Description	Hours	Pedagogy
I	Chin rule, Direct proportion, Example problems.	1	ICT tools
	Indirect proportion, Example problems.	2	Lecture
	Logarithm, Properties of Logarithms, Example problems.	1	Lecture
	Common Logarithms, Characteristic, Mantissa, Example problems.	3	Lecture
II	Calendar, odd days, Example problems.	1	Lecture
	Leap year, Ordinary year, Example problems.	2	Lecture
	Clocks, The fast and Two slow, Example problems.	1	Lecture
III	Factorial Notation, Example problems.	1	Lecture
	Permutation and Combination, Example problems.	1	Lecture
	Probability, Experiment, Random experiment, example problems.	1	Lecture
	Sample Space, Event, Probability occurrence of an event, Example problems.	1	ICT tools
IV	Partnership, Ratio of Division of gains, Working and Sleeping partners, Example problems.	1	Lecture
	Stock-capital, Shares or Stock, Dividend, Example problems.	2	Lecture
	Face Value, Market Value, Brokerage, Example problems.	1	Lecture
V	True discount, Example problems.	2	Lecture
	Banker's discount and some related examples.	2	Lecture
	Banker's gain, Example problems.	2	
Total hours		30	

Course Designer

1. Dr. S. USHA
2. Prof. N.SRIVIVEKA SARATHA.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	MAJOR	20U4MMC7	Sequence and Series	3	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

OBJECTIVES

1. To determine whether or not a sequence converges we can look at what happens to the general term as n gets infinitely large.
2. To Recognize when a sequence is increasing, decreasing, bounded, or monotone and Recognize example of geometric sequences and determine whether they converge or diverge.
3. To Recognize when a geometric series converges and be able to compute its sum in that case(conceptual +Procedural)

Unit	Description	Hours	K-level	CLO
I	Bounded sets-Least Upper Bound-Greatest Lower Bound-Inequalities-Triangle Inequalities- Cauchy Schwarz Inequalities.	10	Up to K3	CLO1
II	Sequences: Sequences-Bounded sequence-Monotonic sequence-Convergent sequence-Divergent sequence-The Algebra of limits.	12	Up to K3	CLO2
III	Behaviour of Monotonic sequence- some theorems on limits-Subsequence-Limit points –Cauchy sequence.	12	Up to K3	CLO3
IV	Infinite series – Comparison test- Kummer’s test-Raabee’s test-D’Alemberts Ratio test- Demorgan’s test-Problems.	12	Up to K3	CLO4
V	Gauss test-Root test –Cauchy’s condensation test-Integral test and problems-Alternating series-Leibnitz’s test-Absolute convergence series.	14	Up to K4	CLO5

Text Book:

Sequence and Series by S. Arumugam and A. ThangapandiIsac, Latest Edition 2012, Gamma Publishing House.

Chapters: 1(1.3,1.4), 2(2.1,2.2,2.5), 3(3.1-3.11), 4, 5(5.1,5.2).

Books for Reference:

1. Real Analysis volume-I by K. Chandra SekharaRao and K.S. Narayanan, S.Viswanadhan (Printers and Publishing Private Limited), 2008.
2. Sequence and Series by M.K. Venkatraman and Manorama Sridhar, The National Publishing Company, 2002.
3. Malik S.C and SavithaArora (1991) – Mathematical Analysis, Wiley Eastern Limited New Delhi.
4. ViswanathNaik, K.- Real Analysis, Emerald Publishers, Chennai.

Web Resources:

1. <http://youtu.be/DRO1kPT4iS8>
2. <https://youtu.be/lfZGtjSWcQs>
3. <https://youtu.be/jD5s2jvnH1k>

Rationale and activities having direct bearing on Nature of course:

Sequence and series play an important role in various aspects of our lives. They help us predict, evaluate and monitor the outcome of a situation or event and help us a lot in decision making. The topic of sequences and series is important to study for a variety of reasons. During the study, students can synthesize many ideas about linear functions, including the effects of having only natural numbers in the domain. The patterns are first studied through manipulative to gain a true sense of what sequences are and are not. Then they use the manipulative to develop the formulas for determining partial sums of series. The information is eventually transferred to the symbolic stage and put to use in the context of real world situations.

Activities having direct bearing on Skill development/Employability/Entrepreneurship:

This course helps in strengthen the students their essentials such as functions, bounded, convergent , divergent, limit point, Infinite series, Ratio test, Root test. The course highlighting smart tips like Best practice, Problem solving, Quiz to help increase their curiosity and also help them to become expert with knowledge of exterior concepts.

Pedagogy :

Chalk and Talk, PPT Group Discussion, Seminar, Quiz, Problem Solving, Tutorial.

COURSE LEARNING OUTCOMES

On the successful completion of the course, students will be able to

CLO1	Recall the basic concepts in Sets and Functions and get the knowledge of Bounded sets and least upper bound and greatest lower bound.	Up to K3
CLO2	Understanding the concept of sequences, bounded, monotonic sequence, convergent, divergent and Oscillating sequence.	Up to K3
CLO3	Understanding the knowledge of subsequence, limit points and Behaviour of Monotonic sequences.	Up to K3
CLO4	Understanding the concept of Inequalities and Recognize when the series converges and diverges.	Up to K3
CLO5	Acquire the information about Alternating series and Absolute convergence series.	Up to K4

Mapping of Course Outcomes (CLOs) with Program Outcomes (POs) & Program Specified Outcomes (PSOs)

	PO					PSO						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	2	2	-	2	1	3	2	3	2	1	-	1
CLO2	3	1	-	1	2	3	2	3	3	3	3	3
CLO3	2	1	1	1	2	3	3	2	3	1	3	3
CLO4	2	1	-	1	1	3	2	3	2	1	3	2
CLO5	3	2	1	1	2	3	2	2	2	3	2	2

3- Advance Application

2- Intermediate Level

1- Basic Level

Blue Print(External Exam)

Mapping with Course Learning Outcomes(CLOs)

Units	CLOs	K. Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO 1	Up to K2	2	K1 &K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K3	2	K1 &K2	1	K1	2(K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1 &K2	1	K2	2(K3&K3)	1(K3)
4	CLO 4	Up to K3	2	K1 &K2	1	K2	2(K3&K3)	1(K3)
5	CLO 5	Up to K4	2	K1 &K2	1	K2	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-		10	10	20	16.67	17%
Total marks	10	10	50	50	120	100	100%

Blue Print (CIA-I)

S.No	CLOs	K. Level	Section A		Section B		Section C (Either/ or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO 1	Up to K2	2	K1 &K2	1	K1	2(K2 & K2)	2(K2&K3)
2	CLO 2	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2	-	-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-	-	10	10	16.67	17
Total marks	4	6	20	30	60	100	100%

Blue Print (CIA-II)

S.No	CLOs	K. Level	Section A		Section B		Section C (Either/ or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO 3	Up to K3	2	K1 &K2	1	K1	2(K2& K2)	2(K2& K3)
2	CLO 4	Up to K3	2	K1 &K2	2	K2	2(K3&K3)	1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2	-	-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-	-	10	10	16.67	17
Total marks	4	6	20	30	60	100	100%

Lesson Plan

UNIT	DESCRIPTION	HOURS	Pedagogy
I	Bounded sets –Least upper bound	2	Chalk and Talk,
	Greatest Lower bound-Inequalities –Triangle inequalities.	2	Chalk and Talk, Problem Solving
	Problems based on Triangle inequalities	3	Chalk and Talk,
	Cauchy Schwarz Inequalities-Problems.	3	PPT, Group
II	Sequence-Bounded sequence-Examples	3	Chalk and Talk,
	Monotone sequence –convergent sequence-Theorems	3	Chalk and Talk, PPT Problem Solving
	Divergent sequence-Problems and Theorems	3	Chalk and Talk,
	The Algebra of Limit-Theorems	3	Chalk and Talk,
III	Behaviour of Monotonic sequence- Geometric sequence	3	Chalk and Talk, Seminar,PPT
	some theorems on limits- problems based on Monotonic sequences.	3	Chalk and Talk, quiz
	Subsequence-Example-Limit points –Theorems and problems.	3	Chalk and Talk,PPT
	Cauchy sequence-Theorems and Problems based on Cauchy sequence.	3	Chalk and Talk, Tutorial
IV	Infinite series – Comparison test-problems.	2	Chalk and Talk,
	Kummer's test-Raabee's test- problems.	4	Chalk and
	D'Alemberts Ratio test- Problems.	3	Chalk and Talk,
	Demorgan's test-Problems.	3	Chalk and
V	Gauss test- Theorems	2	Chalk and Talk,
	Root test -Cauchy's condensation test	3	Chalk and Talk,
	Integral test and problems -Alternating series– Example and problems.	5	Chalk and Talk, Seminar,PPT
	Leibnitz's test-Absolute convergence series-problems.	4	Chalk and Talk ,PPT,Tutorial.
Total Hours		60	

Course Designer:

Dr. M. Revathi.

DEPARTMENT OF MATHEMATICS				CLASS: I B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Core	20U4MMC8	Differential Equations	3	4	25	75	100

Nature of Course			
Knowledge and skill	✓	Employability oriented	
Skill oriented		Entrepreneurship oriented	

Objectives:

1. To introduce the basics of ordinary and partial differential equations
2. Introducing various methods to find the solution of ordinary and partial differential equations
3. Introducing different types to solve first order non-linear ordinary differential equations including Charpit's method
4. To solve second order ordinary differential equations using method of variation of parameters
5. To solve linear system of ordinary differential equations
6. To solve linear and non-linear partial differential equations with different methods.

Unit	Description	Hours	K-level	CL O
I	Differential equations – Definition and examples – order and degree of differential equations – Types of differential equations – Linear and non-linear differential equations – Solving first order and higher degree equations: Equations solvable for p – Equations solvable for x – Equations solvable for y – Clairaut's form.	12	Up to K3	CLO1
II	Second and higher order linear differential equations with constant coefficients – Method of finding complementary functions – Method of finding particular integral for functions of the form e^{mx} , $\sin mx$ or $\cos mx$, x^m ($m \in \mathbb{Z}^+$), $e^{ax} V(x)$, $x^m \sin ax$ or $x^m \cos ax$, $e^{ax} \sin bx x^m$ or $e^{ax} \cos bx x^m$ – Simultaneous differential equations with constant coefficients.	12	Up to K4	CLO2
III	Higher order linear differential equations with variable coefficients - Euler's Homogeneous equations – Legendre's linear equations – Method of variation of parameters – Removal of the first derivative – Change of the dependent variable.	12	Up to K4	CLO3
IV	Partial differential equations – Definition and examples – Formation of partial differential equations by elimination of arbitrary constants – By elimination of arbitrary functions – Types of solution of partial differential equations – Solutions by direct integrals – Solving Lagrange's differential equations $Pp+Qq=R$ by method of grouping and method of multipliers.	12	Up to K3	CLO4
V	First order non-linear partial differential equations - Standard form: $f(p, q) = 0$ – $z = px + qy + f(p, q)$ $f(x, p) = f(y, q)$ – $f(x, p, q) = 0$, $f(y, p, q) = 0$, $f(z, p, q) = 0$ Charpit's method for solving first order non-linear partial differential equations.	12	Up to K4	CLO5

Book for Study:

1. S. Arumugam, A. Thangapandi Issac and A. Somasundaram, Differential Equations And Applications, 2020 Edition, Yes Dee Publishing Pvt. Ltd.

Chapters: 1(1.1, 1.2 and 1.8), 2 (2.1 – 2.5, 2.6 (Type A, Type B, Type D), 2.7), 4 (4.1 – 4.5)

Books for References:

1. S. Narayanan and T. K. Manicavachagam Pillai, Differential Equations and its Applications, 2003, S. Viswanathan Printers.
2. P. Kandasamy and K. Thilagavathi, Mathematics for B.Sc., Vol.III, 2004, S. Chand and Co., New Delhi.
3. M. K. Venkataraman and Mrs. Manorama Sridhar, Differential Equations and Laplace Transforms, 2004, The National Publishing Company.

Web Resources:

1. <http://eqworld.ipmnet.ru/en/solutions/ode.htm>
2. <https://www.khanacademy.org/math/differential-equations>
3. https://mathinsight.org/ordinary_differential_equation_introduction
4. <https://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
5. <https://www.emathhelp.net/calculators/differential-equations/differential-equation-calculator/>
6. <https://www.wolframalpha.com/examples/mathematics/differential-equations/>

Rationale and activities having direct bearing on Nature of Course**Knowledge and Skill**

Differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical and chemical problems using mathematical equations, then solve these equations so that the behavior of the systems concerned can be studied.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course. Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Learn various techniques of getting exact solutions of certain solvable first order non-linear ODE's and linear ODE's of second and higher orders	Up to K3
CLO2	Grasp the concept of a general solution of a linear ODE of second order with variable coefficients and also learn a few methods to obtain the general solution of such equations.	Up to K4
CLO3	Apply a range of techniques to solve first order linear and non-linear PDE's.ODE's.	Up to K4
CLO4	Learn about general solution of first order linear PDE's using the Lagrange's method.	Up to K3
CLO5	Know how to solve first order non-linear PDE's using Charpit's method	Up to K4

K1- Remembering and recalling facts with specific answers

K2 –Basic understanding of facts and stating main ideas with general answers

K3 –Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Mapping of Course Outcomes (CLOs) with Program Outcomes & Program Specified Outcomes(PSOs)

CLOs/POs & PSOs	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	2	3	2		3	2	3	2	3	3	2
CLO2	3	3	2	3	2		3	3	3	3	3	3	3
CLO3	3	3	2	3	3		3	3	3	3	1	3	3
CLO4	3	3	2	3	2		3	2	3	2	3	3	1
CLO5	3	3	2	3	2		3	2	3	-	1	3	2

1. Basic level

2. Intermediate level

3. Advance level

Blue Print

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K 4	2	K1 & K2	1	K2	2(K3 & K3)	1(K4)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3 & K3)	1(K4)
4	CLO 4	Up to K 3	2	K1 & K2	1	K1	2(K2& K2)	1(K3)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	9	7.5	33.33%
K2	5	6	20	-	31	25.83	
K3	-	-	30	30	60	50.00	50.00%
K4	-	-	-	20	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K 3	2	K1 & K2	1	K1	2(K2 &K2)	2(K2/K3)
2	CLO 2	Up to K4	2	K1 & K2	2	K2	2(K3 &K3)	1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2		-	4	6.67	50%
K2	2	4	10	10	26	43.33	
K3	-		10	10	20	33.33	33.33%
K4	-			10	10	16.67	16.67%
Total marks	4	6	20	30	60	100.00	100%

Blue Print for CIA-II

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K4 &K4)	1(K4)
2	CLO 4	Up to K 3	2	K1 & K2	2	K1	2(K2&K2)	2(K2/K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4		-	6	10.00	50%
K2	2	2	10	10	24	40.00	
K3	-			10	10	16.67	16.67%
K4	-		10	10	20	33.33	33.33%
Total marks	4	6	20	30	60	100.00	100%

Lesson Plan

Units	Description	Hours	Pedagogy
I	Ordinary differential Equations: Definition and Examples, Order and degrees of a DE's	2	Lecture
	Types of DE's, Linear and non-linear DE's, Solution of DE's	2	Lecture
	Solving first order but Higher degree DE's: Equations solvable for p	2	Lecture & PPT
	Equation solvable for x	2	Lecture
	Equations solvable for y	2	Lecture
	Clairaut's form	2	Lecture & Group Discussion
II	Second and higher order linear differential equations with constant coefficients	1	Lecture
	Method of finding complementary functions	1	Lecture & Seminar
	Method of finding particular integrals of the form: e^{mx} , $\sin mx$ or $\cos mx$	2	Lecture
	Method of finding particular integrals of the form: x^m ($m \in \mathbb{Z}^+$), $e^{ax} V(X)$	2	Lecture
	Method of finding particular integrals of the form: $x^m \sin ax$ or $x^m \cos ax$,	2	Lecture & PPT
	Method of finding particular integrals of the form: $e^{ax} \sin bx$ or $e^{ax} \cos bx$	2	Lecture & Seminar
	Simultaneous Differential Equations with constant coefficients	2	Lecture & Group Discussion
III	Higher order linear differential equations with variable coefficients	1	Lecture
	Cauchy – Euler's Homogeneous Equations	2	Lecture & PPT
	Legendre's Linear Homogeneous Equations	2	Lecture
	Method of variation of parameters	2	Lecture
	Removal of the first derivative	2	Lecture & Seminar
	Change of dependent variable: Method of reduction of order	3	Lecture & Group Discussion
IV	Partial differential Equations: Definition and examples	1	Lecture
	Formation of PDE's by eliminating the arbitrary constants	2	Lecture
	Formation of PDE's by eliminating the arbitrary functions	2	Lecture & Seminar
	Types of solutions of PDE's, Solutions by direct integration	2	Lecture
	Solving Lagrange's PDE: $Pp+Qq=R$, by method of groupings	2	Lecture & PPT
	Method of multipliers	3	Lecture & Group Discussion
	Solving first order non-linear partial differential equations - Standard forms	1	Lecture
	Equations of the form $f(p, q) = 0$	2	Lecture & Seminar

V	Equations of the form $f(x, p, q) = 0, f(y, p, q) = 0, f(z, p, q) = 0$	3	Lecture
	Equations of the form $f(x, p) = f(y, q)$	2	Lecture & PPT
	Equations of the form $z = px + qy + f(p, q)$	2	Lecture
	Charpit's method for solving first order non-linear partial differential equations.	2	Lecture & Group Discussion
Total Hours		60	

Course Designer:

Dr. V. Ananthaswamy, Assistant Professor, Research Centre and PG Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Add-on		NUMBER SYSTEMS AND BOOLEAN ALGEBRA	2	2	50	50	100

Unit – 1

Binary – Decimal – Octal – Hexadecimal – Definitions – Examples – Conversions.

Unit – 2

Boolean Algebra – Definition – Examples – Problems – Boolean Algebra thro Lattices.

Unit – 3

Properties of Boolean Algebra – Problems based on these properties.

Unit – 4

Boolean function – Boolean expressions – Min terms and Max terms – Boolean function in min terms or max terms.

Unit – 5

Canonical forms or Normal forms – Method to find min term canonical forms – Simplification of Boolean functions – K-Maps – K-Maps with don't care conditions.

Books for Study

1. Switching Theory and Finite Automata Theory by Zvikohavi and Niraj K. Tha, Third Edition 2009, Cambridge University Press.
Chapter: 1 only (For Unit – 1).
2. Discrete Mathematics for Computer Science Courses by P. Duraipandia, Muhil Publishers, First Edition 2008.
Chapter: 10 only (For Unit -2 to Unit – 5).

Books for References:

1. Computer Fundamentals and Programming in C by Anita Goel and Ajay Mittal, Second Impression (2014), Pearson (India).
2. Switching Theory and Logic Design by A.P Godse and D.A. Godse, First Edition 2009, Technical Publications.

Course Designer:

Dr. V. ANANTHASWAMY, Assistant Professor, Research Centre and PG Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Add-on		Basic Mathematics	2	2	50	50	100

Unit – 1

Theory of sets: Representation of sets- Types of sets- Venn Diagram- Set operations- Union-intersection of sets- Complement of set- Differences of two sets- Symmetric Difference- Theorems- De-Morgan's Law – Number of elements in finite set- Miscellaneous illustrations.

Unit – 2

Logarithms: Natural Logarithms- Logarithmic functions- Theorems-Common Logarithms- Anti-Logarithms-Application of common Logarithms

Unit – 3

Ratio: Definition- inverse of ratio- Dividing a number into a given ratio-Commensurable and incommensurable quantities-compound ratio -Duplicate ratio -Triplicate ratio –Sub-duplicate- ratio – Sub-duplicate-Continued ratio –Theorems on ratio –Miscellaneous illustration –Exercise-Answer.

Unit – 4

Proportions: Meaning – Properties of Proportion – principles- Invertendo, Alternedo, Componendo, Dividendo, Convertendo, Componendo And Dividendo- Types of Proportion- Direct proportion- Indirect Proportion- Compound Proportion,- Simple proportion- Continued proportion-Time And Work-Mixtures- Miscellaneous illustration- Exercise- Answers.

Unit – 5

Probability: Terminology- Probability measure- Classical or priori probability- Empirical approach- Addition theorem- Multiplication theorem- Conditional probability-

Books for Study

1. Business Mathematics By M.Manoharan and C.Elango, Palani Paramount Publications,Third revised Edition 2002.
Chapter: 1,2,3,4,9.

Books for References:

1. A text Book of business Mathematics by G. K. Ranganath, C. S. Sampangiram and Y. Rajaram, Himalaya Publishing House (2008).

Course Designer:

Dr.U.Karthik Raja, Assistant Professor, Research Centre and PG Department of Mathematics.

Evaluation pattern for Add-on courses

Internal Components (CIA):50 Marks

Component	Allocation	Suggestive evaluation types (Any one Option)
I	20%	Periodic Assignments (3 Nos./Mini Project/Case Studies
II	15%	Paper Presentation/Group Discussion/Criticism of a Book /Oratorical Skill
III	15%	Quiz/Viva-Voce (Related to the Paper)/Innovative Experiment Modeling
Total	50%	

External Components: 50 Marks

External examination duration : 2 hours

Question paper pattern:

Part – A (Multiple Choice type) (10 X 1 = 10 Marks)

Part – B ((Descriptive type) (4 out of 7 Questions to be answered) (4 X 10 = 40 Marks)

Evaluation pattern for Self-study courses

Assessment components	Marks
Assignments (minimum 2)	25%
Project/innovative experimental design	25%
Paper presentation/ viva voce	25%
Internal test	25%
Total	100%

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. MATHEMATICS				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III&IV	Self Study		TEST OF REASONING	2	-	50	50	100

UNIT-I Non verbal reasoning tests

Completion of series – Classification – Analogical non-verbal reasoning – Pattern comparison between two sets of figures – Arranging figures in proper sequence.

UNIT-II Non verbal reasoning tests(Continued)

Detection of figure out of series – Mirror reflection of a pattern –Detection of hidden figure in a given pattern – Figures rotation – Pattern completion test.

UNIT-III Non verbal reasoning tests(Continued)

Pattern comparison – Grouping of identical figures – Applications of given rules to a set of figures – Pattern rearrangement – Magic square.

UNIT-IV Verbal reasoning tests

Series completion – Types of series completion questions – Verbal classification – Number classification.

UNIT-V Verbal reasoning tests(Continued)

Verbal analogy – Coding and decoding – Sense of direction – Miscellaneous verbal reasoning tests.

Books for References:

1. Edgar Thorpe – Test of Reasoning, Tata McGraw – Hill publishing company limited, New Delhi.
2. Jaikishan, Premkishan – How to crack Test of Reasoning, Arihant publications (india) Limited.

Course Designer:

Dr.V. SANGEETHASUBHA, Assistant Professor, Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Allied	20U3MAC3	Allied Mathematics-III	5	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

COURSE OBJECTIVES:

1. To specify the basic relation between roots and coefficients and solve the transformed equation and to predict approximate solutions to equations.
2. To illustrate the rules of higher order differentiation and to make use of Leibnitz rule to find n^{th} derivative of some standard functions.
3. To understand the properties of definite integrals and methods of integration of higher powers of trigonometric functions and to evaluate double and triple integrals.
4. To explore the physical applications of derivatives of vectors and to compute divergence and curl of vector fields and to evaluate line integrals.
5. To determine the Fourier series of functions and to find the half range sine and cosine Fourier series.

Unit	Description	Hours	K-level	CLO
I	Formation of Equations – Relation between roots and Coefficients- Reciprocal equation –Transformation of Equation – Approximate solutions of Numerical Equations – Newton’s Methods – Horner’s Method.	18	Up to K3	CLO1
II	Differentiability – Chain rule – Differentiation of Inverse trigonometric functions – Differentiation by transformation – Differentiation of logarithmic functions – Differentiation of implicit functions – Higher derivatives – n^{th} derivatives of some standard functions – Leibnitz’s rule – Problems.	20	Up to K2	CLO2
III	Integration by parts – Reduction formula for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$ and $\int \sin^m x \cos^n x \, dx$ (Problems only) – Evaluation of double and triple integrals.	18	Up to K4	CLO3
IV	Vector differentiation – Vector differential operator – Gradient, Divergence and Curl and their simple properties – Directional Derivative and its maximum value — Solenoidal and Irrotational vectors (simple problems only) – Vector integration - Line Integrals.	18	Up to K3	CLO4
V	Fourier series – Fourier series for odd and even functions – Half range Fourier sine and cosine series – Problems.	16	Up to K3	CLO5

Text book:

1. Allied Mathematics I, Dr. S. Arumugam & Isaac, New Gamma Publishing House, Palayamkottai. (2011)
(For Unit I) (Chapter:1)
2. Calculus, Dr.S.Arumugam& Isaac, New Gamma Publishing House,Palayamkottai. (2008)
(For Unit II - Part I - Chapter: 2(2.4 – 2.7, 2.10 – 2.12))(For Units III, V – Part II – Chapter 2(2.7,2.8), Chapter 3(3.1-3.3), Chapter 5)
3. Allied Mathematics II, Dr. S. Arumugam & Isaac, New Gamma Publishing House, Palayamkottai. (2011)
(For Unit IV) (Chapter:1,2)

Books for Reference:

1. Ancillary Mathematics, T.K Manikavasagampillai& Others, Viswanathan Printers and Publishers Pvt. Ltd., Chennai.

Web Resources:

1. <https://www.math24.net/leibniz-formula/>
2. https://www.whitman.edu/mathematics/calculus_online/section08.02.html
3. <http://tutorial.math.lamar.edu/Classes/CalcIII/LineIntegralsVectorFields.aspx>
4. <https://www.khanacademy.org/science/electrical-engineering/ee-signals/ee-fourier-series/v/ee-fourier-series-intro>

Rationale and Activities Having Direct Bearing on Nature of The Course

Trigonometry, Differentiation and Integration play critical roles in resolving a variety of physical issues. The study of vector fields, vector differentiation and integration, which is an important part of physics, is provided in this course. This course teaches the fundamentals of solving equations, differentiation, and integration of vector fields, as well as how to apply that knowledge to real-world problems. This course uses a variety of approaches to teach understudies basic intuition abilities, including exercises, assignments, and quizzes.

Pedagogy:

Lecture, Seminar, Quiz, Tutorial, Group Discussion, Assignment and Power point presentation.

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to

Number	Course Outcome	Knowledge level
CLO 1	Recognize the fundamental relation among roots and coefficients and solve the changed condition and to predict approximate solution for conditions.	Up to K3
CLO 2	Utilize the idea of differentiation to find derivatives of inverse trigonometric functions, implicit function and logarithmic functions.	Up to K2
CLO 3	Evaluate integrals using integration by parts and apply integration to compute double and triple integrals.	Up to K4
CLO 4	Apply vector differentiation to evaluate gradient, divergence and curl of a vector point function and related identities and to evaluate line integrals using vector integration.	Up to K3
CLO 5	Compute the Fourier series of functions.	Up to K3

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analysing, presentation and make inferences with evidences

Mapping with Courses Learning Outcomes (CLOs)

CLO/ PO- PSO	PO					PSO						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO 1	3	2	-	-	1	2	2	2	3	3	-	-
CLO 2	3	2	-	-	1	2	1	2	3	3	-	-
CLO 3	3	2	-	-	1	2	1	2	3	3	-	-
CLO 4	3	2	-	-	1	2	1	2	3	3	-	-
CLO 5	3	2	-	-	1	2	1	2	3	3	-	-

3 – Advance Application 2 - Intermediate Level

1- Basic Level

BLUE PRINT – External Exam

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K3& K3)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K2	2(K1& K1)	1(K2)
3	CLO 3	Up to K4	2	K1 & K2	1	K2	2(K4& K4)	1(K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2(K2& K2)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/Or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	42	42%
K4	-	-	10	10	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

BLUE PRINT – CIA – I

S.No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K – Level	No. of Questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K3& K3)	2(K3)
2	CLO 2	Up to K2	2	K1 & K2	2	K2 & K2	2(K1& K1)	1(K2)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2	10	-	14	23.33	50%
K2	2	4	-	10	16	26.67	
K3	-	-	10	20	30	50	50%
K4	-	-	-	-	-	-	-
Total marks	4	6	20	30	60	100	100%

BLUE PRINT – CIA - II

S. No	CLOs	K level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 3	Up to K4	2	K1 & K2	1	K2 & K2	2(K3&K3)	2(K2&K4)
2	CLO 4	Up to K3	2	K1 & K2	2	K1	2(K1&K1)	1 (K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	26.67	50%
K2	2	2	-	10	14	23.33	
K3	-	-	10	10	20	33.33	33%
K4	-	-	-	10	10	16.67	17%
Total marks	4	6	20	30	60	100	100%

Lesson Plan

Unit	Description	Hours	Mode
I	Formation of Equations	3	Lecture, Group
	Relation between roots and Coefficients	3	Problem Solving
	Reciprocal equation –Transformation of Equation	5	Lecture, Quiz
	Approximate solutions of Numerical Equations – Newton's Methods	4	Quiz
	Horner's Method.	3	Lecture, Problem
II	Differentiability – Chain rule	4	PPT, Lecture
	Differentiation of Inverse trigonometric functions	4	PPT, Tutorial
	Differentiation by transformation	4	Problem Solving
	Differentiation of logarithmic functions – Differentiation of implicit functions	4	Problem Solving
	Higher derivatives – nth derivatives of some standard functions – Leibnitz's rule	4	Lecture, Tutorial
III	Integration by parts	4	Lecture, Tutorial
	Reduction formula for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$ and $\int \sin^m x \cos^n x \, dx$ (Problems only)	6	Tutorial
	Evaluation of double integrals	4	Problem Solving
	Evaluation of triple integrals	4	Problem Solving
IV	Vector differentiation – Vector differential operator	2	PPT, Lecture
	Gradient, Divergence and Curl and their simple properties	4	Problem Solving
	Directional Derivative and its maximum value	4	PPT, Lecture
	Solenoidal and Irrotational vectors (simple problems only)	4	Lecture
	Line Integrals	4	Lecture
V	Fourier Series	2	Problem Solving,
	Fourier Series for odd and even functions	6	PPT, Lecture,
	Half range Fourier sine series	4	Lecture, Assignment
	Half range Fourier cosine series	4	Lecture, Tutorial,
Total Hours		90	

Course Designer:

Mr. P.NATARAJ, Assistant Professor, Department of Mathematics& Statistics (SF).

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Allied	20U4MAC4	Allied Mathematics – IV	5	6	25	75	100

Nature of Course			
Knowledge and skill	✓	Employability oriented	
Skill oriented		Entrepreneurship oriented	

OBJECTIVES

1. To provide students with strong foundation on both ordinary & partial differential equations which will enrich their knowledge to apply it in real life problems.
2. To classify the differential equations with respect to their order & linearity and solving using various methods.
3. To understand the fundamental ideas of Laplace transforms, methods of solving an ordinary differential equation using Laplace transforms and its applications.
4. Enrich and enhance the fundamental knowledge in functions of Complex variables to compute limit, continuity & differentiation of functions of complex variables and to understand Analytic functions & its properties, C-R equations, elementary transformations and bilinear transformation.

Unit	Description	Hours	K-level	CLO
I	Differential equation of first order and first degree – Variable-Separable – Homogeneous and Non-homogeneous differential equations – Exact differential equations – Practical rule for solving an exact differential equations – Integrating factors.	18	Up to K3	CLO1
II	Linear differential equations of higher order – Linear differential equations with constant coefficients – Methods of finding complementary functions – Methods of finding particular integrals for the functions of the type e^{ax} , $\cos ax$, $\sin ax$, x^m , $e^{ax}V$ – Applications of Differential Equations : Growth and Decay.	16	Up to K3	CLO2
III	Formation of partial differential equations – First order partial differential equations: Classification of integrals – Methods of solving first order partial differential equations – Lagrange's linear Equation – Some standard forms of first order partial differential equations (Types 1-4) – Charpit's method.	20	Up to K4	CLO3
IV	Laplace transforms – Inverse Laplace transforms – Solution of ordinary differential equation using Laplace Transforms.	18	Up to K3	CLO4
V	Analytic Functions – Cauchy Riemann Equations – Alternate Forms of Cauchy Riemann Equations – Elementary Transformations – Bilinear Transformation – Cross Ratio.	18	Up to K2	CLO5

Text Book:

1. Dr.S.Arumugam&A. Thangapandi Issac, Allied Mathematics Paper III (MKU), Edition June 2012, New Gamma Publishing House.

Chapters 1 (1.2 – 1.4), 2, 3, 4, 5 (5.2), 6, 7 (7.1 – 7.3).

BOOKS FOR REFERENCE:

1. T.K Manikavasagampillai& Others, Ancillary Mathematics, Volume I, S. Viswanathan Printers and Publishers Pvt Ltd., Chennai.
2. P.Kandasamy&K.Thilagavathy, Allied Mathematics, Volume II, S.Chand& Company Pvt. Ltd.

WEB RESOURCES:

1. <https://www.math.canterbury.ac.nz/php/resources/math100/differential-equations/>
2. <https://www.math24.net/exact-differential-equations/>
3. <https://www.math24.net/higher-order-linear-homogeneous-differential-equations-constant-coefficients/>
4. https://www.brainkart.com/article/Lagrange---s-Linear-Equation_6488/
5. <https://nptel.ac.in/courses/111/106/111106100/>
6. <https://lpsa.swarthmore.edu/LaplaceXform/FwdLaplace/LaplaceProps.html>
7. <https://nptel.ac.in/courses/111/107/111107056/>

RATIONALE AND ACTIVITIES HAVING DIRECT BEARING ON NATURE OF THE COURSE

The role of Differential Equations is very important in the modern technologies to inter-relate and solve a variety of real life problems. Complex Analysis investigates functions of complex variable and it is extremely useful in many branches of Mathematics as well as Physics. This course provides the fundamental knowledge in ODE, PDE&Complex Analysis and also develop skills to apply it in real life problems. This course imparts Problem Solving Skills to the students by the following activities such as Formulating Ordinary & Partial Differential Equations for a real life problems and Solving it using various methods, Exercises, Assignment and Quiz.

Pedagogy:

Lecture, Seminar, Problem Solving, Tutorial, Group Discussion, PPT, Assignment, Quiz, ICT Tools, LMS CANVAS

COURSE LEARNING OUTCOMES

On the successful completion of the course, students will be able to

Number	Course Outcome	Knowledge level
CLO1	Use various methods to solve first order & first degree ordinary differential equations	Up to K3
CLO2	Solve second & higher order differential equations with constant coefficients. Construct the growth & decay model and apply suitable method to solve it	Up to K3
CLO3	Formulate Partial differential equations, classify them with respect to their order & linearity, Analyze and apply various methods to solve first order partial differential equations	Up to K4
CLO4	Find Laplace transform and Inverse Laplace transform of simple functions and use Laplace transform to solve ordinary differential equations	Up to K3
CLO5	Compute limit, continuity & differentiation of functions of complex variables. Determine Analyticity of complex functions, C-R equations and to discuss various regions are transformed by bilinear transformation.	Up to K2

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Mapping with Courses Learning Outcomes (CLOs)

CLO/ PO- PSO	PO					PSO						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO 1	3	2	-	-	1	2	1	2	3	3	-	-
CLO 2	3	2	-	-	1	2	1	2	3	3	-	-
CLO 3	3	2	-	-	1	2	1	2	3	3	-	-
CLO 4	3	2	-	-	1	2	1	2	3	3	-	-
CLO 5	3	2	-	-	1	2	1	2	3	3	-	-

3 - Advanced Application

2 - Intermediate Level

1- Basic Level

BLUE PRINT - EXTERNAL EXAM

S. No	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K-Level	No. of questions	K- level		
1	CLO 1	Up to K3	2	K1& K2	1	K1	2 (K3 & K3)	1 (K3)
2	CLO 2	Up to K3	2	K1& K2	1	K2	2 (K3 & K3)	1 (K3)
3	CLO 3	Up to K4	2	K1& K2	1	K2	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K3	2	K1& K2	1	K1	2 (K1 & K1)	1 (K3)
5	CLO 5	Up to K2	2	K1& K2	1	K2	2 (K2 & K2)	1 (K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No Choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100	100%

BLUE PRINT – CIA - I

S.No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	2 (K2 & K3)
2	CLO 2	Up to K3	2	K1 & K2	2	K2 & K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2	-	-	4	6.67	50%
K2	2	4	10	10	26	43.33	
K3	-	-	10	20	30	50	50%
K4	-	-	-	-	-	-	-
Total marks	4	6	20	30	60	100	100%

BLUE PRINT – CIA - II

S.No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 3	Up to K4	2	K1 & K2	1	K2& K2	2(K3 & K3)	2 (K2& K4)
2	CLO 4	Up to K3	2	K1 & K2	2	K1	2(K1 & K1)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	26.67	50%
K2	2	2	-	10	14	23.33	
K3	-	-	10	10	20	33.33	33%
K4	-	-	-	10	10	16.67	17%
Total marks	4	6	20	30	60	100	100%

LESSON PLAN

Unit	Description	Hours	Mode
I	Introduction – Differential equation of first order and first degree: Variable – Separable	3	Lecture / Group Discussion / PPT / Problem Solving
	Homogeneous and Non-homogeneous differential equations	6	Problem Solving / Tutorial
	Exact Differential equations – Practical rule for solving an exact differential equations	4	Lecture / Problem Solving / Tutorial
	Integrating factors	5	Lecture / Problem Solving / Tutorial
II	Introduction – Linear equation with constant coefficients : Methods of finding complementary functions	3	Lecture / PPT / Problem Solving
	Methods of finding particular integrals – Problems	7	Lecture / PPT / Problem Solving / Tutorial
	Applications of Differential Equations : Growth and Decay	5	Lecture / Group Discussion / Problem Solving
	Quiz	1	ICT Tools / LMS CANVAS
III	Formation of partial differential equations	3	Lecture / PPT / Problem Solving / Group Discussion
	Classification of Integrals	1	PPT / Group Discussion
	Lagrange's linear equation	4	Lecture / Problem Solving/ Tutorial
	Solutions of standard types of first order partial differential equations Type I	2	Problem Solving
	Solutions of standard types of first order partial differential equations Type II	2	Problem Solving

	Solutions of standard types of first order partial differential equations Type III	2	Lecture / Tutorial
	Solutions of standard types of first order partial differential equations Type IV	2	Lecture / PPT / Problem Solving
	Charpit's Method	4	Problem Solving / Tutorial
IV	Laplace transforms	4	Lecture / PPT
	Inverse Laplace transforms	5	Lecture / Seminar / Problem Solving
	Solution of differential equations using Laplace transforms	8	Problem Solving
	Quiz	1	LMS (CANVAS) / ICT Tools
V	Limit, Continuity, Differentiability of Complex functions	2	Lecture / Seminar / Assignment
	Analytic Functions	3	Lecture / Group Discussion / Problem Solving / Assignment
	Cauchy – Riemann Equations	4	Lecture / Problem Solving / Assignment
	Elementary Transformations	3	Lecture / PPT / Group Discussion
	Bilinear Transformation	3	Lecture / Problem Solving / Assignment
	Cross Ratio	3	Lecture / Problem Solving / Assignment / Tutorial
Total Hours		90	

COURSE DESIGNER:

Mr. S. ANANDASRINIVASAN, Assistant Professor, Department of Mathematics (SF).

DEPARTMENT OF MATHEMATICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21MATC05	ASTRONOMY	2	30	50	50	100

Learning Objectives:

- To introduce the student to space science.
- To familiarize the learner with the important of the planets, sun, moon and stellar universe.
- To give a brief history of Astronomy.
- To achieve a highest degree of scientific literacy.

Learning Outcomes:

Learners will be able to

- Acquire concept of spherical trigonometry.
- Gains knowledge regarding celestial sphere and diurnal motion
- Familiar with the Earth, the moon and its properties.
- Study the concepts of Kepler's laws and its properties
- Analyze the characteristics of sidereal and synodic month and classify the successive phases of moon

UNIT - I:

Introduction – Spherical Trigonometry – Sphere – Great circles and Small circles – Axis and poles of a circle – Distance between two points on a sphere – Angle between two circles – Angular radius or Spherical radius-Spherical figures – Spherical triangle - Polar triangle – Relation between the elements of a spherical triangle and its polar triangle – Some properties of spherical triangles.

UNIT - II:

Celestial sphere – Diurnal motion, celestial axis and equator – Celestial horizon – Zenith and Nadir – Celestial meridian – Cardinal points – Northern and Southern hemispheres – Eastern and Western hemispheres – Visible and invisible hemispheres – Declination circles – Verticals – Parallax angle – Transit or Culmination – Due east and Due west – Due south and due north – Annual motion of the sun, ecliptic, obliquity – First point of Aries and first point of Libra- Equinoxes and solstices.

UNIT - III:

Celestial Co- ordinates – Horizontal system – Equatorial system – Meridian system –Ecliptic system – Sidereal times – West hour angle of a body expressed in time units – Latitude of a place – Morning and Evening stars – Circumpolar stars.

UNIT - IV:

The Earth – The Zones of Earth – Terrestrial latitudes and longitudes – Date line – Shape of earth – Geographical and geocentric latitudes of a place – Geographical and Nautical miles – Radius of earth – Dip of horizon – Twilight

UNIT - V:

Kepler's laws - Verification of first law- Newton's deductions – Equation of time – Seasons – Calendar. The moon- Synodic and sidereal periods – Phase of moon. Eclipses – Lunar eclipse and Solar eclipse

TEXT BOOK:

Astronomy(Reprint - 2007) by Prof. S. Kumaravelu and Prof. SusheelaKumaravelu

Course Designer:

Dr. K.M.Dharmalingam, Associate Professor, Department of Mathematics.

DEPARTMENT OF MATHEMATICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21MATC06	VERBAL & NON-VERBAL REASONING	2	2	50	50	100

Learning Objectives

- To enrich and enhance the knowledge of students in both Verbal & Non-Verbal Reasoning
- To enable students to analyse and solve complex problems without relying upon or being limited by language skills

Learning Outcomes

After the completion of this course, students will be able

- To understand and analyze visual information & solve problems using visual reasoning.
- To demonstrate cognitive skills than his / her acquired knowledge.

UNIT I Verbal Reasoning

Analogy – Classification – Series Completion – Coding & Decoding – Blood Relations

UNIT II Verbal Reasoning (Continued)

Puzzle Test – Direction Sense Test – Arithmetical Reasoning – Inserting the Missing Character

UNIT III Logical Reasoning

Logical Venn Diagrams – Logical Sequence of words – Logic : Syllogism

UNIT IV Non-Verbal Reasoning

Series – Analogy – Classification - Analytical Reasoning – Mirror Images – Water Images

UNIT V Non-Verbal Reasoning (Continued)

Completion of Incomplete Pattern – Figure Matrix – Cubes & Dice

TEXT BOOK :

1. R.S. Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, S. Chand & Company Ltd.

REFERENCE BOOK :

1. BS Sijwali&InduSijwali, A New Approach to Reasoning – Verbal, Non-verbal & Analytical, Arihant Publication
2. Jaikishan&Premkishan, How to Crack Test of Reasoning in all competitive examinations, Arihant Publication

WEB RESOURCES

1. <https://learnfrenzy.com/reasoning>
2. <https://www.indiabix.com/non-verbal-reasoning/questions-and-answers/>
3. <https://studymild.com/non-verbal-reasoning/>

Course Designer: Mr. S.Anandsrinivasan, Assistant Professor, Department of Mathematics(SF).

DEPARTMENT OF MATHEMATICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21MATC07	SCILAB	2	30	50	50	100

Learning Objectives:

To make the students aware of SCILAB programming environment.

Students will understand the basics of SCILAB software and code development.

Learning out comes:

The course contents will enable the students to learn basic SCILAB programming

Students will learn to execute SCILAB codes for Vectors, Matrix, ordinary differential equations, Linear and Non-Linear Equations

UNIT - I: Introduction to Scilab

About Scilab and its benefits-Scilab is reliable-Use of Scilab in CNES-Use of Scilab for space mission analysis and flight dynamics-Industrial application of Scilab-Matrix calculation in Scilab-Installing Scilab-Expressions: Show mathematical expressions with numbers-Variables-Diary command-Define symbolic constants-Basic functions-suppressing output- Conditional Branching- 'if' and 'then' with the example- use of the 'else' keyword- use of the 'elseif' keyword- example for select-Iteration-syntax of 'for' statement- Scripts and Functions

UNIT - II: Vector Operations and Matrix Operations

Define vector-Calculate length of a vector-Perform mathematical operations on Vectors such as addition, subtraction and multiplication. Define a matrix-Calculate size of a matrix-Perform mathematical operations on Matrices such as addition, subtraction and multiplication-Matrix Operations-Access the elements of Matrix, Determine the determinant, inverse and eigen values of a matrix.-Define special matrices-Perform elementary row operations-Solve the system of linear equations.

UNIT - III: Ordinary Differential Equations

Solving ODEs using Euler Methods-Solve ODEs using Euler and Modified Euler methods Develop Scilab code to solve ODEs- Solving ODEs using Scilab ode Function-Use Scilab ode function-Solve typical examples of ODEs -Plot the solution

UNIT - IV: Solving Linear Equations

Explain Gauss Elimination method algorithm-Explain code for Gauss Elimination method and solve an example using this code- Explain Gauss Jordan method algorithm- Explain code for Gauss Jordan method and solve an example using this code-Solve system of linear equations using iterative methods-. Use Jacobi and Gauss Seidel iterative methods

UNIT - V: Solving Non-Linear Equations

Numerical methods- Solving Non- linear Equations - Learn how to solve nonlinear equations using numerical methods- Learn Bisection method- Learn Secant method- Learn how to develop Scilab code for solving nonlinear equations

TEXT BOOK:

SCILAB—A Beginner's Approach 1st Edition, by Anil Kumar Verma (January 2018)

Course Designer

Mrs.V.Vijayalakshmi, Assistant Professor, Department of Mathematics(SF).

DEPARTMENT OF MATHEMATICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21MATC04	Formal Languages	2	30	50	50	100

Learning Objectives

- To enable the students to understand the basic concept of compiler design.
- Introduce students to the mathematical foundations of the theory of formal languages and grammars.
- Identify different formal languages and their relationships.

Learning outcomes

- Acquire a fundamental understanding the concepts in formal languages.
- Able to design grammars and different language classes.
- Apply rigorous formal mathematical methods to prove properties of languages and grammars.
- Understand the situation and solve those problems in terms of skills.

UNIT - I:

Introduction –Alphabet-strings-Languages-Phrase structure language-Context sensitive language-Problems.

UNIT - II:

Definition of context free language-Definition of Regular languages and regular grammar-Simple problems.

UNIT – III:

Closure operations-Normal forms lemmas-The families of PSL,CSL,CFL and RL are closed under union, product, star and reflection.

UNIT - IV:

Definition of Homomorphism- ϵ – free homomorphism-The family of CFL is closed under substitution, homomorphism, inverse homomorphism, and not closed intersection and simple problems.

UNIT - V:

Properties of context free language-Generationtrees-Ambiguity in CFL-Definition of Ambiguous Grammar-simple problems.

TEXT BOOK:

Formal languages and Automata by Dr.Ranisiromoney, Revised edition 1979.

Reference Books

1. Discrete Mathematics by Schaum's series(Second Edition)
2. Formal Languages and automata Theory “, K.V.N.Sunitha and N.Kalyani TMH,2010.

Course Designer

Dr.R.CHITRA, Coordinator, Department of Mathematics& Statistics.

I UG Ratifications

Course Code	Course Title	Nature of the course	Rationale	Activities having direct bearing on Skill development / Employability /Entrepreneurship
20U1MAC1	Allied Mathematics-I	Knowledge & Skill	The part of trigonometry, differentiation and integration is vital in taking care of different science issues. An investigation of vector field is given which has an essential influence in applied sciences. This course gives the key information in solving equations, differentiation and integration in vector fields and furthermore create abilities to apply it in real-life issues.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U1MMC1	Calculus	Knowledge & Skill	Calculus is essential for many other fields and sciences. It is a prototype of a thought construction and part of culture. Teaching calculus has long tradition. Its teaching can be learned. If we wanted to teach something else, what would replace it? Calculus develops thinking and problem solving skills.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U1MMC2	Classical Algebra and Trigonometry	Knowledge & Skill	Classical algebra is concerned with finding solutions to equations or systems of equations, i.e., finding the roots, or values of the unknowns, that upon substitution into the original equation will make it a numerical identity. Trigonometry is said to be the most important mathematical relationship ever discovered. Triangles are one of the simplest forms found in nature, but their mathematics has vital importance, especially where precise distance measurements are needed.	This course imparts Problem Solving Skills in the students and is crafted to help the students in identifying the best solution for a given problem. This course helps in strengthen the students their “problem solving skills” with the essentials such as short techniques. Widely used in architecture, engineering and many sciences.

20U2MAC2	Allied mathematics-II	Knowledge & Skill	The course of differential equations constitutes a part of mathematics that plays a prominent role in understanding the applied sciences. This course clarifies the classifications and different solving strategies for ODE and PDE. It builds up the capacity to solve the first and higher-order ODE problems. It assists with examining the sort of PDE and giving answers for the PDE problems. By understanding the critical thinking strategies, students get motivated to solve real-world problems.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U2MMC3	Analytical Geometry(3D) and Vector Calculus	Knowledge & Skill	It is too often the custom to regard analytical geometry and analytical conies as synonymous terms. Most introductory treatises on methods limit their scope to the investigation of properties of curves, lines, spheres, cone and cylinder. A preliminary course in the use of fundamental formulas is clearly essential facility in expression and interpretation has been acquired, it is both instructive and interesting for the student to realize their application, not merely to the conic, but to curves of a more general character. Also It demonstrate the understanding of vectors in both operators and shapes.	This course imparts problem solving skills in the students and is crafted to help the students in identifying the best solution for a given problem. This course helps in strengthen the students their essentials such as functions, plane, lines, spheres, vector functions. Also helps them to become expert with knowledge of exterior concepts.
20U2MMC4	Discrete Mathematics	Knowledge & Skill	-	-

The Madura College (Autonomous), Madurai – 625 011
Department of Mathematics

VISION

To train the students so that they are strong in logic, which enables them to approach, analyze and solve any problem, both scientific and sociological, in an unbiased manner and to enhance the quantitative and analytical skill.

MISSION

- To provide an environment where students can learn and become an efficient and accurate problem solver of Mathematics and Mathematical applications.
- To make the students as Mathematical thinkers and enable them to become a long time learners of Mathematics.
- To make the students to have core knowledge and able to correlate this core mathematical knowledge with other disciplines

PROGRAM EDUCATIONAL OBJECTIVES

- ❖ Proffer a viable option to enhance their knowledge of the subject and explore the other areas.
- ❖ Demonstrate a high level of expertise in the area of professional practice.
- ❖ Gain advanced knowledge of a theoretical and applied topic, skills gained through independent learning.
- ❖ Empower the students to obtain new skill as needed in their employment or education and provide with skill and abilities to facilitate solving real world problem.
- ❖ Educate and motivate students for research studies in mathematics and related fields.

PROGRAMME SPECIFIC OUTCOME

- ❖ Able the students to design the methodology suitable to the problem encountered.
- ❖ Cultivate mathematical abilities, creativity and heuristic thinking to solve unsolved problems leading to mathematical research.
- ❖ Provide strong foundation on pure mathematics and on applied mathematics, empowering student to do higher research.
- ❖ Inculcate mathematical reasoning.
- ❖ Nurture problem solving skills, creativity thinking and logical reasoning skills.
- ❖ Define specific components like axioms, postulates, theorems and proofs.
- ❖ Develop an understanding of philosophical, culture, social, historical and psychological facts of mathematics education.



The Madura College (Autonomous), Madurai – 625 011
Department of Mathematics
M.Sc., Mathematics – Course Structure

Semester	Sub. Code	Title of the Paper	Hours	Credits
I	21P1MMC1	REAL ANALYSIS-I	6	4
	21P1MMC2	ABSTRACT ALGEBRA	5	4
	21P1MMC3	TOPOLOGY	5	4
	21P1MMC4	ORDINARY DIFFERENTIAL EQUATIONS	6	4
	21P1MME1	NUMBER THEORY AND CRYPTOGRAPHY	6	4
	21P1MNM1	QUANTITATIVE APTITUDE FOR COMPETITIVE EXAMINATIONS	2	2
		Total	30	22
II	21P2MMC5	REAL ANALYSIS-II	6	4
	21P2MMC6	LINEAR ALGEBRA	5	4
	21P2MMC7	MECHANICS	5	4
	21P2MMC8	PARTIAL DIFFERENTIAL EQUATIONS	6	4
	21P2MME2	FUZZY SETS AND THEIR APPLICATIONS	6	4
	21P2MNM2	BUSINESS MATHEMATICS	2	2
		Total	30	22
III	21P2MMC9	COMPLEX ANALYSIS	6	4
	21P2MMC10	DIFFERENTIAL GEOMETRY	6	4
	21P2MMC11	FLUID DYNAMICS	5	4
	21P2MMC12	MATHEMATICAL STATISTICS	5	4
	21P2MME3	CORE ELECTIVE-III	4	2
	21P2MMEP1	CORE ELECTIVE PRACTICAL-I	4	2
		Total	30	20
IV	21P2MMC13	FUNCTIONAL ANALYSIS	6	4
	21P2MMC14	OPTIMIZATION TECHNIQUES	6	4
	21P2MMC15	GRAPH THEORY	5	4
	21P2MMC16	MATHEMATICAL METHODS	5	4
	21P2MME4	CORE ELECTIVE-IV	4	2
	21P2MMEP2	CORE ELECTIVE PRACTICAL-I	4	2
		Total	30	20
PROJECT		RESEARCH METHODOLOGY & RESEARCH ETHICS		2
		THESIS WRITING		4
Total Credits				90

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major	21P1MMC1	Real Analysis I	4	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objective:

1. To acquire idea to know real number system and numerical sequence and series.
2. To understand the concepts of continuity and Differentiation.
3. To impart the knowledge of Sequence and series of functions

Unit	Description	Hours	K-level	CLO
I	The Real and Complex number system: Introduction-Ordered sets-Fields-The Real fields-The extended Real number system. Basic Topology: Finite, countable and uncountable sets-Metric spaces-Compact sets-Perfect sets-Connected sets..	18	Up to K3	CLO1
II	Numerical Sequences and series: Convergent sequence-subsequence-Cauchy sequence- Upper and Lower limits-Some special sequences-series-series of nonnegative terms-The Number e-The root and ratio test-Power series-summation of parts-Absolute convergence- Addition and multiplication of series- Rearrangements.	18	Up to K3	CLO2
III	Continuity: Limits of functions- Continuity functions- Continuity and compactness-Continuity and connectedness- Discontinuities-Monotonic functions- Infinite limits and limits at infinity.	18	Up to K3	CLO3
IV	Differentiation: The derivative of a real function-Mean value theorems-The continuity of derivatives- L'Hospital rule-Derivatives of Higher order- Taylor's theorem- Differentiation of vector-valued functions.	18	Up to K4	CLO4
V	Sequence and series of functions: Discussion of main problems-uniform convergence-uniform convergence and continuity- uniform convergence and integration- uniform convergence and differentiation- Equicontinuous families of functions- The stone-weierstrass theorem.	18	Up to K5	CLO5

Book for study:

1. Walter Rudin, Principles of Mathematical Analysis, Tata McGraw- Hill, New York, 1988.
Chapters: 1,2,3,4,5,7

Books for Reference:

1. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
2. H. L. Royden, Real Analysis, Third Edition, Macmillan Publishing Company, New Delhi, 1988.

Web Resources:

<https://nptel.ac.in/courses/111/106/111106053/#>

<https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/>

<http://www.math.louisville.edu/~lee/RealAnalysis/>

Rationale and activities having direct bearing on Nature of the course:

Real analysis is an area of analysis that studies concepts such as sequences and their limits, continuity, differentiation, integration and sequences of functions. By definition, real analysis focuses on the real numbers, often including positive and negative infinity to form the extended real line. Various ideas from real analysis can be generalized from the real line to broader or more abstract contexts.

This course impart theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working.

Pedagogy :

Chalk and Talk, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Remembering the basic concepts of real field and basic topology	Up to K3
CLO2	Understand the idea of numerical sequence & series	Up to K3
CLO3	Understand the concept of limit and continuity with various conditions	Up to K3
CLO4	Identifying the concept of derivatives and its properties	Up to K4
CLO5	Analyzing the concept of convergence with various conditions	Up to K5

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5- Evaluating

Mapping of Course Outcomes (CLOs) with Program Outcomes (POs)

CLOs/POs	PO1	PO2	PO3	PO4	PO5
CLO1	2	3	2	1	3
CLO2	2	3	2	1	3
CLO3	2	3	2	1	3
CLO4	2	3	2	1	3
CLO5	2	3	2	1	3

1. Weakly

2. Medium

3. Strongly

Blue Print

Mapping with Course Outcomes (CLOs)

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. Of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K 3	2	K2& K2	1	K1	2(K2& K2)	1(K3)
3	CLO 3	Up to K 3	2	K3& K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 4	2	K3& K3	1	K2	2(K4& K4)	1(K4)
5	CLO 5	Up to K 4	2	K4& K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2		20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I
Mapping with Course Learning Outcomes (CLOs)

SL. No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K2,K2	2(K2 &K2)	2(K2,K3)
2	CLO 2	Up to K 3	3	K2,K3,K3	2(K3 &K3)	1(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-
K2	6	10	10	26	43.33	43%
K3	4	10	20	34	56.67	57%
K4	-	-	-	-		
Total marks	10	20	30	60	100.00	100%

Blue Print for CIA-II
Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K 3	2	K2,K2	2(K3 &K3)	2(K3,K3)
2	CLO 4	Up to K 4	3	K2,K3,K3	2(K4 &K4)	1(K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	10%
K2	6		-	6	10.00	
K3	4	10	20	34	56.67	57%
K4	-	10	10	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

Blue Print for Assignment
Mapping with Course Learning Outcomes (CLOs)

SL. No	CLOs	K-Level	Component	Marks
1	CLO 5	K5	Assignment	5

K5 – Evaluating.

Lecture Plan

Units	Description	Hours	Pedagogy
	Introduction-Ordered sets	3	Chalk and Talk
	Fields, The Real fields	3	Chalk and Talk
	The extended Real number system	3	Chalk and Talk
	Finite, countable and uncountable sets	3	Chalk and Talk
	Metric spaces	3	Chalk and Talk&Seminar
	Compact sets-Perfect sets, Connected sets.	3	Chalk and Talk & Group Discussion
II	Convergent sequence	3	Chalk and Talk
	subsequence-Cauchy sequence-	3	Chalk and Talk
	Upper and Lower limits-Some special sequences	3	Chalk and Talk
	series of nonnegative terms-The Number e	2	Chalk and Talk
	The root and ratio test-Power series	3	Chalk and Talk
	summation of parts-Absolute convergence	2	Chalk and Talk & Seminar
	Addition and multiplication of series-Rearrangements.	2	Chalk and Talk& Group Discussion
III	Limits of functions, Continuity functions	3	Chalk and Talk
	Continuity and compactness	3	Chalk and Talk
	Continuity and connectedness	3	Chalk and Talk
	Discontinuities	3	Chalk and Talk
	Monotonic functions	3	Chalk and Talk & Seminar
	Infinite limits and limits at infinity.	3	Chalk and Talk& Group Discussion
IV	The derivative of a real function	3	Chalk and Talk
	Mean value theorems	3	Chalk and Talk&
	The continuity of derivatives	3	Chalk and Talk & Group Discussion
	L'Hospital rule-Derivatives of Higher order	3	
	Taylor's theorem	3	
	Differentiation of vector valued functions.	3	
V	Discussion of main problems-uniform convergence	3	Chalk and Talk
	uniform convergence and continuity	3	Chalk and Talk &
	uniform convergence and integration	3	Chalk and Talk
	uniform convergence and differentiation	3	Chalk and Talk
	Equicontinuous families of functions	3	Chalk and Talk & Seminar
	The stone-weierstrass theorem.	3	Chalk and Talk & Group Discussion
Total Hours		90	

Course Designer:

Dr. U. Karthik Raja, Assistant Professor, Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major	21P1MMC2	ABSTRACT ALGEBRA	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

OBJECTIVES:

The objective of this course is to introduce the basic ideas of counting principle, Sylow subgroups, finite abelian groups, field theory and Galois Theory and to see its application to the solvability of polynomial equations by radicals.

Unit	Description	Hours	K-level	CLO
I	Sylow's Theorem: Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems – double coset – the normalizer of a group.	15	Up to K2	CLO1
II	Finite Abelian Groups: External and Internal direct Products – structure theorem for finite abelian groups – non isomorphic abelian groups - polynomial rings.	17	Up to K3	CLO2
III	Splitting Field : Polynomials over rational fields – the Eisenstein criterion - extension fields – roots of polynomials – splitting fields.	15	Up to K4	CLO3
IV	Galois Theory: More about roots – simple extension – separable extension – fixed fields – symmetric rational functions – normal extension - Galois group – fundamental theorem of Galois theory.	16	Up to K4	CLO4
V	Solvability by radicals: Solvable group – the commutator subgroup – Solvability by radicals - finite fields-Wedderburn Theorem.	12	Up to K5	CLO5

BOOK FOR STUDY:

1. I.N. Herstein, Topics in Algebra, 2nd Edition, John Wiley and Sons, New York, 1975.

UNIT	CHAPTER(S)	SECTIONS
I	2	2.11 & 2.12
II	2 & 3	2.13, 2.14, 3.9
III	3 & 5	3.10, 5.1, 5.3
IV	5	5.5 & 5.6
V	5 & 7	5.7, 7.1

BOOKS FOR REFERENCES:

1. S. Lang, "Algebra", 3rd Edition, Addison-Wesley, Mass, 1993.
2. John B. Fraleigh, "A First Course in Abstract Algebra", Addison Wesley, Mass, 1982.
3. Joseph A. Gallian, "Contemporary Abstract Algebra"-9th edition, 2016.

WEB RESOURCES:

1. <http://math.uchicago.edu/~may/REU2016/REUPapers/Idelhaj.pdf>
2. <http://torus.math.uiuc.edu/jms/m317/handouts/finabel.pdf>
3. https://orion.math.iastate.edu/tathagat/teaching/18_math302/302notes-week15.pdf
4. <https://nrich.maths.org/1422>
5. <http://www.math.brown.edu/dabramov/MA/f1314/251/Zijian-notes.pdf>

RATIONALE AND ACTIVITIES HAVING DIRECT BEARING ON NATURE OF COURSE:

Algebra helps to develop your critical thinking, Knowledge to find number of Sylow subgroups, Algebraic structures with their associated homomorphisms, form mathematical categories and given polynomial is solvable by radicals or not.

PEDAGOGY:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion and Power point presentation.

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to

Number	Course Outcome	Knowledge level
CLO 1	Recall the concepts of counting principle, Normalizer group and understand the parts of Sylow's theorems	Up to K2
CLO 2	Understand the different kinds of ideas about finite abelian groups and theorems about polynomial rings	Up to K3
CLO 3	Examine splitting field in rational fields, extension fields, splitting fields and understand about Eisenstein criterion	Up to K4
CLO 4	Use the concept of Galois theory and able to apply it in several extension fields.	Up to K4
CLO 5	Examine whether the polynomial is solvable in radicals and learn about Wedderburn theorem.	Up to K5

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 – Evaluate the mistakes in answers

Mapping with Courses Learning Outcomes (CLOs)

CLO/ PO	PO				
	PO1	PO2	PO3	PO4	PO5
CLO 1	3	2	2	2	1
CLO 2	3	2	2	-	1
CLO 3	3	2	3	-	2
CLO 4	3	2	-	-	2
CLO 5	3	-	-	2	3

3 – Advance Application

2 - Intermediate Level

1- Basic Level

BLUE PRINT – External Exam

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4/K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels.

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total marks	10	10	50	50	120	100	100%

BLUE PRINT – CIA - I

Sl.No	CLOs	K Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1, K2	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	3	K1, K1, K2	2(K2 & K2)	2(K3, K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	6	10	-	16	26.67	67
K2	4	10	10	24	40	
K3	-	-	20	20	33.33	33%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

BLUE PRINT – CIA - II

Sl.No	CLOs	K level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K4	2	K2,K2	2(K2 & K2)	2(K3&K4)
2	CLO 4	Up to K4	3	K2,K3,K3	2(K3 & K3)	1(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	30%
K2	8	10	-	18	30	
K3	2	10	20	32	53.33	53%
K4	-	-	10	10	16.67	17%
K5		-	-	-	-	-
Total Marks	6	20	30	60	100	100%

LESSON PLAN

Unit	Description	Hours	Mode
I	Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems	8	Lecture, Quiz
	Double coset – the normalizer of a group.	7	Problem Solving
II	External and Internal direct Products – structure theorem for finite abelian groups	8	Lecture, Quiz
	Non isomorphic abelian groups - polynomial rings.	9	Quiz
III	Polynomials over rational fields – the Eisenstein criterion	7	PPT, Lecture
	extension fields – roots of polynomials – splitting fields	8	
IV	More about roots – simple extension – separable extension	5	Lecture, Tutorial
	fixed fields – symmetric rational functions – normal extension	6	Lecture, Tutorial
	Galois group – fundamental theorem of Galois theory	5	Tutorial
V	Solvable group – the commutator subgroup – Solvability by radicals	6	PPT, Lecture
	Finite fields- Wedderburn Theorem.	6	Lecture
Total Hours		75	

COURSE DESIGNER:

1. Dr. S. USHA, Assistant Professor, Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core	21P1MMC3	Topology	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

The objective of the course is

- To impart knowledge on topological spaces and their properties such as compactness, connectedness, metrizable, countability & separation axioms etc.,
- To demonstrate construction of new topological spaces out of given ones by means of operations like union, intersection and finite & infinite Cartesian product
- To analyze the structure of topological spaces applying continuous functions and homeomorphisms

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	TOPOLOGICAL SPACES AND CONTINUOUS FUNCTIONS: Types of Topological Spaces and Examples -Basis for a topology - The order topology -The product topology on $X \times Y$ - The subspace topology - Closed sets and limit points - Continuous functions	12	K3	1
II	PRODUCT TOPOLOGY & CONNECTEDNESS: The Product Topology - The metric topology - Sequence lemma- Uniform limit theorem- Connected spaces - Connected subspaces of the real line - Components and Local connectedness	12	K4	2
III	COMPACTNESS & COMPLETE METRIC SPACES: Compact topological spaces - Compact subspaces of the real line – Limit Point Compactness – complete metric spaces – compactness in metric spaces.	12	K4	3

IV	COUNTABILITY & SEPERATION AXIOMS: First and Second countable spaces - Lindeloff and Separable Spaces - Countability axioms - The separation axioms - Normal spaces - The Urysohn lemma	12	K4	4
V	URYSOHN, TYCHONOFF THEOREMS AND COMPACTIFICATION: The Urysohn Metrization Theorem - Tietze Extension Theorem - The Tychonoff theorem – Stone Cech compactification	12	K2	5

Book for Study:

- Topology (Second Edition), James R. Munkres, Prentice – Hall of India, Private Ltd, New Delhi (2014).

Unit –I: Sections 12 to 18 of Chapter 2

Unit –II: Sections 19 to 21 of Chapter 2 - Sections 23 to 25 of Chapter 3

Unit –III: Sections 26 to 28 of Chapter 3 - Sections 43 and 45 of Chapter 7

Unit –IV: Sections 30 to 33 of Chapter 4

Unit –V: Sections 34 and 35 of Chapter 4 - Sections 37 and 38 of Chapter 5

Books for References:

1. Introduction to Topology and Modern Analysis, G.F. Simmons, Tata McGraw-Hill Edition, New Delhi (2004).
2. Introduction to Topology (3rd Edition), Bert Mendelson, Dover Publications, New York (1990).
3. Principles of Topology, Fred H. Croom, Dover Publications, New York, (2016).
4. Theory and Problems of General Topology, Seymour Lipschutz, McGraw-Hill Edition, New Delhi (2006).
5. Introduction to Topology, Colin Adams and Robert Franzosa, Pearson Publications, New Delhi (2009).

Web Resources:

1. <https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/index.htm>
2. <https://www.topologywithouttears.net/topbook.pdf>
3. <https://www.math.colostate.edu/~renzo/teaching/Topology10/Notes.pdf>
4. https://www.youtube.com/playlist?list=PLpG_ISEhQ6z0Q5MaIvdn5tBJFWfp9fZtQ
5. <https://freevideolectures.com/course/3528/topology>

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course learning Outcomes

On the successful completion of the course, students will be able to

CLO #	Description	K- level
CLO 1	Verify whether or not a given set together with a collection of its subsets a topological space, to construct the topologies generated by bases and sub-bases, to determine the closure and interior of a set, to find the product of two topological spaces, identify continuous functions	K3
CLO 2	Compare the box and the product topologies, to recognize metrizable spaces, to identify connected topological spaces, to construct new connected spaces out of given ones, to find out connected subspaces of the real line	K4
CLO 3	Determine the compactness of a topological space, to find out compact subspaces of the real line	K4
CLO 4	Recognize various types of topological spaces such as first & second countable, Lindeloff, Hausdorff based on the countability and separation axioms	K4
CLO 5	Prove certain named theorems on separation and compactness	K2

Mapping with CLOs with POs

#	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7
CLO -1	-	-	2	1	3	-	-
CLO -2	-	1	2	2	3	-	-
CLO -3	-	1	2	2	3	2	-
CLO -4	-	2	3	2	3	2	-
CLO -5	-	2	3	2	3	2	-

Advance application– 3

Intermediate level–2

Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K2 / K3	1	K1	2 (K1/K1)	1 (K3)
2	CLO 2	Up to K4	2	K2 / K3	1	K2	2 (K3/K3)	1 (K4)
3	CLO 3	Up to K4	2	K3 / K4	1	K2	2 (K4/K4)	1 (K3)
4	CLO 4	Up to K4	2	K3 / K4	1	K3	2 (K4/K4)	1 (K4)
5	CLO 5	Up to K2	2	K1 / K1	1	K1	2 (K2/K2)	1 (K2)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consoli- dated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

CIA I – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 1	Up to K3	1	K2	2	K3	1	K2
			1	K3			1	K3
2	CLO 2	Up to K4	2	K2	2	K4	1	K4
			1	K3				
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CIA II – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 4	Up to K4	3	K3	2	K4	1	K3
							1	K4
2	CLO 5	Up to K2	1	K2	2	K2	1	K2
			1	K3				
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

COURSE PLAN

UNIT	Topics to be covered	Hour(s)	Pedagogy
I	Topological spaces – introduction – definition and Examples - Types of Topological Spaces	2	Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion
	Basis and subbasis for a topology – topology generated by bases and subbases	2	
	The order topology	1	
	The product topology on $X \times Y$ - The subspace topology	2	
	Closed sets and limits points	2	
	Continuous functions	2	
	Tutorial	1	
II	The Product Topology – Definition of Box topology and product topology	1	Chalk and talk, PPT, Interaction, Group Discussion and Assignment
	Comparison of Box topology and product topology and related theorems	1	
	Metric topology: Metrizable space – standard bounded metric, Euclidean metric and square metric	1	
	Topologies generated by square and Euclidean metrics	1	
	Uniform topology	1	
	Sequence lemma-Uniform limit theorem	1	
	Connected topological spaces – definition and example – construction of new connected spaces from the given ones	1	
	Connected subspaces of the real line	2	
	Components and Local connectedness	2	
	Tutorial	1	
III	Compact topological spaces – definition and examples –properties	2	Chalk and talk, PPT, Interaction, Assignment and Seminar
	Finite product of compact topological spaces – tube Lemma – finite intersection property	2	
	Compact subspaces of the real line – Extreme value theorem – Lebesgue number Lemma –Uniform continuity theorem	2	
	Limit Point Compactness	1	
	Complete metric spaces	2	
	Compactness in metric spaces.	2	
	Tutorial	1	
IV	The countability axioms - First and Second countable spaces	2	Chalk and talk, PPT, Interaction and e-Quiz
	Lindeloff and Separable Spaces	2	
	The separation axioms – Hausdroff, Regular and Normal spaces	2	
	Properties of Normal spaces	2	
	The Urysohn lemma – Completely regular spaces	3	
	Tutorial	1	
V	The Urysohn Metrization Theorem	2	Chalk and talk and Interaction
	Tietze Extension Theorem	3	
	The Tychonoff Theorem	2	
	Compactification – definition and examples	2	
	Stone Cech compactification	2	
	Tutorial	1	
Total Hours		60	

Course Designer: Dr.I.SAHUL HAMID, Assistant Professor of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core 4	21P1MMC4	Ordinary Differential Equations	4	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. Develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points.
2. Study the existence and uniqueness of the solutions of first order differential equations.
3. To solve the second order and n -th order Initial value problems.
4. Introduce the students to the technique of solving various problems of engineering and science.
5. Study the concepts relating to the order and linearity of ODEs, analytic and computational solution methods for ODEs .

Course content

Unit	Description	Hours	K-level	CLOs
I	Linear Homogeneous Equations with Constant Coefficients Introduction – Second order homogeneous equations – Initial value problem for second order equations – Linear dependence and independence – A formula for Wronskian.	18	K2	1
II	Linear Non-Homogeneous Equations with Constant Coefficients The Non-Homogeneous equations of order two – Homogeneous and Non-Homogeneous equations of order n – Initial value problems for n -th order equations – Annihilator method to solve Non-Homogeneous equations.	18	K3	2
III	Linear Equations with Variable Coefficients Initial value problem – Existence and Uniqueness theorem – The Wronskian and Linear independence – Reduction of the order of a Homogeneous equation – The Non-Homogeneous equation – Homogeneous equations with analytic coefficients – The Legendre equations.	18	K4	3
IV	Linear Equations with Regular Singular Points The Euler equations – Second order equations with Regular singular points – Exceptional cases – The Bessel equation – The Bessel equation continued.	18	K4	4

V	Existence and Uniqueness of Solutions to First Order Equations Equations with variable separated – Exact equations – The method of successive approximation – The Lipschitz condition – Convergence of successive approximation – Non-local existence of solutions – Approximations to and uniqueness of solutions.	18	K5	5

Book for Study:

1. Earl A. Coddington, An Introduction to Ordinary Differential Equations – Prentice – Hall of India Private Limited, New Delhi, 2008.

Books for References:

1. Williams E. Boyce and Richard C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 10th edition, John Wiley and Sons, New York, 2012.
2. M. D., Raisinghania, Advanced Differential Equations, S. Chand & Company Limited, New Delhi, 2012.
3. George F. Simmons, Differential Equations with Application and Historical Notes, Tata McGraw Hill, New Delhi, 1974.
4. B. Rai, D. P. Choudhury and H. I. Freedman, A Course in Ordinary Differential Equations, Narosh Publishing House, Private Limited, New Delhi, 2012.
5. Ravi. P. Agarwal and Ramesh C. Gupta, Essentials of Ordinary Differential Equations, McGraw Hill, New York, 1991.

Web Resources:

1. <http://eqworld.ipmnet.ru/en/solutions/ode.htm>
2. <https://www.khanacademy.org/math/differential-equations>
3. <https://mathinsight.org/ordinary-differential-equation-introduction>
4. <https://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
5. <https://www.emathhelp.net/calculators/differential-equations/differential-equation-calculator/>
6. <https://www.wolframalpha.com/examples/mathematics/differential-equations/>

Rationale and activities having direct bearing on Nature of Course

Knowledge and Skill

Ordinary differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical problems using mathematical equations, then solve these equations so that the behaviour of the systems concerned can be studied.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Knowing the basic concepts Linearly Independent and dependent functions for solving Linear differential equations.	K2
CLO2	Acquire understanding of Homogeneous and Non-Homogeneous of second and higher order ODE's and solves them.	K3
CLO3	Solve problems using methods of undetermined coefficients, reduction of the order of equation and able to pertain Legendre equations.	K4
CLO4	Able to analyze problems in linear second order differential equations and able to pertain Bessel functions.	K4
CLO5	Know about exact differential equations and existence, uniqueness and continuity of solutions of first order ODE's,	K5

K1- Remembering and recalling facts with specific answers

K2 –Basic understanding of facts and stating main ideas with general answers

K3 –Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the ode problems

Mapping of Course Outcomes (CLOs) with Program Outcomes(POs)

CLOs/Pos	PO1	PO2	PO3	PO4	PO5
CLO1	3	2	3	3	3
CLO2	3	2	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	2	2	3	2

1. Basic level

2. Intermediate level

3. Advance level

External Blue Print
Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K 4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
5	CLO 5	Up to K5	2	K3& K4	1	K3	2(K4& K4)	1(K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the ode problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	26.67%
K5	-	-	-	10	10	8.33	8.33%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I

Sl. No.	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K2& K3	2(K3& K3)	2(K2, K3)
2	CLO 2	Up to K4	3	K2,K2, K3	2(K4&K4)	1(K3/ K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the ode problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or Choice)	Section C (Open Choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-
K2	3	-	1	16	26.67	26.67%
K3	2	2	1	24	40	40%
K4	-	2	1	20	33.33	33.33%
Total marks	10	20	30	60	100.00	100%

Blue Print for CIA-II
Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K 3	2	K2& K3	2(K3& K3)	2(K2, K3)
2	CLO 4	Up to K4	3	K2,K2, K3	2(K4&K4)	1(K3/ K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the ode problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or Choice)	Section C (Open Choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-
K2	3	-	1	16	26.67	26.67%
K3	2	2	1	24	40	40%
K4	-	2	1	20	33.33	33.33%
Total marks	10	20	30	60	100.00	100%

Lesson Plan

Units	Description	Hours	Pedagogy
I	Introduction	2	Lecture
	Second order homogeneous equations	3	Lecture
	Initial value problem for second order equations	3	Lecture & PPT
	Linear dependence and independence	3	Lecture
	Problems on Linear dependence and independence	3	Lecture
	A formula for Wronskian	4	Lecture & Group Discussion
II	The Non-Homogeneous equations of order two	3	Lecture
	Homogeneous equations of order n	3	Lecture & Seminar
	Non-Homogeneous equation of order n	3	Lecture
	Initial value problems for n -th order equations	3	Lecture & PPT
	Annihilator method	3	Lecture
	Annihilator method to solve Non-Homogeneous	3	Lecture & Seminar
III	Initial value problem	3	Lecture
	Existence and Uniqueness theorem	3	Lecture & PPT
	The Wronskian and Linear independence	3	Lecture
	Reduction of the order of a Homogeneous equation	3	Lecture
	Reduction of the order of a Homogeneous equation	3	Lecture & Seminar
	Homogeneous equations with analytic coefficients	3	Lecture & Group Discussion
	The Legendre equations.	3	
IV	The Euler equations	4	Lecture
	Second order equations with Regular singular points	4	Lecture
	Exceptional cases	3	Lecture & Seminar
	The Bessel equation	4	Lecture
	The Bessel equation continued.	4	Lecture & PPT
V	Equations with variable separated	2	Lecture
	Exact equations	3	Lecture & Seminar
	The method of successive approximation	2	Lecture
	The Lipschitz condition	3	Lecture & PPT
	Convergence of successive approximation	3	Assignment
	Non-local existence of solutions.	2	Lecture & Group Discussion
	Approximations to and uniqueness of solutions.	3	Lecture
Total Hours		90	

Course Designer: Dr. V. Ananthaswamy, Assistant Professor, Research Centre & PG Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Elective 1	21P1MME1	Number Theory and Cryptography	4	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To understand the fundamental number theoretical algorithms and techniques.
2. Able to identify number theoretical functions and study their properties.
3. To learn and analyze certain types of Diophantine equations.
4. To apply the number theoretic concepts in modern cryptography.

Unit	Description	Hours	K-level	CLO
I	Divisibility – Division algorithm – GCD – Euclidean algorithm – LCM — Congruence's – Euler's Theorem – Fermat's theorem – Wilson's theorem – Solutions of congruence's – The Chinese Remainder Theorem	27	Up to K3	CLO1
II	Quadratic residues – Lemma of Gauss – Gaussian reciprocity law – Jacobi symbol.	17	Up to K4	CLO2
III	Arithmetic functions – The Moebius Inversion formula – Multiplication of arithmetic functions.	16	Up to K2	CLO3
IV	Diophantine Equation – The linear equation – Pythagorean Triangle - The equation $x^2 + y^2 = z^2$ – The equation $x^4 + y^4 = z^2$ – sum of four and five squares.	15	Up to K4	CLO4
V	Discrete logarithm – Principles of public key – Cryptosystem – RSA algorithm – Elliptic curve cryptography.	15	Up to K3	CLO5

Books for Study:

1. An introduction to the theory of numbers by Ivan Niven and Herbert +

Chapters: 1(1.2), 2(2.1-2.3), 3(3.1- 3.3), 4(4.2, 4.3, 4.4*), 5(5.1, 5.3, 5.6*).

***Chapter: 4(4.4), 5(5.6)** is presented in 3rd edition 1972.Cryptography and Network Security

- Principles and Practice by William Stallings, Prentice Hall, Fifth Edition, New Delhi, 2011.
Chapter: 8(8.5), 9(9.1-9.2), 10(10.4)

Books for Reference:

- Tom Apostol, Introduction to Analytic Number theory, Narosa Publications, New Delhi
Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York, 1987.
- David M. Burton, Elementary Number Theory, Wm.C. Brown Publishers, Dubuque, Iowa, 1989.

Web Resources:

- <https://nptel.ac.in/courses/106/103/106103015/>
- https://onlinecourses.nptel.ac.in/noc20_ma42/preview

Rationale and activities having direct bearing on nature of course:

Understanding of the course helps to encrypt and decrypt messages using basic concept of number theory, and to break the code using RSA carelessly.

Pedagogy :

Chalk and Talk, Problem Solving, Tutorial, Group Discussion, Quiz, Seminar.

Course Learning Outcomes

On the successful completion of the course, students will be able to

Number	Course outcome	knowledge level
CLO1	Understand the concept of divisibility and congruence.	Up to K3
CLO2	Learn the idea of Quadratic residues and reciprocity.	Up to K4
CLO3	Solve the number theoretical functions .	Up to K2
CLO4	Identify and solve Diophantine equations.	Up to K4
CLO5	Implement number theoretical concepts in cryptography.	Up to K3

K1- Recall, K2 – Understanding, K3 – Applying, K4- analyzing

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	2	3
CO2	1	-	3	2	1
CO3	1	1	3	2	2
CO4	-	-	3	2	3
CO5	2	2	3	2	3

1. Basic level

2. Intermediate level

3. Advance level

Units	CLOs	K-level	Section A		Section B		Section C	Section D
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level	(Either/or Choice)	(Open Choice)
1	CLO 1	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
3	CLO 3	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

BLUE PRINT – External Examination

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

The Components of assessment

S.No	CLO	Test Component	Marks	K Level
1	5	Assignment	5 Marks	K3
2	5	Seminar	5 Marks	K2
3	5	Quiz	5 Marks	K2

BLUE PRINT – CIA - 1

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

S.No.	CLOs	K-level	Section A		Section B	Section C
			Short Answers			
			No. of Questions	K-Level	(Either/or Choice)	(Open Choice)
1	CLO 1	Up to K3	3	K2,K2,K3	2(K2 & K2)	2(K3, K3)
2	CLO 2	Up to K4	2	K2, K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K2	6	10	-	16	26.67	27%
K3	4	-	20	24	40.00	40%
K4	-	10	10	20	33.33	33%
Total marks	10	20	30	60	100	100%

BLUE PRINT – CIA -2

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

S.No.	CLOs	K-level	Section B		Section C	Section D
			Short Answers			
			No. of Questions	K-Level	(Either/or Choice)	(Open Choice)
1	CLO 3	Up to K2	3	K1,K1,K2	2(K2 & K2)	1(K2)
2	CLO 4	Up to K4	2	K2, K3	2(K3 & K3)	2(K3,K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	06.67	46.67%
K2	4	10	10	24	40.00	
K3	2	10	10	22	36.67	36.67%
K4	-	-	10	10	16.67	16.67%
Total marks	10	20	30	60	100	100%

Lesson Plan

UNIT	DESCRIPTION	HOURS	PEDAGOGY
I	Divisibility - Division algorithm	4	Chalk and Talk, Problem Solving, Tutorial
	GCD, Euclidean algorithm	4	
	LCM and Properties	5	
	Congruence's - Euler's Theorem	4	
	Fermat's theorem – Wilson's theorem	5	
	Solutions of congruence's – The Chinese Remainder Theorem	5	
II	Quadratic residues – Lemma of Gauss	8	Chalk and Talk, Problem Solving, Tutorial
	Gaussian reciprocity law – Jacobi symbol.	9	
III	Arithmetic functions	6	Chalk and Talk, Problem Solving, quiz
	The Moebius Inversion formula	4	
	Multiplication of arithmetic functions.	6	
IV	Diophantine Equation – The linear equation – Pythagorean Triangle	6	Problem Solving, Seminar
	The equation $x^2 + y^2 = z^2$	3	
	The equation $x^4 + y^4 = z^2$.	3	
	sum of four and five squares	3	
V	Discrete logarithm– Principles of public key	6	Chalk and Talk, Problem Solving
	Cryptosystem – RSA algorithm	5	
	Elliptic curve cryptography.	4	
	Total Hours	90	

Course Designer: Dr. I. Padmavathi, Assistant Professor of Mathematics,
The Madura College(Autonomous), Madurai.

DEPARTMENT OF MATHEMATICS				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	NME	21P1MNM1	Quantitative Aptitude for Competitive Examinations	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To learn simplest tricks to find percentage, profit, loss, permutation, combination and probability.
2. To apply numerical techniques in solving quantitative aptitude.
3. To understand the shortcuts for the competitive exams.

Unit	Description	Hours	K-level	CLO
I	Problems on Numbers: Introduction – important facts on sum, difference, product of two numbers, average, ratio, fraction – some other related problems – Problems on Ages: present ages – age ratio – some related problems.	6	K2	CLO1
II	Percentage: Introduction – important facts and formulae – results on populations – results on depreciation – difference percentage – some other related problems – Profit and Loss: calculate cost price and selling price – calculate profit% and loss% – Problems.	6	K2	CLO2
III	Time and work: Important ideas and formulae – days and hours calculations for workers works separately or together – problems – Problems on train: calculate train speed and distance – time to pass a pole or station of train of ‘L’ meter – speed of two train travel in same and opposite direction – Problems.	6	K2	CLO3
IV	Calendar: odd days – leap year – ordinary year – counting of odd days – day of the week – related to odd days – problems – Clocks: Important facts – too fast and too slow – related problems.	6	K2	CLO4
V	Permutations and Combinations: factorial notation – permutations – combinations – solved examples – Probability: random experiment – sample space – event – probability of occurrence of outcomes and event – results on probability – solved examples.	6	K2	CLO5

Book for Study:

1. Dr. R. S. Aggarwal, Quantitative Aptitude for competitive examinations (Fully Solved), 2011 Revised Edition, S. Chand & Company Ltd.

Sections: - 7, 8, 10, 11, 15, 18, 27, 28, 30 31.

Books for Reference:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, 2020 Seventh Edition, McGraw Hill Publisher.
2. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, 2019 Fourth Edition, Pearson India Publisher.

Web Resources:

1. <https://www.youtube.com/playlist?list=PLXjJ5c4vskp6yidDJs-NttEQwng8tu6Lo>
2. <https://www.careerbless.com/aptitude/qa/home.php>
3. <https://youtu.be/mLd41elDRTE>

Rationale and activities having direct bearing on nature of course:

Thinking critically and applying basic mathematics skills to solve problems on numbers, ages, trains, time & work, calendar, clocks, probability and etc., and developing proficiency in numerical and quantitative reasoning.

Activities having direct bearing on Employability:

This course imparts problem solving skills in the students and is crafted to help the students in identifying the best solution for a given problem. This course helps in strengthen the students in their “Aptitude knowledge” with the essentials short cut techniques.

Pedagogy:

Chalk and Talk, Seminar, Quiz, Problem solving and Tutorials.

COURSE LEARNING OUTCOMES

Number	Course outcome	knowledge level
CLO1	Learn mathematical tricks to solve the problems on numbers and ages	K2
CLO2	Learn shortcuts in finding profit percentage and loss percentage	K2
CLO3	Understand the idea of solving problems on time & work and trains	K2
CLO4	Acquire the knowledge in calendar and clock problems	K2
CLO5	Solve the problems on probability, permutation and combination	K2

Mapping of Course Learning Outcomes (CLOs) with Program Outcomes (POs) and Program Specified Outcomes (PSOs)

CLO\ PO	PO				
	PO1	PO2	PO3	PO4	PO5
CLO1	3	1	-	3	-
CLO2	3	1	-	3	-
CLO3	3	1	-	3	-
CLO4	3	1	-	3	-
CLO5	3	1	-	3	-

3- Advance Application 2- Intermediate Level 1- Basic Level

Blue Print – External Exam

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K. Level	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO1	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
2	CLO2	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
3	CLO3	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
4	CLO4	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
5	CLO5	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	-	70		70	53.85	54%
Total marks	10	70	50	130	100.00	100%

The Components of assessment

S.No	CLO	Test Component	Marks	K Level
1	5	Assignment	5 Marks	K2
2	5	Seminar	5 Marks	K1
3	5	Quiz	5 Marks	K2

Blue Print – CIA – I

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K. Level	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO1	Up to K2	3 (K1)	2(K2 & K2)	2(K1&K1)
2	CLO2	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100	100%

Blue Print – CIA – II

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K. Level	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO3	Up to K2	3(K1)	2(K2 & K2)	2(K1&K1)
2	CLO4	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

LESSON PLAN

UNIT	DESCRIPTION	Hours	MODE
I	Problems on Numbers: Introduction - important facts on sum, difference, product of two numbers, average, ratio, fraction	6	Chalk and Talk
	some related problems		Problem
	Problems on Ages: present ages – age ratio - some related problems .		Tutorial
II	Percentage: Introduction – important facts and formulae – –	6	Chalk and
	results on populations – results on depreciation – difference percentage – some other related problems.		Problem Solving
	Profit and Loss: calculate cost price and selling price – calculate profit% and loss% – Example Problems.		Problem Solving
III	Time and work: Important ideas and formulae	6	Chalk and
	days and hours calculations for workers works separately or together – problems		Problem Solving
	Problems on train: calculate train speed and distance		Chalk and
	time to pass a pole or station of train of ‘L’ meter – speed of two train travel in same and opposite direction – Problems.		Problem Solving
IV	Calendar, odd days, Example problems.	6	Chalk and
	Leap year, Ordinary year, Example problems.		Seminar
	Clocks, The fast and Two slow, Example problems.		Problem
V	Factorial Notation, Example problems.	6	Chalk and
	Permutation and Combination, Example problems.		Seminar
	Probability, Experiment, Random experiment, example problems.		Problem
	Sample Space, Event, Probability occurrence of an event, Example problems.		Tutorial
TOTAL HOURS		30	

Course Designer: Dr. I. Padmavathi, Assistant Professor of Mathematics,
The Madura College(Autonomous), Madurai.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major	21P2MMC6	Real Analysis II	4	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objective:

1. To learn about advanced topics in Riemann's Stieltjes Integrals.
2. To acquire idea to know functions of several variables.
3. To obtain the knowledge of The Lebesgue measure & integral.

Unit	Description	Hours	K-level	CLO
I	Functions of bounded variation: Introduction- properties of monotonic functions – Functions of bounded variation- Total variation - Additive property of total variation – Total variation of $[a, x]$ as a function of x - function of bounded variation expressed as the difference of two increasing functions. Riemann – Stieltjes Integral: Definition and Existence – Properties – Integration and Differentiation – Integration of vector valued functions – Rectifiable curves.	12	Up to K3	CLO1
II	Functions of several variables: Linear transformation – Differentiation – The Contraction Principle- The inverse function theorem – The implicit function theorem.	12	Up to K3	CLO2
III	Determinants Derivatives of higher order- Differentiation of integrals.	12	Up to K3	CLO3
IV	Lebesgue measure: Outer measure – Measurable sets and Lebesgue measure – Nonmeasurable sets - Measurable functions – Littlewood's three principles.	12	Up to K4	CLO4
V	The Lebesgue integral: The Lebesgue integral of a bounded function over a set of finite measure – The integral of a nonnegative function – The general Lebesgue integral – Lebesgue's Monotone Convergence Theorem and Dominated Convergence Theorem.	12	Up to K5	CLO5

Books for study:

1. Walter Rudin, Principles of Mathematical Analysis, Tata McGraw- Hill, New York, 1988.
Chapters: 6 & 9
2. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
Chapters: 6(6.1-6.7)
3. H. L. Royden, Real Analysis, Third Edition, Macmillan Publishing Company, New Delhi, 1988.
Chapters: 3 & 4

Books for Reference:

1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi 1981.
2. Inder K. Rana, An Introduction to Measure and Integration, 2nd Edition, Narosa Publishing House, 2015.
3. Gelbaum, B. R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.

Web Resources:

<https://nptel.ac.in/courses/111/101/111101005/>
<https://nptel.ac.in/courses/111/101/111101100/>
<https://nptel.ac.in/courses/111/108/111108135/>
https://www.cmi.ac.in/~prateek/measure_theory/

Rationale and activities having direct bearing on Nature of the course:

Real analysis is an area of [analysis](#) that studies concepts such as sequences and their limits, continuity, [differentiation](#), [integration](#), functions of several variables and sequences of functions. Measure theory is the study of measures. It generalizes the intuitive notions of length, area, and volume. The earliest and most important examples are Jordan measure and Lebesgue measure, but other examples are Borel measure, probability measure, complex measure, and Haar measure.

This course impart theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques for a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working

Pedagogy :

Chalk and Talk, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Remembering the upper and lower integrals and the Riemann conditions.	Up to K3
CLO2	Determine the Functions of several variables	Up to K3
CLO3	Understand the concept of Differentiation of integrals	Up to K3
CLO4	Identifying the concept of Lebesgue measure	Up to K4
CLO5	Analyzing the concept of Lebesgue integral	Up to K5

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Mapping of Course Outcomes (CLOs) with Program Outcomes(POs)

CLOs/POs	PO1	PO2	PO3	PO4	PO5
CLO1	2	3	2	1	3
CLO2	2	3	2	1	3
CLO3	2	3	2	1	3
CLO4	2	3	2	1	3
CLO5	2	3	2	1	3

1.Weakly

2. Medium

3. Strongly

Blue Print**Mapping with Course Outcomes (CLOs)**

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. Of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K2 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K 4	2	K3 & K3	1	K2	2(K4& K4)	1(K4)
3	CLO 3	Up to K 3	2	K3 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 3	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
5	CLO 5	Up to K 5	2	K4 & K4	1	K3	2(K4 & K4)	1(K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	
K4	2		20	10	32	26.67	26.67%
K5	-		-	10	10	8.33	8.33%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 1	Up to K 3	3	K2,K2	2(K3 &K3)	2(K3,K3)
2	CLO 2	Up to K 4	2	K2,K3,K3	2(K4 &K4)	1(K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	10%
K2	6		-	6	10.00	
K3	4	10	20	34	56.67	57%
K4	-	10	10	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

Blue Print for CIA-II

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K 3	2	K1,K2	2(K1 &K1)	2(K2,K2)
2	CLO 4	Up to K 3	3	K2,K2,K3	2(K3 &K3)	1(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	10	-	12	20.00	20%
K2	6	-	20	26	43.33	43%
K3	2	10	10	22	36.67	37%
K4	-	-	-	-		
Total marks	10	20	30	60	100.00	100%

Lecture Plan

Units	Description	Hours	Pedagogy
I	Introduction- properties of monotonic functions	2	Chalk and Talk
	Functions of bounded variation- Total variation	2	Chalk and Talk
	Additive property of total variation – Total variation of $[a, x]$ as a function of x	2	Chalk and Talk
	function of bounded variation expressed as the difference of two increasing functions.	2	Chalk and Talk
	Riemann – Stieltjes Integral: Definition and Existence – Properties	2	Chalk and Talk
	Integration and Differentiation – Integration of vector valued functions – Rectifiable curves.	2	Chalk and Talk & Group Discussion
II	Linear transformation	3	Chalk and Talk
	Differentiation	3	Chalk and Talk
	The inverse function theorem	3	Chalk and Talk
	The implicit function theorem	3	Chalk and Talk
III	Determinants- Derivatives of higher order- Differentiation of integrals.	4	Chalk and Talk
	Derivatives of higher order-	4	Chalk and Talk
	Differentiation of integrals.	4	Chalk and Talk& Group Discussion
IV	Outer measure	3	Chalk and Talk &
	Measurable sets and Lebesgue measure	3	Chalk and Talk&
	Nonmeasurable sets - Measurable functions	3	Chalk and Talk & Group Discussion
	Littlewood's three principles.	3	
V	The Lebesgue integral of a bounded function over a set of finite measure	3	Chalk and Talk
	The integral of a nonnegative function	3	Chalk and Talk &
	The general Lebesgue integral	3	Chalk and Talk
	Lebesgue's Monotone Convergence Theorem and Dominated Convergence Theorem.	3	Chalk and Talk & Group Discussion
	Total Hours	60	

Course Designer:

Dr. U. Karthik Raja, Assistant Professor, Department of Mathematics., The Madura College.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major	21P2MMC7	Linear Algebra	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objective:

1. To acquire idea to know linear transformation and its algebra.
2. To understand the concepts of polynomials, Determinants with properties
3. To impart the knowledge of Rational forms and Jordan forms.

Unit	Description	Hours	K-level	CLO
I	Linear transformations : Linear transformations –The Algebra of Linear transformations– Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals.	12	Up to K3	CLO1
II	Algebra of polynomials: Algebras-The algebra of polynomials – Polynomial ideals - The prime factorization of a polynomial– Commutative rings- Determinant functions.	12	Up to K3	CLO2
III	Determinants: Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials.	12	Up to K3	CLO3
IV	Diagonalization:Invariant subspaces – Simultaneous triangulations – Simultaneous diagonalization – Direct-Sum decompositions – Invariant direct sums – Primary decomposition theorem.	12	Up to K4	CLO4
V	The Rational and Jordan forms:Cyclic subspaces – Cyclic decompositions theorem (Statement only) –Generalized Cayley – Hamilton theorem - Rational forms – Jordan forms.	12	Up to K5	CLO5

Book for study:

1. Kenneth M Hoffman and Ray Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, 2013.
Chapters: 3(3.1-3.5),4(4.1,4.2,4.4,4.5),5(5.1-5.4),6,7(7.1-7.3).

Books for Reference:

1. M. Artin, "Algebra", Prentice Hall of India Pvt. Ltd., 2005.
2. I.N. Herstein, "Topics in Algebra", 2nd Edition, Wiley Eastern Ltd, New Delhi, 2013.

Web Resources

<https://nptel.ac.in/courses/111/106/111106051/>

<https://www.khanacademy.org/math/linear-algebra>

<https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/>

Rationale and activities having direct bearing on Nature of the course:

Linear algebra is central to almost all areas of mathematics. For instance, linear algebra is fundamental in modern presentations of geometry, including for defining basic objects such as lines, planes and rotations. Linear algebra is also used in most sciences and fields of engineering, because it allows modeling many natural phenomena, and computing efficiently with such models.

This course impart theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques for a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working

Pedagogy :

Chalk and Talk, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Remembering the basic concepts of Linear transformation	Up to K3
CLO2	Understand the idea of algebra of polynomials	Up to K3
CLO3	Understand the concept of Determinants and matrix with various conditions	Up to K3
CLO4	Identifying the concept of diagonalization and its properties	Up to K4
CLO5	Analyzing the concept of Rational and Jordan forms	Up to K5

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluation

Mapping of Course Outcomes (CLOs) with Program Outcomes(POs)

CLOs/POs	PO1	PO2	PO3	PO4	PO5
CLO1	2	3	2	1	3
CLO2	2	3	2	1	3
CLO3	2	3	2	1	3
CLO4	2	3	2	1	3
CLO5	2	3	2	1	3

1.Weekly

2. Medium

3. Strongly

Blue Print

Mapping with Course Outcomes (CLOs)

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K1 & K2	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K 3	2	K1 & K2	1	K1	2(K2& K2)	1(K3)
3	CLO 3	Up to K 3	2	K1 & K2	1	K1	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K3& K3)	1(K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating

Distribution of section wise marks with K levels. *

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	6	10	-	21	17.50	42%
K2	5	4	10	10	29	24.16	
K3	-		20	20	40	33.34	33%
K4	-		10	20	30	25.00	25%
Total marks	10	10	50	50	120	100	100%

*The above table is mandatory and common to all the departments.

Blue Print for CIA-I

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 1	Up to K 3	3	K2,K3	2(K2 &K2)	2(K2,K3)
2	CLO 2	Up to K 3	2	K2,K2,K3	2(K3 &K3)	1(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels. *

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-
K2	6	10	10	26	43.33	43%
K3	4	10	20	34	56.67	57%
K4	-	-	-	-		
Total marks	10	20	30	60	100.00	100%

Blue Print for CIA-II
Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K 3	2	K2,K2	2(K3 &K3)	2(K2,K3)
2	CLO 4	Up to K 4	3	K2,K3,K3	2(K4 &K4)	1(K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels. *

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	27%
K2	6		10	16	26.67	
K3	4	10	10	24	40.00	40%
K4	-	10	10	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

Blue Print for Assignment
Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-Level	Component	Marks
1	CLO 5	K5	Assignment	5

K5 – Evaluating.

Lecture Plan

Units	Description	Hours	Pedagogy
I	Linear transformations	3	Chalk and Talk
	The Algebra of Linear transformations	3	Chalk and Talk
	Isomorphism of vector spaces	2	Chalk and Talk
	Representations of linear transformations by matrices	2	Chalk and Talk& Seminar
	Linear Functionals.	2	Chalk and Talk & Group Discussion
II	Algebras	2	Chalk and Talk
	The algebra of polynomials	2	Chalk and Talk& Seminar
	Polynomial ideals	2	Chalk and Talk
	The prime factorization of a polynomial	2	Chalk and Talk
	Commutative rings	2	Chalk and Talk& Group Discussion
	Determinant functions.	2	Chalk and Talk & Seminar
III	Permutations and the uniqueness of determinants	3	Chalk and Talk
	Classical adjoint of a (square) matrix	3	Chalk and Talk
	Inverse of an invertible matrix using determinants	2	Chalk and Talk
	Characteristic values	2	Chalk and Talk
	Annihilating polynomials	2	Chalk and Talk & Seminar
IV	Invariant subspaces	2	Chalk and Talk
	Simultaneous triangulations	2	Chalk and Talk&
	Simultaneous Diagonalization	2	Chalk and Talk & Group Discussion
	Direct-sum decompositions	2	
	Invariant direct sums	2	
	Primary decomposition theorem	2	
V	Cyclic subspaces	2	Chalk and Talk
	Cyclic decompositions theorem (Statement only)	2	Chalk and Talk & Seminar
	Generalized Cayley	2	Chalk and Talk
	Hamilton theorem	2	Chalk and Talk
	Rational forms	2	Chalk and Talk & Seminar
	Jordan forms	2	Chalk and Talk & Group Discussion
Total Hours		60	

Course Designer:

Dr. S. Usha, Assistant Professor, Department of Mathematics

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major	21P2MMC7	MECHANICS	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

COURSE OBJECTIVES:

- To create a foundation for understanding basic principles of mechanics and some classical problems.
- To learn Lagrangian and Hamiltonian formulations of classical mechanics
- To learn the importance and consequences of canonical transformations

Unit	Description	Hours	K-level	CLO
I	Introductory concepts: Mechanical system – generalized coordinates – constraints – virtual work – d'Alembert's principle - energy and momentum – equilibrium and stability – kinetic energy – angular momentum.	14	Up to K2	CLO1
II	Lagrange's equations: Derivation of Lagrange's equations for different conditions – Lagrange equations for some simple systems - integrals of motion – Routhian procedure – natural system – Liouville's system – small oscillations.	17	Up to K3	CLO2
III	Hamilton's equations: Stationary values - Hamilton's principle under different conditions – Hamilton's equations – the Legendre transformation – modified Hamilton's principle – principle of least action.	15	Up to K4	CLO3
IV	Hamilton-Jacobi theory: Hamilton's principle function – canonical integral – Pfaffian differential form – Hamilton-Jacobi equation – Jacobi's theorem – modified Hamilton-Jacobi equation – separability – Liouville's system Stackel's theorem.	15	Up to K4	CLO4
V	Canonical transformations: Differential forms and generating functions – some simple, point and momentum transformations - Lagrange and Poisson brackets.	14	Up to K5	CLO5

Book for Study:

1. D.T. Greenwood, Classical Dynamics, Prentice Hall of India Pvt. Ltd, New Delhi, 1979.

Books for References:

1. H. Goldstein, C. Poole & J. Safko, Classical Mechanics, Pearson Education, New Delhi, 2002.
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.R. Taylor, Classical Mechanics, University Science Books, Sausalito 2005.

Web Resources:

1. [https://kisi.deu.edu.tr/secil.erim/Chapter_1_Introduction_SE\(1\).pdf](https://kisi.deu.edu.tr/secil.erim/Chapter_1_Introduction_SE(1).pdf)
2. <http://kestrel.nmt.edu/~raymond/classes/ph321/notes/lagrange/lagrange.pdf>
3. <https://www.physics.rutgers.edu/~shapiro/507/book3.pdf>
4. <http://complex.gmu.edu/www-physics/phys705/notes/015.5%20Hamilton-Jacobi%20Equation.pdf>
5. <http://complex.gmu.edu/www-physics/phys705/notes/014%20Canonical%20Transformation%20I.pdf>

RATIONALE AND ACTIVITIES HAVING DIRECT BEARING ON NATURE OF COURSE:

Knowledge of the motion of non-quantum mechanical, low-energy particles in weak gravitational fields and Hamilton-Jacobi in identifying conserved quantities for a mechanical system.

PEDAGOGY:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion and Power point presentation.

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to

Number	Course Outcome	Knowledge level
CLO 1	Understand the concepts of mechanical system, energy, momentum and d'Alembert's principle	Up to K2
CLO 2	Use the concept of Lagrange's equations in simple systems and in Routhian procedure, Liouville's system.	Up to K3
CLO 3	Evaluate stationary values using Hamilton's equations and find about Liouville's system	Up to K4
CLO 4	Use Hamilton Jacobi theory and find pfaffin differential form, Liouville's system stackel's theorem	Up to K4
CLO 5	Acquire the knowledge about canonical transformations, momentum transformations and poisson brackets	Up to K5

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Mapping with Courses Learning Outcomes (CLOs)

CLO/PO	PO				
	PO1	PO2	PO3	PO4	PO5
CLO 1	3	2	2	2	1
CLO 2	3	2	2	-	1
CLO 3	3	2	3	-	2
CLO 4	3	2	-	-	2
CLO 5	3	-	-	2	3

3 – Advance Application

2 - Intermediate Level

1- Basic Level

BLUE PRINT – External Exam

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4/K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section-wise marks with K levels.

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total marks	10	10	50	50	120	100	100%

BLUE PRINT – CIA - I

Sl.No	CLOs	K Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1,K2	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	3	K1, K1, K2	2(K2 & K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	6	10	-	16	26.67	67%
K2	4	10	10	24	40	
K3	-	-	20	20	33.33	33%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total marks	10	20	30	60	100	100%

BLUE PRINT – CIA - II

Sl.No	CLOs	K level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K4	2	K2, K2	2(K3 & K3)	1(K3, K4)
2	CLO 4	Up to K4	3	K2, K2, K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	13%
K2	8	-	-	8	13.33	
K3	2	10	10	22	36.67	37%
K4	-	10	20	30	50	50%
K5	-	-	-	-	-	-
Total marks	10	20	30	60	100	100%

LESSON PLAN

Unit	Description	Hours	Mode
I	Introductory concepts: mechanical system – generalized coordinates – constraints – virtual work	14	Lecture, Quiz
	d'Alembert's principle - energy and momentum – equilibrium and stability – kinetic energy – angular momentum		Problem Solving
II	Lagrange's equations: derivation of Lagrange's equations for different conditions	17	Lecture, Quiz
	Lagrange equations for some simple systems - integrals of motion – Routhian procedure		Quiz
	Natural system – Liouville's system – small oscillations.		Lecture, Problem
III	Hamilton's equations: stationary values - Hamilton's principle under different conditions	15	PPT, Lecture
	Hamilton's equations – the Legendre transformation		PPT, Tutorial
	modified Hamilton's principle – principle of least action.		Problem Solving
IV	Hamilton-Jacobi theory: Hamilton's principle function – canonical integral	15	Lecture, Tutorial
	Pfaffian differential form – Hamilton-Jacobi equation		Lecture, Tutorial
	separability – Liouville's system Stackel's theorem		Tutorial
V	Canonical transformations: differential forms and generating functions	14	PPT, Lecture
	some simple, point and momentum transformations		Lecture
	Lagrange and Poisson brackets		Lecture
Total Hours		75	

Course Designers:

Dr. V. SANGEETHASUBHA, Assistant Professor, Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Core	21P2MMC8	Partial Differential Equations	4	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. Develop strong background on finding various solutions to first order linear and nonlinear Partial Differential Equations (PDE's).
2. To solve the nonlinear PDE's by Charpit's method and Jacobi's method.
3. To focus the formulation of first and second orders PDE's.
4. To classify and solving for three basic types namely Hyperbolic, Parabolic and Elliptic PDE's.
5. Solving of PDEs which include heat, wave and Laplace's equation that arise in various physical systems.

Course content

Unit	Description	Hours	K-Level	CLOs
I	Partial Differential Equations of the First Order: Partial Differential Equations – Origin of Partial Differential Equations – Cauchy's problem for first order equations – Linear Equations of the first order – Integral surface passing through a given curve – Surfaces orthogonal to a given system of surfaces.	18	K2	1
II	Partial Differential Equations of the First Order (Continued) Nonlinear Partial Differential Equations of the first order - Compatible system of first order equations – Charpit's method – Special types of first order equations – Solutions satisfying given conditions – Jacobi's method.	18	K3	2
III	Partial Differential Equations of the Second Order The origin of second order Partial Differential Equations – Linear Partial Differential Equations with constant coefficients – Equations with variable coefficients – Separation of variables – Method of Integral Transforms.	18	K4	3
IV	Laplace's Equation and Diffusion Equation Elementary solutions of Laplace's equation – Boundary value problems – Separation of variables – Elementary solutions of the Diffusion equation – Separation of variables – The use of Integral Transforms.	18	K4	4

V	The Wave Equation Elementary solutions of the one dimensional wave equations – Vibrating membrane : Application of the calculus of variations – Three dimensional problem – General solutions of the wave equation.	18	K5	5

Book for study:

1. Ian Sneddon, Elements of Partial Differential Equations, International Student Edition, McGraw-Hill International Book Company, New Delhi, 1983.
Chapters: 2 (2.1 to 2.6, 2.7, 2.9 to 2.13), 3 (3.1, 3.4, 3.5. 3.9, 3.10), 4 (4.2, 4.4, 4.5), 5 (5.2, 5.4 – 5.6), 6 (6.3 to 6.5).

Books for References:

1. K. Sankara Rao, Introduction to Partial Differential Equations, Third Edition, PHI Learning, New Delhi, 2011.
2. M.D. Raisinghania Advanced Differential Equations, S. Chand and Company Ltd., New Delhi, 2001.
3. J. N. Sharma & K. Singh, Partial Differential Equations for Engineer and Scientists, Narosha Publishing House, 2001.
4. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill Book Company, New York, 1968.

Web Resources:

- 1.<http://eqworld.ipmnet.ru/en/solutions/ode.htm>
- 2.<https://www.khanacademy.org/math/differential-equations>
- 3.https://mathinsight.org/ordinary_differential_equation_introduction
- 4.<https://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
- 5.<https://www.emathhelp.net/calculators/differential-equations/differential-equation-calculator/>
- 6.<https://www.wolframalpha.com/examples/mathematics/differential-equations/>

Rationale and activities having direct bearing on Nature of Course

Knowledge and Skill

Partial differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical problems using mathematical equations, then solve these equations so that the behavior of the systems concerned can be studied.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Explain the basic concepts of Partial Differential Equations and solve the various types of partial differential equation like Cauchy's problem ,linear equation of first order, Surfaces orthogonal to given system of surfaces.	K2
CLO2	Acquire the knowledge of Nonlinear Partial Differential Equations of the first order and solve the special types of first order partial differential equations.	K3
CLO3	Illustrate the basic concepts of second order Partial Differential Equations and explain the various methods of second order partial equations.	K4
CLO4	Able to analyze problems in the area of Laplace's equation, Boundary value problems, Diffusion equation and the use of Integral Transforms.	K4
CLO5	Ability to calculate the solutions of one dimensional wave equations and three dimensional problems.	K5

K1- Remembering and recalling facts with specific answers

K2 –Basic understanding of facts and stating main ideas with general answers

K3 –Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the pde problems

Mapping of Course Outcomes (CLOs) with Program Outcomes

CLOs/POs	PO1	PO2	PO3	PO4	PO5
CLO1	3	2	3	3	3
CLO2	3	2	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	2	2	3	2

1. Basic level

2. Intermediate level

3. Advance level

Blue Print
Mapping with Course Learning Outcomes (CLOs)

S. No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2& K2)	1(K3)
3	CLO 3	Up to K 4	2	K2& K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 4	2	K3& K4	1	K2	2(K4& K4)	1(K4)
5	CLO 5	Up to K 5	2	K3& K4	1	K3	2(K4& K4)	1(K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the pde problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	26.67%
K5	-	-	-	10	10	8.33	8.33%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I

S. No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K2& K3	2(K3& K3)	2(K2, K3)
2	CLO 2	Up to K4	3	K2,K2, K3	2(K4&K4)	1(K3/ K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the pde problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or Choice)	Section C (Open Choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-
K2	3	-	1	16	26.67	26.67%
K3	2	2	1	24	40	40%
K4	-	2	1	20	33.33	33.33%
Total marks	10	20	30	60	100.00	100%

Blue Print for CIA-II

Mapping with Course Learning Outcomes (CLOs)

SL. No	CLOs	K-level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K-Level		
1	CLO 3	Up to K 3	2	K2& K3	2(K3& K3)	2(K2, K3)
2	CLO 4	Up to K4	3	K2,K2, K3	2(K4&K4)	1(K3/ K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each Section			10		10	20

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or Choice)	Section C (Open Choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-
K2	3	-	1	16	26.67	26.67%
K3	2	2	1	24	40	40%
K4	-	2	1	20	33.33	33.33%
Total marks	10	20	30	60	100.00	100%

Lesson Plan

Units	Description	Hours	Pedagogy
I	Partial Differential Equations	2	Lecture
	Origin of Partial Differential Equations	3	Lecture
	Cauchy's problem for first order equations	1	Lecture & PPT
	Linear Equations of the first order	4	Lecture
	Integral surface passing through a given curve	4	Lecture
	Surfaces orthogonal to a given system of surfaces.	4	Lecture & Group
II	Nonlinear Partial Differential Equations of the first order	2	Lecture
	Compatible system of first order equations	4	Lecture & Seminar
	Charpit's method	3	Lecture
	Special types of first order equations	2	Lecture & PPT
	Solutions satisfying given conditions	3	Lecture
	Jacobi's method.	4	Lecture & Seminar
III	The origin of second order Partial Differential Equations	2	Lecture
	Linear Partial Differential Equations with constant coefficients	4	Lecture & PPT
	Equations with variable coefficients	4	Lecture
	Separation of variables	4	Lecture
	Method of integral transforms.	4	Lecture & Seminar
IV	Elementary solutions of Laplace's equation	3	Lecture
	Boundary value problems	3	Lecture
	Separation of variables	3	Lecture & PPT
	Elementary solutions of the Diffusion equation	3	Lecture
	Separation of variables.	2	Lecture
	The use of Integral Transforms	4	Lecture & Group
V	Elementary solutions of the one dimensional wave	3	Lecture
	Vibrating membrane	3	Lecture & Seminar
	Application of the calculus of variations	4	Lecture & PPT
	Three dimensional problem	4	Assignment
	General solutions of the wave equation	4	Lecture & Group
Total Hours		90	

Course Designer: Dr. V. Ananthaswamy, Assistant Professor, Research Centre and PG Department of Mathematics.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Elective 2	21P2MME2	Fuzzy sets and its Applications	4	6	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

1. To provide an understanding of the basic mathematical elements of the theory of fuzzy Sets and crisp sets.
2. To furnish and emphasis on the operations on fuzzy sets and apply the properties.
3. To explain the concept of fuzzy relation and crisp relation.
4. To enable the students to solve the fuzzy linear programming using decision making in Fuzzy environments
5. To provide the sufficient real life application thus the students can face the competitive world.

Course content

Unit	Description	Hours	K-Level	CLOs
I	Crisp sets and fuzzy sets: Overview of Classical Sets, Membership Function, Height of a fuzzy set – Normal and sub normal fuzzy sets – Support – Level sets, fuzzy points, α -cuts – Decomposition Theorems, Extension Principle.	18	K2	1
II	Operation on fuzzy sets: Standard fuzzy operations – Union, intersection and complement – properties De. Morgan's laws - α -Cuts of fuzzy operations.	18	K3	2
III	Fuzzy relations: Cartesian Product, Crisp relations – cardinality – operations and properties of Crisp and Fuzzy relations. Image and inverse image of fuzzy sets - Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.	18	K3	3
IV	Decision making in Fuzzy environments: General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming.	18	K4	4
V	Applications: Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications.	18	K4	5

. Book for study:

1. George J.Klir and Bo Yuan , Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Learning Private Limited, New Delhi (2009).

Books for References:

1. A. K. Bhargava; Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt. Limited (2013).
2. K.Pundir and R.Pundir, Fuzzy sets and their application, Published by A Pragati edition (2012)
3. H.J. Zimmermann, Fuzzy set theory and its application

Web Resources:

1. <https://youtu.be/IZWTduVCrf8>
2. <https://youtu.be/LUz-FbwPh3Q>
3. <https://youtu.be/oWqXwCEfY78>
4. https://youtu.be/a2i-lHS-c_I
5. <https://youtu.be/1m4KSMsjdaM>

Rationale and activities having direct bearing on nature of course:

Fuzzy sets and its applications are most emerging technology targeting industrial applications have added a promising new dimension to the existing domain of conventional control systems. There are many examples of this kind in industrial applications, for which fuzzy sets and fuzzy logic are easy to use. The applications of fuzzy logic, once thought to be an obscure mathematical curiosity, can be found in many engineering and scientific works. This branch of mathematics has instilled new life into scientific fields that have been dormant for a long time.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Illustrate the concepts of Classical Sets, fuzzy sets, fuzzy points and α -cuts.	K2
CLO2	Analyze the axioms and build operations on fuzzy sets	K3
CLO3	Able to know the concept of various relations of fuzzy sets. Using this to analyse the properties and operations of Crisp and Fuzzy relations.	K3
CLO4	Apply and evaluate multistage decision making in dynamic systems.	K4
CLO5	Enhance the knowledge in various branches like Fuzzy Systems, Genetic Algorithms, Medicine, Economics.	K4

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented – solving problems

K4 - Examining, analyzing, presentation and make inference with evidences.

Mapping of Course Outcomes (CLOs) with Program Outcomes

CLOs/POs	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	2	1
CLO2	3	3	3	3	1
CLO3	3	3	2	2	1
CLO4	3	3	3	3	1
CLO5	3	2	3	2	2

1. Basic level

2. Intermediate level

3. Advance level

Blue Print

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2& K2)	1(K3)
3	CLO 3	Up to K 4	2	K2& K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 4	2	K3& K4	1	K2	2(K4& K4)	1(K4)
5	CLO 5	Up to K 4	2	K3& K4	1	K3	2(K4& K4)	1(K4/K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1 & K1	2	K1	2(K1& K1)	2(K2)
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2& K2)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	6	10	-	18	30	65%
K2	1	-	10	20	21	35	
K3	1	-	-	10	21	35	35%
K4	-	-	-	-	-	-	-
Total marks	4	6	20	30	60	100.00	100%

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

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SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 3	Up to K 4	2	K2& K3	2	K2	2(K3 & K3)	2(K3)
2	CLO 4	Up to K 4	2	K3& K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	-	-	-	-	-	-	11.67%
K2	1	6		-	7	11.67	
K3	2	-	10	20	32	53.33	53.33%
K4	1	-	10	10	21	35	35%
Total marks	4	6	20	30	60	100.00	

Lesson Plan

Units	Description	Hours	Pedagogy
I	Introduction	2	Lecture
	Overview of Classical Sets,	3	Lecture
	Membership Function, Height of a fuzzy set	3	Lecture
	Normal and sub normal fuzzy sets , Support, Level sets.	3	Lecture
	fuzzy points, α -cuts.	3	Lecture
	Decomposition Theorems, Extension Principle.	4	Lecture & Group Discussion
II	Standard fuzzy operations.	3	Lecture
	Fuzzy Union , Intersection.	3	Lecture & Seminar
	Fuzzy Complement.	3	Lecture
	Properties De. Morgan's laws	3	Lecture
	Properties De. Morgan's laws	3	Lecture
	α -Cuts of fuzzy operations.	3	Lecture& Seminar
III	Cartesian Product, Crisp relations – cardinality.	3	Lecture
	operations and properties of Crisp and Fuzzy relations	3	Lecture
	Image and inverse image of fuzzy sets	3	Lecture
	Image and inverse image of fuzzy sets	3	Lecture
	Various definitions of fuzzy operations	3	Lecture & Seminar
	Generalizations – Non interacting fuzzy sets	3	Lecture & Group Discussion
	Tolerance and equivalence relations.	3	
IV	General Discussion – Individual Decision making	4	Lecture
	Multi person decision making	4	Lecture
	Multi criteria decision making	3	Lecture & Seminar
	Multi stage decision making , fuzzy ranking methods	4	Lecture
	Fuzzy linear programming	4	Lecture
V	Application in Medicine	2	Lecture
	Application in Economics	3	Lecture & Seminar
	Fuzzy Systems and Genetic Algorithms.	2	Lecture
	Fuzzy Regression.	3	Lecture
	Interpersonal Communication.	3	Assignment
	Other Applications	2	Lecture & Group Discussion
	Application in reallife situations	3	Lecture
Total Hours		90	

Course Designer:

Mrs.V.Vijayalakshmi S.F.

DEPARTMENT OF MATHEMATICS				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	NME	21P2MNM2	BUSINESS MATHEMATICS	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

COURSE OBJECTIVES:

1. To obtain the knowledge of ratios and proportions.
2. To gain knowledge about solving linear equation by matrix.
3. To acquire idea about Measures of central tendency and Measures of dispersion.
4. To understand concept of probability.

Unit	Description	Hours	K-level	CLO
I	Theory of Indices: Positive integral indices – Law of indices – Zero and negative indices – Fractional indices.	5	Up to K2	CLO1
II	Logarithms: Logarithm – Properties of Logarithms – Common Logarithm.	5	Up to K2	CLO2
III	Progression: Sequence of Numbers – Arithmetic Progression – Geometric Progression – Arithmetic and Geometric means.	7	Up to K2	CLO3
IV	Ratio and Proportion: Ratio – Compounding, Duplicate, Triplicate and Sub-duplicate of ratio's – Proportion – Rules of Proportion – Direct, Inverse, Compound and Continued proportion.	6	Up to K2	CLO4
V	Commercial Arithmetic: Simple interest – Compound interest – Annuities – Percentage – Discount – True discount, Banker's discount and Banker's gain.	7	Up to K2	CLO5

Book for Study:

1. G. K. Ranganath, C.S. Sampagiram and Y. Rajaram, "Business Mathematics", Third edition, 2019, Himalaya Publishing House, Mumbai.

Books for References:

1. M. Manokaran & . Elango, "Business Mathematics", Paramount Publications, Palani.

Web Resources:

- 1.http://amsi.org.au/teacher_modules/Indices_and_logarithms.html
- 2.<https://www.mathcentre.ac.uk/resources/uploaded/mc-ty-apgp-2009-1.pdf>
- 3.<https://www.onlinemath4all.com/types-of-ratios.html>
- 4.<https://www.toppr.com/guides/quantitative-aptitude/profit-and-loss/bankers-discount/>

Rationale and Activities Having Direct Bearing on Nature of Course:

Understand elementary arithmetic, including fractions, decimals, and percentages and acquire idea about Measures of central tendency and Measures of dispersion.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion and Power point presentation.

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to

Number	Course Outcome	Knowledge level
CLO 1	Understand the concepts of Law of indices and Fractional indices	Up to K2
CLO 2	Recall the concept of Logarithm, Properties of Logarithms and learn Common Logarithm.	Up to K2
CLO 3	Understand the concept of Sequence of Numbers, Arithmetic Progression, Geometric Progression.	Up to K2
CLO 4	Understand the concepts of Ratio, Compounding, Duplicate, Triplicate and Sub-duplicate of ratio's and Proportion	Up to K2
CLO 5	Understand the concept of Simple interest, Compound interest, Annuities, Percentage and Discount	Up to K2

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

Mapping with Courses Learning Outcomes (CLOs)

CLO/PO	PO				
	PO1	PO2	PO3	PO4	PO5
CLO 1	3	-	-	1	-
CLO 2	3	-	-	1	-
CLO 3	3	-	-	1	-
CLO 4	3	-	-	3	-
CLO 5	3	-	-	3	-

3 – Advance Application

2 - Intermediate Level

1- Basic Level

Blue Print – External Exam

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K. Level	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO1	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
2	CLO2	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
3	CLO3	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
4	CLO4	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
5	CLO5	Up to K2	1(K1)	2 (K2 & K2)	1 (K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	-	70		70	53.85	54%
Total marks	10	70	50	130	100.00	100%

The Components of assessment

S.No	CLO	Test Component	Marks	K Level
1	5	Assignment	5 Marks	K2
2	5	Seminar	5 Marks	K1
3	5	Quiz	5 Marks	K2

Blue Print – CIA – I

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K. Level	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO1	Up to K2	3 (K1)	2(K2 & K2)	2(K1&K1)
2	CLO2	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100	100%

Blue Print – CIA – II

Articulation Mapping K-level with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K. Level	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)
1	CLO3	Up to K2	3(K1)	2(K2 & K2)	2(K1&K1)
2	CLO4	Up to K2	2(K1)	2(K2 & K2)	1(K1)
No. of Questions to be asked			5	4	3
No. of Questions to be answered			5	2	2
Marks for each question			2	5	10
Total Marks for each Section			10	10	20

Distribution of Section-wise Marks with K levels

K Levels	Section A (Short Answers)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	30	40	66.67	67%
K2	-	20	-	20	33.33	33%
Total marks	10	20	30	60	100.00	100%

LESSON PLAN

Unit	Description	Hours	Mode
I	Positive integral indices	2	Lecture, Quiz
	Zero and negative indices – Fractional indices	3	Problem Solving
II	Logarithm – Properties of Logarithms – Common Logarithm	5	Lecture, Quiz, Problem Solving
III	Sequence of Numbers – Arithmetic Progression – Geometric Progression	4	Lecture
	Arithmetic and Geometric means .	3	Tutorial
IV	Ratio – Compounding, Duplicate, Triplicate and Sub-duplicate of ratio's	3	Lecture, Tutorial
	Proportion – Rules of Proportion – Direct, Inverse, Compound and Continued proportion.	3	Problem Solving
V	Simple interest – Compound interest – Annuities – Percentage	4	Lecture
	Discount – True discount, Banker's discount and Banker's gain.	3	Problem Solving
Total Hours		30	

COURSE DESIGNER:

1. Dr. V. SANGEETHASUBHA, Assistant Professor, Department of Mathematics.

Department of Statistics

Revised Curriculum
(Choice Based Credit system with Outcome Based Education)
Academic Year 2020-2021 onwards

I and II semesters (M.Sc. Statistics)

DEPARTMENT OF STATISTICS

VISION

Vision of the Statistics department is to develop student's ability to think analytically, speculatively and imaginatively and to encourage them to pursue higher education for the purpose of continuous curriculum innovations.

MISSION

- To help students develop their intellect and faith.
- To provide excellent training in scientific data collections, data management, methods and procedure of data analysis.
- To facilitate students to see themselves as professional, as part of a discipline with skills and abilities valuable in business, teaching and publishing.

Programme Outcomes (POs)

SI.No.	On completion of the programme, the student will
PO1	Proffer a viable option to enhance their knowledge of the subject and explore the other areas.
PO2	Demonstrate a high level of expertise in the area of professional practice.
PO3	Gain advanced knowledge of a theoretical and applied topic, skills gained through independent learning
PO4	Empower the students to obtain new skill as needed in their employment or education and provide with skill and abilities to facilitate solving real world problem.
PO5	Educate and motivate students for research studies in Statistics and related fields.

Programme Specific Outcomes (PSOs)

SI. No.	On completion of the programme, the student will
PSO1	Able the students to design the methodology suitable to the problem encountered.
PSO2	Comprehend the theoretical aspects of statistics
PSO3	Provide strong foundation on pure and applied statistics, empowering student's statistical abilities, creativity and heuristic thinking towards higher research.
PSO4	Recognize the importance of statistical modeling simulation, computing, and the role of approximation and mathematical approaches to analyze the real world problems.
PSO5	Ability to analyze the data by using statistical software.
PSO6	Able to synthesize mathematical, statistical, financial and actuarial theory, in the field of financial and insurance issues.
PSO7	Collection of relevant data, analyse and identify improvement needs for measurement systems in industrial organizations.

Eligibility criteria for Admission

A candidate who has acquired B.Sc., degree in Statistics or B.Sc., degree in Mathematics shall permit to join the course.

Duration of the Course

The students shall undergo prescribed course of study for the period of two academic years under CBCS semester pattern with outcome based education.

Medium of Instruction: English

System: Choice Based Credit System with Outcome Based Model

Courses of Study with Credit Distribution

Category	No. of Course	No. of Credits
Major core theory	12	48
Major core Practical	8	16
Major core Elective	4	16
Non – Major Elective	2	4
Project	1	6
Total	27	90

Nature of the Course

Courses are classified according to the following nature

- Knowledge & Skill
- Employability Oriented
- Entrepreneurship Oriented

Teaching & Evaluation Pattern

- Outcome Based Education (OBE) & Assessment

This curriculum is designed based on Tamilnadu State Council for Higher Education (TANSCHE) State Integrated Board of Studies and UGC.

Students understanding must be built on and assessed for wide range of learning activities, which includes different approaches and are classified along several bases, such as

Based on purpose:

- **Formative** (Internal tests, Assignment, Seminar, Quiz, ICT based Assignment etc.,)
- **Summative** (Evaluation of students learning at the end of instructional unit)

Based on Domain knowledge: (Post Graduate Up to K5 Levels)

- Assessment through K1, K2, K3, K4 & K5

Evaluation

Methods	Marks
Formative (CIA)	25
Summative (External)	75
Total	100

Formative Test (CIA-Continuous Internal Assessment): 25 Marks

- Centralised system of Internal Assessment Tests
- There will be a two internal assessment tests
- Duration of Internal assessment test will be 2 hours
- Students shall write retest on the genuine grounds if they are absent in either Test I or Test II with the approval of HoD and the Principal.

Question Paper Pattern for Formative Test

Section	Question pattern	Marks
A	Short answer (5 X 2 marks)	10
B	Either / Or type (2 X 5 marks)	10
C	Open choice type (2 out of 3 X 10 marks)	20
Total		40

The blue print for the internal test will be as follows.

Units	CLOs	K- Level	SectionA		SectionB (Either/or Choice)	SectionC (OpenChoice)
			ShortAnswers			
			No.of Questions	K- Level		
1	CLOx	Up toK3	2	K2,K3	2(K3 & K3)	2(K2,K3)
2	CLOy	Up toK4	3	K2,K3,K4	2(K4 & K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

- ✓ K1- Remembering and recalling facts with specific answers
- ✓ K2- Basic understanding of facts and stating main ideas with general answers
- ✓ K3- Application oriented- Solving Problems
- ✓ K4- Examining, analyzing, presentation and make inferences with evidences
- For the purpose of Formative assessment (CIA), the course teacher may decide the CLO for the two tests as per the following conditions.
 - i. Any two CLOs shall be considered for the first test.
 - ii. Two CLOs (other than those already considered for the first test) shall be considered for the second test.
 - iii. The remaining CLO may be considered for assignment

Question Paper Pattern for Summative Examination

Section	Question pattern	Marks
A	Multiple choice (10 X 1 marks)	10
B	Short answer (5 X 2 marks)	10
C	Either / Or type (5 X 5 marks)	25
D	Open choice type (3 out of 5 X 10 marks)	30
Total		75

In respect of external examinations passing minimum is 45% for PG Courses and in total, aggregate of 50%. The curriculum is revised to suit the changing trends by propagation of ideas ensuring professional growth through innovative method of teaching.

Evaluation Pattern for Practical Papers

I) Continuous Internal Assessment: 50 Marks

Internal Components	Marks
Internal test	30
Observation	10
Continuous class assessment	10
Total	50

II). External Assessment: 50 Marks

Total marks (I + II): 100 Marks

DEPARTMENT OF STATISTICS
THE MADURA COLLEGE (AUTONOMOUS), MADURAI
M.Sc. Statistics curriculum structure

(Under OBE pattern for the students admitted during the academic year 2021-22 onwards)

Sem.	Course Type	Course Code	Course Title	Hours	Credits
I	Major Core -	21P1SMC1	Real Analysis and Linear Algebra	5	4
	Major Core -	21P1SMC2	Distribution Theory	5	4
	Major Core -	21P1SMC3	Operations Research	5	4
	Major Core Elective - 1	21P1SME1(A)/ 21P1SME1(B)	Actuarial Statistics / Data Mining	5	4
	NME – 1	21P1SNM1	Introduction to Non – Parametric Statistics	2	2
	Practical - 1	21P1SMP1	Statistical Practical - I (calculated based)	4	2
	Practical - 2	21P1NMP2	Data analysis with MS-Excel	4	2
			Total number of hours and credits	30	22
II	Major Core –	21P2SMC4	Measure and Probability Theory	5	4
	Major Core –	21P2SMC5	Statistical Estimation Theory	5	4
	Major Core –	21P2SMC6	Sampling Techniques	5	4
	Major Core Elective - 2	21P2SME2 (A)/ 21P2SME2 (B)	Reliability Theory and Survival Analysis / Time series analysis	5	4
	NME – 2	21P2SNM2	Industrial Statistics	2	2
	Practical - 3	21P2SMP3	Statistical Practical - II (calculated based)	4	2
	Practical - 4	21P2NMP4	Statistical Data Analysis using SPSS	4	2
			Total number of hours and credits	30	22
III	Major Core –	21P3SMC7	Testing Statistical Hypotheses	6	4
	Major Core –	21P3SMC8	Multivariate Statistical Analysis	6	4
	Major Core –	21P3SMC9	Stochastic Processes	5	4
	Major Core Elective - 3	21P3SME3 (A) /	Econometrics / Demography	5	4
	Practical - 5	21P3SMP5	Statistical Practical – III (Calculated based)	4	2
	Practical - 6	21P3SMP6	Programming in R	4	2
			Total number of hours and credits	30	20
IV	Major Core –	21P4SMC10	Linear Models and Design of Experiments	6	4
	Major Core –	21P4SMC11	Statistical Quality Control and Reliability	6	4
	Major Core -	21P4SMC12	Programming in Python	5	4
	Major Core Elective - 4	21P4SME4	Applied Regression Analysis / Categorical data analysis	5	4
	Practical - 7	21P4SMP7	Statistics Practical - IV (Calculated based)	4	2
	Practical - 8	21P4SMP8	Lab: Practical in Python	4	2
			Project	-	6
			Total number of hours and credits	30	26
Grand Total number of hours and Credits				120	90

M.Sc. Statistics - I Year – First Semester

Course Type	Course Code	Course Title	Hours	Credits
Major Core - 1	21P1SMC1	Real Analysis and Linear Algebra	5	4
Major Core - 2	21P1SMC2	Distribution Theory	5	4
Major Core - 3	21P1SMC3	Operations Research	5	4
Major Core Elective - 1	21P1SME1 (A) /21P1SME1(B)	Actuarial Statistics / Data Mining	5	4
NME – 1	21P1SNM1	Introduction to Non – Parametric Statistics	2	2
Practical - 1	21P1SMP1	Statistical Practical - I (calculated based)	4	2
Practical - 2	21P1SMP2	Data analysis with MS-Excel	4	2
		Total number of hours and credits	30	22

Semester wise Mapping of Course with Programme Outcomes (POs)

	Course Type	Major Core – 1	Major Core – 2	Major Core – 3	Major Core Elective - 1	Major Core Elective - 2	Practical - 1	Practical - 2
	Course Title	Real Analysis and Linear Algebra	Distribution Theory	Operations Research	Actuarial Statistics	Data Mining	Statistical Practical - I (calculated based)	Data analysis with MS-Excel
GRADUATE ATTRIBUTES PROGRAM OUTCOMES (POS)	PO1	3	3	3	3	3	3	2
	PO2	2	3	3	2	2	3	3
	PO3	2	3	3	2	3	3	2
	PO4	2	2	2	1	3	3	3
	PO5	1	3	3	1	3	2	2

3- Advance Application 2- Intermediate Level 1- Basic Level
Semester wise Mapping of Course with Programme Specific Outcomes (PSOs)

	Course Type	Major Core – 1	Major Core – 2	Major Core – 3	Major Core Elective - 1	Major Core Elective - 1	Practical - 1	Practical - 2
	Course Title	Real Analysis and Linear Algebra	Distribution Theory	Operations Research	Actuarial Statistics	Data Mining	Statistical Practical - I (calculated based)	Data analysis with MS-Excel
GRADUATE ATTRIBUTES PROGRAM OUTCOMES (POS)	PSO1	3	3	3	2	3	3	2
	PSO2	2	3	3	2	3	1	1
	PSO3	2	3	3	3	3	2	2
	PSO4	3	2	2	2	3	3	1
	PSO5	2	2	1	3	2	1	3
	PSO6	3	3	3	2	2	2	1
	PSO7	1	2	3	3	3	3	3

3- Advance Application 2- Intermediate Level 1- Basic Level

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core – 1	21P1SMC1	Real Analysis and Linear Algebra	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

The main objectives of this course are to:

1. Expose the students to get knowledge on real analysis and linear algebra.
2. Grasp the concepts of convergence of sequence and series of real numbers.
3. Develop the ability of proving theorems and solving the problems in real analysis and linear algebra.

Unit	Description	Hours	K-Level	CLO(s)
1	Introduction to n-dimensional Euclidean space and metric space – Countability, supremum and infimum of sets of real numbers – Bolzano-Weirstrass theorem. Convergence of sequences and series of real numbers – absolute and conditional convergence – Point-wise and uniform convergence – Tests for absolute, conditional and uniform convergence – Properties of uniform convergence.	18	K2	1
2	Real valued functions - Limits and continuity and uniform continuity – Differentiability – Maxima and Minima of functions – mean value theorem, Taylor's theorem – functions of several variables.	13	K3	2
3	Riemann-Stieltjes sums – Riemann-Stieltjes integral – Properties and Evaluation – Fundamental theorem – Differentiation under integral sign – Leibnitz's rule - Improper integrals - Multiple integrals and their evaluation by repeated integration.	15	K3	3
4	Vector Space - sub-space, basis of vector space – Gram-Schmidt orthogonalization. Linear transformation (LT) and its properties – matrix of linear transformation – matrix of inverse transformation – change of basis, orthogonal transformation, dual space.	13	K4	4
5	Linear equations – Generalized inverse of a matrix. Eigenvalues and eigenvectors of a LT –Diagonalizable LT, Cayley-Hamilton theorem and minimum polynomial for a LT – Eigenvalues of matrix polynomials. Quadratic forms and their classifications- Sylvester's law of inertia – reduction involving the eigen-values of the matrix.	16	K4	5

Books for Reference:

1. Malik, S.C., and Arora, S, (2009), Mathematical Analysis, Second Edition, New Age International, New Delhi.
2. Arora, S, (1988), Real Analysis, SatyaPrakashanMandir, New Delhi.
3. Rudin, W. (2016), Principles of Mathematical Analysis, Fourteenth reprints McGraw-Hill, New Delhi.
4. Kenneth Hoffman and Ray Kanze 2nd Edition (1971) Linear Algebra PHI publisher, New Jersey
5. Goldberg, R.R. (1976) Methods of Real Analysis, Oxford & IBH, New Delhi.
6. Apostol, T.M. (1997) Mathematical Analysis, Narosa, New Delhi.
7. Somasundaram,D. (2002) Mathematical Analysis, Narosa, New Delhi.
8. Datta, K.E. (1991) Matrix and Linear Algebra, Prentice-Hall, New Delhi.
9. Rao, C.R. (1973) Linear Statistical Inference and its Applications, Wiley Eastern, New Delhi.
10. Searle, S.R. (1973) Linear Models, Wiley, New York.
11. Ramachandra Rao, A. and Bhimasankaran, P.(1992) LinearAlgebra, Tata McGraw Hill, New Delhi.
12. Ajit Kumar and Kumaresan, S, (2014), A Basic Course in Real Analysis, Chapman and Hall/CRC Press.

Web references:

1. Euclidean space and metric space:
<https://www.math.uci.edu/~gpatrick/source/205b06/chapviii.pdf>
2. Mean value theorem
<https://byjus.com/jee/mean-value-theorem/>
<https://www.youtube.com/watch?v=xYOrYLq3fE0>
3. Taylors theorem
<https://www.youtube.com/watch?v=LEspaisjDFE>
4. Riemann-Stieltjes integral
<https://www.youtube.com/watch?v=TpKleWgcmC8>
5. Vector space
<https://www.youtube.com/watch?v=1XIT3Y2oyAU>
6. Linear transformation and matrix
https://amsi.org.au/ESA_Senior_Years/SeniorTopic8/8a/8a_2content_3.html
7. Linear algebra
<https://www.commonlounge.com/discussion/efdfcf2937b94fbeb7a3e1a309381d85>

Rationale for Nature of the course

This course will enable the students to comprehend the theoretical and applied concepts of Real analysis and Linear Algebra which enables to apply for the statistical concepts.

Pedagogy:

Chalk and Talk, PPT, Assignments, Seminar, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Introduction to n-dimensional Euclidean space and metric space	2	Chalk and Talk, PPT, problem solving and Assignments
	Countability, supremum and infimum of sets of real numbers	3	
	Bolzano-Weirstrass theorem	2	
	Convergence of sequences and series of real numbers	3	
	absolute and conditional convergence	2	
	Point-wise and uniform convergence	2	
	Tests for absolute, conditional and uniform convergence	3	
	Properties of uniform convergence	1	
II	Real valued functions - Limits and continuity and uniform continuity	3	Chalk and Talk, PPT, problem solving and Assignments
	Differentiability – Maxima and Minima of functions	2	
	Mean value theorem	3	
	Taylor's theorem	2	
	Functions of several variables	3	
III	Riemann-Stieltjes sums	2	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	Riemann-Stieltjes integral	2	
	Properties and Evaluation	1	
	Fundamental theorem	2	
	Differentiation under integral sign	2	
	Leibnitz's rule	2	
	Improper integrals	2	
	Multiple integrals and their evaluation by repeated integration	2	
IV	Vector Space - sub-space, basis of vector space	2	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	Gram-Schmidt orthogonalization	2	
	Linear transformation and its properties	2	
	Matrix of linear transformation	3	
	Matrix of inverse transformation	2	
	Change of basis, orthogonal transformation, dual space	2	
V	Linear equations – Generalized inverse of a matrix	2	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	Eigenvalues and eigenvectors of a linear transformations	2	
	Diagonalizable linear transformations	2	
	Cayley-Hamilton theorem and minimum polynomial for a linear transformations	3	
	Eigenvalues of matrix polynomials	2	
	Quadratic forms and their classifications	2	
	Sylvester's law of inertia	2	
	Reduction involving the eigen-values of the matrix	1	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the meaning of converges in sequences and series of real	Up to K2
CLO-2	Identify the given functions are continuous or discontinuous.	Up to K3
CLO-3	Understand the conditions for integrability of real valued functions.	Up to K3
CLO-4	Describe the fundament concepts of vector and linear transformations.	Up to K4
CLO-5	Determine the characteristic roots, eigen vector, the nature and reduction of quadratic forms.	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	3	2	1		2	2
CLO-2	2	2	2	2	1	2	1
CLO-3	3	1	2	1		2	1
CLO-4	2	2	1		1		1
CLO-5	2	3	2		2	3	2

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA-I–BluePrint

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 1	Up to K2	2	K1, K1	2	K2, K2	1	K2
CLO 2	Up to K3	3	K2, K2, K3	2	K3 , K3	2	K3, K3
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-I: Distribution of section wise marks with K-levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	46.67%
K2	4	10	10	24	40	
K3	2	10	20	32	53.33	53.33%
K4	-	-	-	-	-	-
Total marks	10	20	30	60	100	100

CIA-II Blue Print

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 3	Up to K3	2	K1, K1	2	K2, K3	2	K2, K3
CLO 4	Up to K4	3	K2, K2, K3	2	K3, K4	1	K4
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-II: Distribution of section wise marks with K-levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25.00	25.00%
Total marks	10	20	30	60	100	100

Summative Examination -Blue Print

Units	CLOs	K- Level	SectionA		SectionB		SectionC (Either/or Choice)	SectionD (OpenChoice)
			MCQs		ShortAnswers			
			No.of Question	K- Level	No.of Questions	K- Level		
1	CLO1	Up to K2	2	K1& K1	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up to K3	2	K2& K3	1	K1	2(K3&K3)	1(K3)
3	CLO3	Up to K3	2	K2& K3	1	K2	2(K2&K2)	1(K3)
4	CLO4	Up to K4	2	K3& K4	1	K2	2(K4&K4)	1(K4)
5	CLO5	Up to K4	2	K3& K4	1	K3	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

Distribution of Marks with K Level for Summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
K5	-	-		-			
Total	10	10	50	50	120	100	100

Course Designers:

1. Dr. R MADHANAGOPAL
2. Dr. M. VENKATESWARAN

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core – 2	21P1SMC2	Distribution Theory	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To equip the students with knowledge of various probability distributions
2. Create and apply customized probability distributions

Unit	Description	Hours	K-level	CLO(s)
I	(Basic probability distributions – Binomial, Poisson, negative binomial, hypergeometric, multinomial, normal, uniform – Only for introduction purpose not for examination) Gamma, Beta distributions and their applications. Logarithmic and power series distributions – compound distribution – compound Binomial and compound Poisson distributions – Lognormal distribution – Cauchy distribution.	19	K2	1
II	Truncated distributions – left truncated binomial – left truncated Poisson – left and right truncated Normal distributions – Non-central Student's t , χ^2 and F distributions.	16	K3	2
III	Bivariate Normal distribution – Moment generating function – marginal and conditional distributions. Moments – Distribution of correlation coefficient when population correlation coefficient is equal to zero – Distribution of Regression coefficients.	13	K4	3
IV	Distributions of order statistics - median, range and mid-range. Distribution of Quantiles– Sample cumulative distribution function and its properties.	13	K3	4
V	Distribution of quadratic forms in normal random variables, their mean and variance, independence of quadratic forms, independence of linear and quadratic forms, Fisher-Cochran's theorem.	14	K4	5

Books for Reference:

1. Rohatgi, V.K. and Saleh, A.K.M.D.E. (2011) An Introduction to Probability and Statistics, Wiley, New Delhi.
2. Johnson, N. L., Kemp, A.W., and Kotz, S. (2005). Univariate Discrete Distributions, Third Edition, John Wiley and Sons, New York.

3. Johnson, N. L., Kotz, S., and Balakrishnan, N. (2004). Continuous Univariate Distributions. Vol. I, John Wiley and Sons (Asia), Singapore.
4. Johnson, N.L Kotz, S. and Balakrishnan, N. (2014) Continuous Univariate Distributions, Vol. II. Wiley, Singapore.
5. Mukhopadhyay, P, (2002), Mathematical Statistics, Book and Allied Publishers, New Delhi.
6. David, H.A. (1971): Order Statistics, Wiley, New York.
7. Bhuyan, K. C (2010), Probability Distribution Theory and Statistical Inference, New Central Book agency private ltd, Reprint, 2015
8. Mood, A.M., Graybill, F.A., and Boes, D.C, (1974), Introduction to the Theory of Statistics, Third Edition, McGraw-Hill International Edition.
9. Dudewicz, E.J., and Mishra, S. N. (1988). Modern Mathematical Statistics, John Wiley & Sons, New York.
10. Rao, C. R. (2009). Linear Statistical Inference and Its Applications, Second Edition, John Wiley and Sons, New York.
11. Karian, Z.A., and Dudewicz, E.J. (2011). Handbook of Fitting Statistical Distributions with R, Chapman and Hall.

Web references:

1. Basic probability distributions
https://www.cse.iitk.ac.in/users/piyush/courses/pml_fall17/material/probabilty_tutorial.pdf
https://www.colorado.edu/amath/sites/default/files/attached-files/lesson3_probdistns.pdf
<http://www.ams.sunysb.edu/~linli/teaching/ams-310/lecture-notes-3.pdf>
2. Continuous Distribution
<http://www.utstat.utoronto.ca/~radford/sta247.F11/IPSUR6.pdf>
<https://www.patnauniversity.ac.in/e-content/science/stat/MScStatistics7.pdf>
3. Truncated Distribution
<http://parker.ad.siu.edu/Olive/ch4.pdf>
4. Non-central distribution
<http://pages.stat.wisc.edu/~shao/stat609/stat609-13.pdf>
5. Bivariate Normal distribution
<https://www.bauer.uh.edu/rsusmel/phd/sR-5.pdf>
<http://www1.maths.leeds.ac.uk/~sta6ajb/math2715/lec19-20.pdf>
6. Order Statistics
<https://www2.stat.duke.edu/courses/Spring12/sta104.1/Lectures/Lec15.pdf>
<http://www.math.ntu.edu.tw/~hchen/teaching/LargeSample/notes/noteorder.pdf>
7. Distribution of quadratic forms
http://www.math.louisville.edu/~rsgill01/668/Ch_5_Notes.html
<http://users.stat.umn.edu/~sandy/courses/8311/handouts/ch05.pdf>

Rationale for Nature of the course

This course facilitates the student to identify the nature of data and suitable distribution to be fitted. Student is able to apply the real time data by fitting a suitable distribution.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Exercise problems on distributions given on realtime situations

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Basic probability distributions – Binomial, Poisson, negative binomial, hypergeometric, multinomial, normal, uniform	6	PPT, Chalk and Talk and Assignments
	Gamma, Beta distributions and their applications	4	
	Logarithmic and power series distributions	4	
	Compound distribution – compound Binomial and compound Poisson distributions	3	
	Lognormal distribution – Cauchy distribution	2	
II	Truncated distributions – left truncated binomial – left truncated Poisson	5	PPT, Chalk and Talk and Assignments
	left and right truncated Normal distributions	4	
	Non-central <i>Student's t</i> , χ^2 and F distributions.	7	
III	Bivariate Normal distribution – Moment generating function – marginal and conditional distributions. Moments	5	PPT, Chalk and Talk, Assignments and seminar
	Distribution of correlation coefficient when population correlation coefficient is equal to zero	4	
	Distribution of Regression coefficients	4	
IV	Distributions of order statistics - median, range and mid-range	7	PPT, Chalk andTalk, Assignments and seminar
	Distribution of Quantiles– Sample cumulative distribution function and its properties.	6	
V	Distribution of quadratic forms in normal random variables, their mean and variance,	5	PPT, Chalk and Talk, Assignments and seminar
	independence of quadratic forms, independence of linear and quadratic forms	5	
	Fisher-Cochran's theorem	4	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the type of statistical situation to which different distributions can be applied.	Up to K2
CLO-2	Acquire knowledge of various discrete and continuous probability distributions and their applications in real life problems.	Up to K3
CLO-3	Develop the properties of bivariate probability distributions	Up to K4
CLO-4	Define order statistics and obtain their sampling distributions	Up to K3
CLO-5	Use distribution of quadratic forms to solve statistical problems.	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	1	3	3	3		1
CLO-2	2	1	3	3	3	1	1
CLO-3	3	1	3	2	3		1
CLO-4	2	1	3	2	3		1
CLO-5	3	1	3	2	3		1

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA I – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 1	Up to K2	2	K1 , K1	2	K1,K1	1	K2
2	CLO 2	Up to K3	3	K2, K2,K3	2	K2,K2	2	K3, K3
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-I :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	10	-	14	23.33	63.33%
K2	4	10	10	24	40.00	
K3	2	-	20	22	36.67	36.67%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total marks	10	20	30	60	100	100

CIA II – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K4	3	K1,K2, K3	2	K3, K4	2	K3, K4
2	CLO 4	Up to K3	2	K1, K2	2	K3 , K4	1	K3
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	13.34%
K2	4	-	-	4	6.67	
K3	2	10	20	32	53.33	53.33%
K4	-	10	10	20	33.33	33.33%
K5	-	-	-	-	-	-
Total marks	10	20	30	60	100	100

Summative Examination -Blue Print

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
4	CLO 4	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

Course Designers:

1. Dr. P. Vetri Selvi
2. Dr. M. Venkateswaran

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core – 3	21P1SMC3	Operations Research	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To introduce students the statistical and mathematical formulations for handling a range of business based problems.
2. To develop a broad appreciation of different types of decision-making environments.

Unit	Description	Hours	K-level	CLO(s)
I	(Linear Programming problem – Simplex and Dual Simplex methods. Transportation and assignment problems and their solution. Sensitivity Analysis – Variation in cost vector ‘c’ – Variation in the requirement vector ‘b’ – Addition and Deletion of single variable – Addition and Deletion of single constraint.	17	K2	1
II	Parametric Programming – parameterization of the cost vector ‘c’ – Parameterization of requirement vector ‘b’ – All integer programming problem – Mixed integer programming problem – Branch and Bound techniques.	16	K3	2
III	Non-linear programming problem (NLPP) – Kuhn-Tucker condition – Wolfe’s and Beale’s algorithms for solving quadratic programming problem.	11	K3	3
IV	Inventory models – Structure of Inventory system – General deterministic problem for one item, one level – Inventory models with and without shortage – Multi item deterministic problem – one level model with one break.	16	K4	4
V	Queuing theory – Basic characteristics of queuing models – Arrival and service distribution – Steady state solution of M/M/1 and M/M/C models with associated distribution of queue length and waiting time – M/G/I queue and Pollazec-Khinchin result.	15	K4	5

Books for Reference:

1. Gass, S.I. (1985) Linear Programming, Methods and Applications. Courier Dover, New York.
2. Gupta, P.K. and Man Mohan. (1979) Operations Research: Linear Programming and Theory of Games, 3/e, Sultan Chand & Sons, New Delhi.
3. Hadley, G (1963) Linear Programming. Addison Wesley,
4. Hillier, F.S. and Lieberman, G.J. (2005) Introduction to Operations Research, 9/e, McGraw Hill, New York.
5. Sharma, J.K. (2013) Operations Research: Problems and Solutions, 5/e, Macmillan India, New Delhi.
6. Sharma, S.D. (2010) Operations Research, Kedarnath Ramnath, Meerut.
7. Swarup, K. Mohan, M. and Gupta, P.K. (2001) Operations Research, Sultan Chand & Sons, New Delhi.
8. Taha, H.A. (2011) Operations Research- An Introduction. 9/e, Prentice Hall, New Delhi.
9. Rao S.S. (1972), Optimization: Theory and Applications, Wiley Eastern (P) Ltd., New Delhi

Web Resources:

1. Linear Programming Simple, Transportation and Assignment Problems:
http://www.phpsimplex.com/en/simplex_method_example.htm
<https://www.youtube.com/watch?v=-YBIR1UF-UY>
2. Sensitivity analysis:
<https://www.youtube.com/watch?v=DNZpiOCdC6w>
<http://web.mit.edu/15.053/www/AMP-Chapter-03.pdf>
3. Inventory models
<http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=90023>
<https://www.youtube.com/watch?v=y2m3-dgtWG0>
4. Queuing theory:
<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2969>
<https://www.youtube.com/watch?v=7EB5A3Iv-xk>

Rationale for Nature of the course

This course enables the students to gain in-depth knowledge on advance level of optimization technique problems in both theoretical and application orientation.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Seminars / Assignments on industry based problems related to optimization

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	(Linear Programming problem – Simplex and Dual Simplex methods. Transportation and assignment problems and their solution.	4	PPT, Chalk and Talk and Assignments
	Sensitivity Analysis	3	
	Variation in cost vector 'c'	2	
	Variation in the requirement vector 'b'	3	
	Addition and Deletion of single variable	2	
	Addition and Deletion of single constraint	3	
II	Parametric Programming – parameterization of the cost vector 'c'	3	PPT, Chalk and Talk and Assignments
	Parameterization of requirement vector 'b'	3	
	All integer programming problem	3	
	Mixed integer programming problem	3	
	Branch and Bound techniques	4	
III	Non-linear programming problem (NLPP) – Kuhn-Tucker condition	5	PPT, Chalk and Talk , seminar and Assignments
	Wolfe's and Beale's algorithms for solving quadratic programming problem	6	
IV	Inventory models – Structure of Inventory system	3	PPT, Chalk and Talk , Assignments and Seminar
	General deterministic problem for one item, one level	3	
	Inventory models with and without shortage	5	
	Multi item deterministic problem	3	
	one level model with one break	2	
V	Queuing theory – Basic characteristics of queuing models	3	PPT, Chalk and Talk , Assignments and Seminar
	Arrival and service distribution	2	
	Steady state solution of M/M/1 and M/M/C models with associated distribution of queue length and waiting time	5	
	M/G/I queue and Pollazeck-Khinchin result	5	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Perform sensitivity analysis to identify the direction and magnitude of change of a linear programming model's optimal solution as the input data change.	Up to K2
CLO-2	Describe the theoretical workings of the solution methods for parametric programming and integer linear programming problems and demonstrate them by solving the problems.	Up to K3
CLO-3	Capability to develop non-linear programming problems.	Up to K3
CLO-4	Explains various cost related to inventory models and develop, extent various deterministic inventory problems to analysis real world systems.	Up to K4
CLO-5	Deep understanding of the theoretical background of queuing systems, apply and extend queuing models to analyse real world systems.	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	3	3	2		2	2
CLO-2	2	2	1	2		2	2
CLO-3	1	2	1	2		2	2
CLO-4	1	2	2	2		2	3
CLO-5	2	2	2	2	2	1	2

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA-I-BluePrint

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 1	Up to K2	2	K1, K1	2	K2, K2	1	K2
CLO 2	Up to K3	3	K2, K2, K3	2	K3 , K3	2	K3, K3
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-I :: Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	46.67%
K2	4	10	10	24	40.00	
K3	2	10	20	32	53.33	53.33%
K4	-	-	-	-	-	-
Total marks	10	20	30	60	100	100

CIA-II–BluePrint

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 3	Up to K3	2	K1, K1	2	K2, K3	2	K2, K3
CLO 4	Up to K4	3	K2, K2, K3	2	K3, K4	1	K4
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-II :: Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25	25.00%
Total marks	10	20	30	60	100	100%

Summative Examination -Blue Print

Units	CLOs	K- Level	SectionA		SectionB		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		ShortAnswers			
			No.of Questions	K- Level	No.of Questions	K-Level		
1	CLO1	Up toK2	2	K1& K1	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up toK3	2	K2& K2	1	K1	2(K2&K2)	1(K3)
3	CLO3	Up toK3	2	K3& K3	1	K2	2(K3&K3)	1(K3)
4	CLO4	Up toK4	2	K3& K4	1	K2	2(K4&K4)	1(K4)
5	CLO5	Up toK4	2	K3& K4	1	K3	2(K4&K4)	1(K4)
No.of Questions to be asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

Distribution of Marks with K Level for Summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total	10	10	50	50	120	100	100

Course Designers:

Dr. R. Madhanagopal

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	C Elective – 2 (A)	21P1SME1 (A)	Actuarial Statistics	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

- To impart basic concepts and terminologies related to actuarial studies
- To develop a greater understanding of statistical principles and their application in actuarial science.

Unit	Description	Hours	K-level	CLO(s)
I	Measures of Mortality:- Life tables and its relation with survival function - life table function at non integer age (fractional ages) – analytical laws of mortality - Gompertz and Makeham's laws of mortality – Select, ultimate and aggregate mortality tables.	16	K2	1
II	Abridged life tables – construction of abridged life tables – methods by Read and Merrell, Greville's, Kings and JIA method. Utility Theory – Insurance and Utility Theory.	16	K4	2
III	Models for individual claims and their sums – multiple life function – joint life status and last survival status.	15	K3	3
IV	Policy Values: Nature of reserve - prospective and retrospective reserves - fractional premiums and fractional durations - modified reserves - Continuous reserves - Surrender values and paid up policies - Industrial assurance - Children's deferred assurances - Joint life and last survivorship.	16	K4	4
V	Pension Funds: Capital sums on retirement and death- widow's pensions - Sickness benefits - Benefits dependent on marriage.	12	K3	5

Books for Reference

1. Barclay G.W. (1970) Techniques of Population Analysis, Wiley, New York.
2. Borowiak, D.S. and Shapiro, A.F. (2013) Financial and Actuarial Statistics: An Introduction, CRC Press, London.
3. Donald, D.W.A. (1970) Compound Interest and Annuities-certain, For The Institute of Actuaries and the Faculty of Actuaries at the University Press.
4. Spurgeon, E.T. (2011) Life Contingencies, Cambridge University Press, Cambridge.
5. Hooker, P.F. Longley, L.H Cook (1957) Life and other contingencies, Cambridge.
6. Alistair Neill (1977) Life contingencies, Heinemann Professional Publishing, Portsmouth.
7. Hossack, I.B. Pollard, J.H. and Zehnwirth, B.(1999) Introductory statistics with

Web references:

1. Measure of Mortality: Life tables
https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004032240235577Anupama_Singh_Mortality_and_its_measures.pdf
2. Gompertz and Makeham's laws of mortality
https://en.wikipedia.org/wiki/Gompertz%E2%80%93Makeham_law_of_mortality
<https://web.stanford.edu/~jhj1/teachingdocs/Jones-mortmodel2005.pdf>
3. Abridged life tables – construction of abridged life tables
https://www.cdc.gov/nchs/data/series/sr_02/sr02_004.pdf
https://www.statsdirect.com/help/survival_analysis/abridged_life_table.htm
4. Policy Values
<https://www.math.umd.edu/~slud/s470/BookChaps/01Book.pdf>
5. https://www.actuariayfinanzas.net/images/sampledData/FundamentalsofActuarialMathematics_S.DavidPromislow2015.pdf

Rationale for Nature of the course

Provides a grounding in mathematical and statistical methods it equips with knowledge of statistical distributions and methods to summarize data.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving on Life tables & premium of insurance

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Measures of Mortality:- Life tables and its relation with survival function - life table function at non integer age.	5	PPT, Chalk and Talk and Assignments
	analytical laws of mortality	6	
	Gompertz and Makeham's laws of mortality – Select, ultimate and aggregate mortality tables.	5	
II	Abridged life tables – construction of abridged life tables	5	PPT, Chalk and Talk and Assignments
	Methods by Read and Merrell, Greville's, Kings and JIA method.	6	
	Utility Theory – Insurance and Utility Theory.	5	
III	Models for individual claims and their sums	5	PPT, Chalk and Talk, Assignments and seminar
	Multiple life function	5	
	Joint life status and last survival status.	5	
IV	Policy Values: Nature of reserve - prospective and retrospective reserves - fractional premiums and fractional durations - modified reserves - Continuous reserves	4	PPT, Chalk and Talk, Assignments and seminar
	Surrender values and paid up policies	4	
	Industrial assurance	4	
	Children's deferred assurances - Joint life and last survivorship.	4	
V	Pension Funds: Capital sums on retirement and death	6	PPT, Chalk and Talk, Assignments and seminar
	widow's pensions - Sickness benefits - Benefits dependent on marriage.	6	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Acquire the knowledge of different lifetime random variables.	Up to K2
CLO-2	Know how to construct life tables and understand different types of insurances.	Up to K4
CLO-3	Knowledge about models for individual claims and their sums.	Up to K3
CLO-4	Calculate quantities such as premiums and reserves using actuarial techniques	Up to K4
CLO-5	Describe, explain and apply the fundamental theories of actuarial science as they apply in pension funds	Up to K3

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1			3		3	2	1
CLO-2		2			3	3	
CLO-3	2		2		3		2
CLO-4		2	2		3		
CLO-5	2	2			2	3	

CIA I – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 1	Up to K2	2	K1 & K2	2	K2,K2	1	K2
2	CLO 2	Up to K4	3	K1 ,K2, K3	2	K3, K4	2	K3,K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	46.67%
K2	4	10	10	24	40	
K3	2	5	10	17	28.33	28.33%
K4	-	5	10	15	25	25%
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA II – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	3	K1,K1, K2	2	K2,K3	2	K2, K3
2	CLO 4	Up to K4	2	K2, K3	2	K3, K4	1	K3
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.34%
K2	4	5	10	19	31.67	
K3	2	10	20	32	53.33	53.33%
K4	-	5	-	5	8.33	8.33%
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

Summative Examination– Blue Print

Unit	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

Course Designers:

- 1. Dr. A. Saberunnisa**
- 2. Dr. M. Rabert**

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	C Elective – 2(B)	21P1SME1 (B)	Data Mining	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To teach principles, concepts and applications of data warehousing and data mining
2. To introduce the task of data mining as an important phase of knowledge recovery process
3. Characterize the kinds of patterns that can be discovered by association rule mining

Unit	Description	Hours	K-level	CLO(s)
I	Introduction: Data mining - Kinds of data – Data mining Functionalities - Classification of Data mining Systems - Major Issues on Data mining - Introduction to OLAP - OLAP technology for Data Mining - Data warehousing - Data warehousing to Data mining - Optimizing Data for mining - Data preprocessing	16	K3	1
II	Data Mining Primitives: Data mining Query language - Association Rules in large - Data mining - KDD Process - Fuzzy sets and logic - Classification and Prediction: Information retrieval - Dimensional Modeling of Data - Pattern Matching - Estimation Error- EM and MLE.	15	K2	2
III	Models based on Summarization: Bayes Theorem - Chi squared Statistics - Regression - Decision Tree - Neural Networks - Genetic Algorithms - Cluster Analysis – Outlier - Cluster Vs Classification - Clustering Issues - Impact of Outliers on clustering- Clustering problems - Clustering Approaches.	17	K3	3
IV	Clustering Algorithms: Hierarchical algorithm – Single Link- MST Single Link - Complete Link - Average Link- Dendrogram - Partitional Algorithm – MST - Squared Error - K-Means - Nearest Neighbor – PAM – BEA – GA - Categorical algorithm - Large Database.	12	K4	4
V	Web Mining: Introduction - Web data - Web Knowledge Mining Taxonomy - Web Content mining - Web Usage Mining Research - Ontology based web mining Research - Web mining Applications.	15	K4	5

Books for Reference:

1. Berry, J.A. and Linoff, G.S. (2011) Data Mining Techniques (3/e), Wiley, New York.
2. Chattamvelli, R. (2009) Data mining Methods, Alpha Science International, Oxford.
3. Dunham, M.H. (2006) Data mining: Introductory and Advanced Topics, Pearson, New Delhi .
4. Gorunescu, F. (2010) Data mining Concepts, Models and Techniques. Springer, New York.
5. Han, J. and Kamber, M (2001) Data Mining Concepts and Techniques, Morgan Kaufmann Publications, Massachusetts.
6. Hand, D. Mannila, H. and Smyth, P (2001) Principles of Data mining, MIT Press, Cambridge.
7. Larose, D.T. (2005) Discovering Knowledge in Data: An Introduction to Data Mining, Wiley, Toronto.
8. Pujari, A.K. (2001) Data Mining Techniques, Universities Press, Hyderabad.
9. Sivanandam S.N. and Sumathi, S (2006) Data Mining Concepts, Tasks and Techniques, Springer, New Delhi.
10. Brieman, L. Friedman, J.H. Olshen, R.A. and Stone, C.J. (1984) Classification and regression trees, Wadsworth & Brooks, California.

Web References:

1. Types of Sources of Data in Data Mining
<https://www.geeksforgeeks.org/types-of-sources-of-data-in-data-mining/>
2. Introduction to OLAP - OLAP technology for Data Mining
https://www.tutorialspoint.com/dwh/dwh_olap.htm
3. Data mining Primitives
http://www.brainkart.com/article/Data-mining-primitives_8311/
4. Neural Network <https://www.getsmarter.com>
5. Web Mining
<https://www.techopedia.com/definition/15634/web-mining>

Rationale for Nature of the course

Analyzes massive volumes of data to discover business intelligence that helps companies solve problems, mitigate risks, and seize new opportunities.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Seminars / Assignments on different algorithms in current scenario

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Introduction, Data mining, Kinds of data, Data mining Functionalities	3	PPT, Chalk and Talk and Assignments
	Classification of Data mining Systems, Major Issues on Data mining	3	
	Introduction to OLAP - OLAP technology for Data Mining	3	
	Data warehousing, Data warehousing to Data mining	4	
	Optimizing Data for mining, Data preprocessing	3	
II	Data mining Query language , Association Rules in large	3	PPT, Chalk and Talk and Assignments
	Data mining, KDD Process, Fuzzy sets and logic	3	
	Classification and Prediction, Information retrieval	3	
	Dimensional Modeling of Data, Pattern Matching	3	
	Estimation Error, EM and MLE	3	
III	Bayes Theorem , Chi squared Statistics	3	PPT, Chalk and Talk, Assignments and seminar
	Regression, Decision Tree, Neural Networks	3	
	Genetic Algorithms , Cluster Analysis , Outlier	3	
	Cluster Vs Classification , Clustering Issues	3	
	Impact of Outliers on clustering	2	
	Clustering problems , Clustering Approaches	3	
IV	Clustering Algorithms, Hierarchical algorithm, single link	2	PPT, Chalk and Talk, Assignments and seminar
	MST Single Link - Complete Link - Average Link	2	
	Dendrogram - Partitional Algorithm	2	
	MST - Squared Error - K-Means	2	
	- Nearest Neighbor – PAM – BEA – GA -	2	
	Categorical algorithm - Large Database	2	
V	Web Mining Introduction , Web data	3	PPT, Chalk and Talk, Assignments and seminar
	Web Knowledge Mining Taxonomy	3	
	Web Content mining	3	
	Web Usage Mining Research	3	
	Ontology based web mining Research, Applications	3	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Explain the concepts of data warehouse and Analyze OLAP tool Analyze the basic functions of data warehouse and data mining.	Up to K3
CLO-2	Compare and evaluate different data mining techniques like classification, prediction and association rule mining	Up to K2
CLO-3	Categorize and carefully differentiate between situations for applying different data-mining techniques: Chi square, Regression, cluster, and outlier analysis.	Up to K3
CLO-4	Evaluate the performance of different data-mining algorithms.	Up to K4
CLO-5	Describe complex data types with respect to web mining	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1				3			2
CLO-2		3	1				
CLO-3		1				2	
CLO-4	3	2	3				
CLO-5						1	3

CIA I – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 1	Up to K3	3	K2, K2,K3	2	K3,K3	2	K3, K3
2	CLO 2	Up to K2	2	K1, K1	2	K2,K2	1	K2
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	46.67%
K2	4	10	10	24	40.00	
K3	2	10	20	32	53.33	53.33%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA II – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	3	K1,K1, K2	2	K3, K3	2	K3, K3
2	CLO 4	Up to K4	2	K2, K3	2	K4, K4	1	K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	13.34%
K2	4	-	-	4	6.67	
K3	2	10	20	32	53.33	53.33%
K4	-	10	10	20	33.33	33.33%
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

Summative Examination – Blue Print

Units	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO -1	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
2	CLO -2	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
3	CLO -3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO -4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO -5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

Course Designers:

1. Dr. M. Venkateswaran
2. Dr. A. Saberunnisa

DEPARTMENT OF STATISTICS				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	NME – I	21P1SNM1	Introduction to Non – Parametric Statistics	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To explore knowledge in the advanced methods of nonparametric inference.
2. To derive inference for samples drawn from distribution free population.

Unit	Description	Hours	K-level	CLO(s)
I	Introduction - Fundamental statistical concept - Run test for randomness, χ_2 goodness of fit test. Kolmogrov – Smirnov one sample test, Kolmogrov – Smirnov two sample test, Binomial test, Point estimator and confidence interval for probability of success.	8	K2	1
II	One sample location problems – Wilcoxon signed rank test. Fishers sign test. Asymptotic test of symmetry – Estimators and confidence interval.	6	K2	2
III	Two sample problems – Wilcoxon rank sum test for location parameter (Mann – Whitney). Test for dispersion parameter – Rank test, Rank like test (Moses), Millers asymptotic test based on Jackknife.	4	K2	3
IV	One way layout – Kruskal Wallis test - Test for ordered alternatives, Multiple comparison based on Kruskal Wallis rank sums. Two way layout - Friedman's rank sums test. Test for ordered alternatives, multiple comparisons.	6	K2	4
V	Kendals test for independence - Theil's test for regression coefficients - Hollander's test for parallelism of two regression lines.	6	K2	5

Books for References:

1. Gibbons (2003), Non parametric Statistical Inference, McGraw –Hill Kogakusha, Ltd.
2. Hollander Myles & Wolfe D.A.(1973) , Non parametric Statistical Methods, John Wiley & Sons.

Web Pages:

1. Introduction of non-Parametric methods:
<https://corporatefinanceinstitute.com/resources/knowledge/other/nonparametric-tests/>

<https://www.yourarticlelibrary.com/statistics-2/non-parametric-tests-concepts-precautions-and-advantages-statistics/92360>

<https://statisticsbyjim.com/hypothesis-testing/nonparametric-parametric-tests/>

<https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/parametric-and-non-parametric-data/>

2. Theil's test:

https://www.youtube.com/watch?v=OqBFv_omR1E

3. Hollander's test for parallelism of two regression lines

<https://ufdc.ufl.edu/AA00025285/00001>

Rationale for Nature of the course

In this course, the basic non-parametric statistical tests are introduced. Explained when non-parametric test should be used and equivalent non-parametric test for most widely used parametric tests such as t – test, ANOVA, correlation etc., and other useful non-parametric test are demonstrated with practical application for real time data.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving sessions with the sample real time data

Pedagogy

Chalk and Talk, PPT, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Introduction - Fundamental statistical concept	1	PPT , Chalk and Talk, Problem solving Interaction
	Run test for randomness, χ^2 goodness of fit	3	
	Kolmogrov – Smirnov one and two sample test	1	
	Binomial test,	2	
	Point estimator and confidence interval for probability of success.	1	
II	Wilcoxon signed rank test	1	PPT , Chalk and Talk, Problem solving Interaction,
	Fishers sign test	1	
	Asymptotic test of symmetry	2	
	Estimators and confidence interval	2	
III	Wilcoxon rank sum test	1	PPT , Chalk and Talk, Problem solving Interaction
	Rank test, Rank like test	1	
	Millers asymptotic test based on Jackknife	2	
IV	Kruskal Wallis test	2	PPT , Chalk and Talk, Problem solving Interaction,
	Kruskal Wallis rank sums	2	
	Friedman's rank sums test	2	
V	Kendals test for independence	2	PPT , Chalk and Talk, Problem solving
	Theil's test for regression coefficients	2	
	Hollander's test for parallelism of two regression lines	2	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Solve hypothesis testing problems where the assumptions for the parametric inferential tools to be applied are not fulfilled. .	Up toK2
CLO-2	Understand the problem associated with skewed data.	Up toK2
CLO-3	Formulate, test and interpret various hypothesis tests for location, scale, and independence problems.	Up toK2
CLO-4	Characterize, compare, and contrast different nonparametric hypothesis tests.	Up toK2
CLO-5	Present and communicate, both orally and in written-form, the results of statistical analyses of nonparametric data	Up toK2

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	2	2	2		2	2
CLO-2	2	2	3	2		2	2
CLO-3	1	2	2	2		2	3
CLO-4	1	1		2	2	2	1
CLO-5	2	1	2	2		2	1

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA-I–BluePrint

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
CLO 2	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

CIA-II – Blue Print

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
CLO 4	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

CIA-II :: Distribution of Section wise Marks with K levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

CLO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination -Blue Print

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Marks with K Level for Summative Examination

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

Course Designers:
Dr. R. Madhanagopal

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Practical – 1	21P1SMP1	Statistical Practical – I	2	4	50	50	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Description	Hours	K-Level	CLO(s)
Distribution Theory Fitting of Distributions	5	K2	1
Operation Techniques Sensitivity Analysis and parametric Programming. Variation in cost vector C. Variation in requirement vector B. Addition of single variable. Deletion of single variable	15	K3	2
Parameterization of the cost vector C. Parameterization of the requirement vector B. Non-Linear Programming Problem: Kuhn-Tucker conditions. All Integer Programming using Gomory's constraint.	15	K3	3
Inventory Control exercises.	10	K4	4
Queueing Models	15	K4	5

Books for reference:

1. Rohatgi, V.K. and Saleh, A.K.M.D.E. (2011) An Introduction to Probability and Statistics, Wiley, New Delhi.
2. Johnson, N. L., Kotz, S., and Balakrishnan, N. (2004). Continuous Univariate Distributions. Vol.I, John Wiley and Sons (Asia), Singapore.
3. Johnson, N.L Kotz, S. and Balakrishnan, N. (2014) Continuous Univariate Distributions, Vol. II. Wiley, Singapore.
4. Mukhopadhyay, P, (2002), Mathematical Statistics, Book and Allied Publishers, New Delhi.
5. Mood, A.M., Graybill, F.A., and Boes, D.C, (1974), Introduction to the Theory of Statistics, Third Edition, McGraw-Hill International Edition.
6. Gass, S.I. (1985) Linear Programming, Methods and Applications. Courier Dover, New York.
7. Gupta, P.K. and Man Mohan. (1979) Operations Research: Linear Programming and Theory of Games, 3/e, Sultan Chand & Sons, New Delhi.
8. Taha, H.A. (2011) Operations Research- An Introduction. 9/e., Prentice Hall, New Delhi.
9. Rao S.S. (1972), Optimization: Theory and Applications, Wiley Eastern (P) Ltd., New Delhi

Web references:

1. Basic probability distributions
https://www.cse.iitk.ac.in/users/piyush/courses/pml_fall17/material/probabilty_tutorial.pdf
2. Continuous Distribution
<http://www.utstat.utoronto.ca/~radford/sta247.F11/IPSUR6.pdf>
3. Linear Programming Simple, Transportation and Assignment Problems:
http://www.phpsimplex.com/en/simplex_method_example.htm
<https://www.youtube.com/watch?v=-YBIR1UF-UY>
4. Sensitivity analysis:
<https://www.youtube.com/watch?v=DNZpiOCdC6w>
<http://web.mit.edu/15.053/www/AMP-Chapter-03.pdf>
5. Inventory models
<http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=90023>
<https://www.youtube.com/watch?v=y2m3-dgtWG0>
6. Queuing theory:
<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2969>
<https://www.youtube.com/watch?v=7EB5A3Iv-xk>

Rationale for Nature of the course

This course helps the students to learn the Resource Techniques with real time problems

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving session using calculator will be conducted. Interpretation on the data and its analysis will be focused lot with real time problems.

Pedagogy :

Chalk and talk, Calculator

Course Learning Outcomes (CLOs)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level
CLO1	Identify the type of statistical situation to which different distributions can be applied.	Up to K2
CLO2	Acquire knowledge of various discrete and continuous probability distributions and their applications in real life problems.	Up to K3
CLO3	Capability to develop non-linear programming problems.	Up to K3
CLO4	Explains various cost related to inventory models and develop, extent various deterministic inventory problems to analysis real world systems.	Up to K4
CLO5	Deep understanding of the theoretical background of queuing systems, apply and extend queuing models to analyse real world systems.	Up to K4

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	2	1	3	3	3		1
CLO2	2	1	3	3	3	1	1
CLO3	1	2	1	2		2	2
CLO4	1	2	2	2		2	3
CLO5	2	2	2	2	2	1	2

Advance application– 3; Intermediate level–2;

Basic level–1

Course Designer

1. Dr.A. Saburnnisa

2. Dr.P. Vetri Selvi

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Practical - 2	21P1SMP2	Statistical Data Analysis with MS-Excel	2	4	50	50	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

The main emphasis of this course is to equip the student with necessary analytic and technical skills to compute the various measures using MS-Excel.

Description	Hours	K-Level	CLO(s)
Functions for basic Statistics: Measure of central tendency: Average – Trimmean – Harmean – Geomean. Location measure of central tendency: Median – Mode. Other location parameters: Maximum, Minimum, Percentiles – Quartiles – Rank Measure of Dispersion: Variance, Standard deviation. Shape of density function: Skewness – Kurtosis	5	K2	1
Probability density functions and Confidence intervals: Normal – Standard Normal – T – F – Chi-square. Beta – Gamma – Exponential – Weibull and Fisher. Binomial – Poisson – Hypergeometric – Negative binomial	10	K3	2
Statistical tools: <i>Basic Statistics:</i> Descriptive statistics – Rank and Percentile – Correlation - Covariance <i>Hypothesis Testing:</i> Parametric: Z test – T test – ANOVA (one and two factor). Non Parametric: Sign test – Run test (one and two samples) – Mann-whitney U test – Kruskal-wallis test – Friedman test	15	K3	3
Predictive analytics: Regression analysis (simple and multiple) – Logistic regression. <i>Time series analysis:</i> Simple moving average – Weighted moving average – Simple exponential smoothing – Holt's linear trend – Holt-winter method – ARIMA – Seasonal ARIMA – ARIMAX	15	K4	4
Multivariate analysis: Hotelling T square tests – MANOVA (one and two factor) – Factor analysis – K-mean cluster – Discriminant analysis – Correspondence analysis	15	K4	5

Books for references

Berk, K.N and Carey, P. Data Analysis with Excel, 3rd edition, Brooks-Cole, Boston, USA (2010).
Guerrero, H. Excel Data analysis Modeling and Simulation, Springer, London (2010).
Conrad Carlberg, Predictive Analytics: Microsoft Excel, 2nd edition, Pearson Education, USA (2018).
Neil H. Spencer , Essentials of Multivariate Data Analysis, 1st Edition, CRC Press, USA (2014)

Webpages

www.real-statistics.com
<https://qymatix.de/en/predictive-sales-analytics-excel-example/>
<http://cameron.econ.ucdavis.edu/excel/ex23normalprobabilities.html>.\$\$\$
<https://www.statisticshowto.com/probability-and-statistics/excel-statistics/>
<https://www.excel-easy.com/>

Rationale for Nature of the course

This computer based course will help the students in developing the data format for spread sheet application and do the appropriate statistical analysis and interpret the outcome obtain in the excel.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Through this course student's data management in the spread sheet, selection and application of appropriate statistics data analysis will be amplified. Students will be employed in data analysis companies.

Pedagogy

Demonstration and Practical session in computer lab.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO1	Perform data calculation using basic statistical functions through Excel	Up to K2
CLO2	Calculate Probability distribution using excel in-build function.	Up to K3
CLO3	Analyze data and estimate optimal parameter using data analysis tools package Add-ins.	Up to K3
CLO4	Compute predictive analysis through excel and give inferences	Up to K4
CLO5	Conduct and interpret the outcome of multivariate analysis using excel – Add-ins.	Up to K4

Mapping close with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	1	2	1	3	1	3
CLO-2	2	1	2	2	3	1	3
CLO-3	2	3	3	3	3	2	3
CLO-4	2	3	3	3	3	2	3
CLO-5	2	3	3	3	3	2	3

Advance application – 3; Intermediate level – 2; Basic level – 1

Course Designer:

1. Dr. R. madhanagopal

M.Sc Statistics - I Year – Second Semester

Course Type	Course Code	Course Title	Hours	Credits
Major Core – 4	21P2SMC4	Measure and Probability Theory	5	4
Major Core – 5	21P2SMC5	Statistical Estimation Theory	5	4
Major Core – 6	21P2SMC6	Sampling Techniques	5	4
Major Core Elective - 2	21P2SME2 (A) / 21P2SME2 (B)	Reliability Theory and Survival Analysis / Time series analysis	5	4
NME – 2	21P2SNM2	Industrial Statistics	2	2
Practical – 3	21P2SMP3	Statistical Practical - II (calculated based)	4	2
Practical – 4	21P2SMP4	Statistical Data Analysis using SPSS	4	2
Total number of hours and credits			30	22

Semester wise Mapping of Course with Programme Outcomes (POs)

	Course Type	Major Core– 4	Major Core–5	Major Core–6	Major Core Elective-2	Major Core Elective-2	Practical-3	Practical–4
	Course Title	Measure and Probability Theory	Statistical Estimation Theory	Sampling Techniques	Reliability Theory and Survival Analysis	Time series analysis	Statistical Practical - II (calculated based)	Statistical Data Analysis using SPSS
GR ADUATE ATTRIBUTES PROGRAM OUTCOMES (POS)	PO1	3	3	3	3	3	2	3
	PO2	2	2	3	3	3	3	2
	PO3	3	3	3	3	3	2	3
	PO4	2	3	3	3	3	3	3
	PO5	3	3	3	3	3	1	3

3- Advance Application 2- Intermediate Level 1- Basic Level

Semester wise Mapping of Course with Programme Specific Outcomes (PSOs)

	Course Type	Major Core-4	Major Core-5	Major Core-6	Major Core Elective-2	Major Core Elective-2	Practical-3	Practical-4
	Course Title	Measure and Probability Theory	Statistical Estimation Theory	Sampling Techniques	Reliability Theory and Survival Analysis	Time series analysis	Statistical Practical - II (calculated based)	Statistical Data Analysis using SPSS
GRADUATE ATTRIBUTES PROGRAM OUTCOMES (POS)	PSO1	3	3	3	3	3	2	3
	PSO2	3	3	3	3	3	2	2
	PSO3	2	2	3	3	3	2	3
	PSO4	3	2	3	3	3	2	3
	PSO5	1	1	2	3	3	3	3
	PSO6	2	1	2	1	1	1	1
	PSO7	1	2	3	3	3	2	3

3- Advance Application 2- Intermediate Level 1- Basic Level

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core -4	21P2SMC4	Measure and Probability Theory	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To gain the knowledge on Set theory, limits, probability and inequalities
2. To connect between probability theory and other branches of mathematics in particular measure theory, complex and functional analysis

Unit	Description	Hours	K-level	CLO(s)
I	Limit Superior, Limit inferior and limit of a sequence of sets – Field and Sigma field - Monotone class – Functions and inverse functions – Borel field – Countable and finitely additive set function – Measurable space – Measure space – Measure, Properties of Measure. Lebesgue – Steiltjes measure – Lebesgue measure. Measurable function, Simple function. Concept of almost everywhere. Approximation theorem (statement only).	17	K2	1
II	Measure Integral – Properties – Monotone convergence theorem – Fatou's lemma – Dominated convergence theorem (statement only) – Absolute continuity of two measures – Radon-Nykodym theorem (statement only). Product sets and Fubini's theorem (statement only).	15	K3	2
III	Probability measure – Random variable – distribution function – Expectation – inequalities – Jensen, Basic, Cauchy-Schwartz. Conditional probability - Conditional expectation – Independence of random variables – Borel-Cantelli Lemma – Kolmogorov Zero – one law.	16	K4	3
IV	Convergence of random variables – almost sure, in law, in probability, in rth mean and their interrelations – Characteristic function – Inversion formula, Convergence of distribution functions and characteristic functions – Helly-Bray theorem – Continuity theorem, Uniqueness theorem.	13	K4	4
V	Law of large numbers – Weak law of large numbers – Kolmogorov's strong law of large numbers – Glivenko – Cantelli Theorem – Central limit theorems – de-Moivre's – Laplace Theorem, Lindeberg–Cramer - Levy theorem, Liapounov's theorem.	14	K4	5

Books for Reference:

1. De Barra, G. (1987) Measure Theory and Integration, Wiley Eastern, New Delhi.
2. Tucker, H.G. (1967) A Graduate Course in Probability, Academic Press, New York.
3. Munroe, M.E. (1965) Measure and Integration, Addison & Wesley, New York.
4. Bhat B. R, (2014), Modern Probability Theory (Fourth Edition), New Age International, New Delhi (Reprint 2015).
5. Ash, B.R, (1972), Real Analysis and Probability, Academic Press, New York.
6. Billingsley P, (2012), Probability and Measure (Third Edition), John Wiley & Sons, New York.
7. Chow, Y.S. and Teicher, H, (2012), Probability Theory; Independence, Interchange ability, Martingales (Second Edition). Springer Limited.
8. Feller, W. (1972), An Introduction to Probability Theory and Its Applications, Volume II, John Wiley & Sons, New York. (Reprint, 2008).
9. Loe 've, M. (1978), Probability Theory (Fourth Edition), Springer-Verlag, New York.
10. Rana, I.K. (2005), An Introduction to Measure and Integration (Second Edition), Morgan & Claypool.
11. Rohatgi, V.K. and Saleh, A.K.Md.E. (2011), An Introduction to Probability and Statistics (Second Edition). John Wiley & Sons, New York.
12. Ross, S.M (2010). A First Course in Probability. Pearson Prentice Hall.

Web references:

1. Measure & Probability: <https://nptel.ac.in/courses/111/101/111101100/#>
2. Law of Large Numbers: <https://www.youtube.com/watch?v=VpuN8vCQ--M>
3. Central Limit Theorem: <https://www.youtube.com/watch?v=JNm3M9cqWyc>
4. <https://www.youtube.com/watch?v=YAIJCEDH2uY>
5. Inequalities in Probability: <https://www.youtube.com/watch?v=nrDkb2MAwSA>
6. <https://www.youtube.com/watch?v=DWsDqKlW7Z4>

Rationale for Nature of the course

This course introduces measure theory in a rigorous way and explores some applications to probability theory. Both of these are core mathematical disciplines. In addition, the knowledge of probability theory provided in this course is essential basis for further courses in mathematical finance.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Exercise problems relate to probability or chance based given on realtime situations

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Limit Superior, Limit inferior and limit of a sequence of sets	3	PPT, Chalk and Talk and Assignments
	Field and Sigma field	2	
	Monotone class – Functions and inverse functions	3	
	Borel field	1	
	Countable and finitely additive set function – Measurable space – Measure space – Measure, Properties of Measure	2	
	Lebesgue – Steiltjes measure – Lebesgue measure	2	
	Measurable function, Simple function. Concept of almost everywhere	2	
	Approximation theorem (statement only).	2	
II	Measure Integral – Properties	3	PPT, Chalk and Talk and Assignments
	Monotone convergence theorem – Fatou's lemma	4	
	Dominated convergence theorem (statement only)	3	
	Absolute continuity of two measures	2	
	Radon-Nykodym theorem (statement only). Product sets and Fubini's theorem (statement only).	3	
III	Probability measure	2	PPT, Chalk and Talk, Assignments and seminar
	Random variable –distribution function Expectation	3	
	inequalities – Jensen, Basic, Cauchy-Schwartz.	3	
	Conditional probability - Conditional expectation	4	
	Independence of random variables	2	
	Borel-Cantelli Lemma – Kolmogorov Zero – one law	2	
IV	Convergence of random variables – almost sure, in law, in probability, in rth mean and their interrelations —	4	PPT, Chalk and Talk, Assignments and seminar
	Characteristic function – Inversion formula	2	
	Convergence of distribution functions and characteristic functions	3	
	Helly-Bray theorem	2	
	Continuity theorem, Uniqueness theorem. State Integrated Board of Studies – Statistics PG	2	
V	Law of large numbers	2	PPT, Chalk and Talk, Assignments and seminar
	Kolmogorov's strong law of large numbers-Glivenko	2	
	Cantelli Theorem – Central limit theorems de-Moivre's	3	
	Weak law of large numbers - Laplace Theorem	3	
	Lindeberg-Cramer - Levy theorem,	2	
	Liapounov's theorem.	2	

Course Learning Outcomes

On the successful completion of the course, students attain

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	The knowledge on function, limit and set theory	Up to K2
CLO-2	The knowledge on Measure integral and to apply convergence theorem	Up to K3
CLO-3	To derive the inequalities and apply the probability in distributions	Up to K3
CLO-4	To identify the convergence of sequences/situations	Up to K4
CLO-5	To apply the law of large numbers and central limit theorem in the real time situations	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	2	3	2		2	2
CLO-2	1	2	1	2		1	2
CLO-3	1	3	2	2		2	2
CLO-4	1	2	2	2		1	2
CLO-5	1	1	2	2	2	2	2

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA - I - BLUE PRINT

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 1	Up to K2	3	K1, K1, K2	2	K1, K2	1	K2
CLO 2	Up to K3	2	K2, K3	2	K2 , K3	2	K3, K3
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	5	-	9	15.00	55%
K2	4	10	10	24	40.00	
K3	2	5	20	27	45.00	45%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA-II – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	2	K1, K2	2	K2, K3	1	K3
2	CLO 4	Up to K4	3	K1, K2,K3	2	K3, K4	2	K2, K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25	25%
K5	-	-	-	-	-	-
Total marks	10	20	30	60	100	100

Summative Examination– Blue Print

S.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Question s	K-Level	No. of Questions	K- Level			
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)	
2	CLO 2	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of sectionwise marks with K levels for Summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	33.33%
K2	2	2	10	10	24	20.00	
K3	4	4	10	20	38	31.67	31.67%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total	10	10	50	50	120	100	100

Course Designers:

1. Dr. M. Venkateswaran
2. Dr. M. Rabert

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core – 5	21P2SMC5	Statistical Estimation Theory	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To make the students acquainted with the classical approach of the inferential procedure for drawing conclusions from the data while allowing for random variation
2. To forming the foundations of the basic elements if statistical inference, viz. point estimation and interval estimation

Unit	Description	Hours	K-level	CLO(s)
I	Parametric point estimation. Consistency – weak consistency, consistency in rth mean, strong consistency, sufficient conditions for consistency. Efficiency of estimators. Sufficient statistics – Factorization theorem, Distributions admitting sufficient statistic, procedure for finding minimal sufficient statistic.	15	K2	1
II	Unbiased estimator. Uniformly minimum variance unbiased estimator (UMUE) - necessary and sufficient conditions for an unbiased estimator to be UMVUE; Completeness and boundedly completeness; relationship between complete statistic and minimal sufficient statistic; Rao-Blackwell theorem, Lehmann-Scheffe theorem, Basu's theorem. Information inequality – Cramer-Rao (CR) inequality, Kiefer-Chapman-Robbins (KCR) inequality, Bhattacharya inequality.	16	K3	2
III	Methods of point estimation – Method of Moments, Method of Maximum Likelihood. Method of scoring, EM algorithm. Method of minimum chi-square, Method of modified minimum chi-square. Properties of these estimators (both large and small samples).	12	K3	3
IV	Interval estimation – Fundamental notions of interval estimation, applications of Chebychev's inequality. Shortest length confidence intervals and their construction. Construction of confidence intervals applying maximum likelihood estimator and central limit theorem.	14	K4	4
V	Bayes estimation – concept of prior, posterior distributions. Conjugate and non-informative priors. Bayes estimator under quadratic error loss function – Elementary notions of minimax estimation – application.	18	K4	5

Books for Reference:

1. Rajagopalan M and Dhanavanthan P, (2012), Statistical Inference, PHI Learning Pvt. Ltd., New Delhi.
2. Rohatgi, V.K and Saleh, A.K.Md.E, (2011), An Introduction to Probability and Statistics Second Edition, John Wiley & Sons, New York.
3. Mukhopadhyay, P, (2002), Mathematical Statistics, Book and Allied Publishers, New Delhi.
4. Lehmann, E.L. and Casella, G. (1998) Theory of Point Estimation, 2/e, Springer, New York.
5. Casella G and Berger R L, (2002). Statistical Inference, Second Edition, Thompson Learning, New York. (Reprint, 2007).
6. Goon, A M, Gupta M.K and Dasgupta B, (1989), An Outline of Statistical Theory, Vol. II, World Press, Kolkata.
7. Bansal, A.K, (2007), Bayesian Parametric Inference, Narosa Publishing House, New Delhi.
8. Mood A.M, Graybill F.A and Boes D.C, (1974), Introduction to Theory of Statistics, Third Edition, McGraw-Hill International Edition.
9. Berger, J.O, (1985), Statistical Decision Theory and Bayesian Analysis, Second Edition, Springer Verlag, New York.
10. Kale, B.K, (2005), A First Course in Parametric Inference, Second Edition, Narosa Publishing House, New Delhi. (Reprint, 2007).
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12. Keith, K, (2000), Mathematical Statistics, Chapman and Hall/CRC, New York.
13. Rao, C.R, (2009), Linear Statistical Inference and Its Applications, Second Edition, John Wiley & Sons, New York, US.
14. Santhakumaran A. (2004), Probability Models and their Parametric Estimation, K.P. Jam Publication, Chennai.

Web references:

1. Point Estimation
<http://web.mit.edu/14.381/www/Estimation.pdf>
2. Unbiased estimator
https://www.math.arizona.edu/~jwatkins/N_unbiased.pdf
3. Properties of Point Estimators and Methods of Estimation
http://www.utstat.toronto.edu/~olgac/sta255_2013/notes/sta255_Lecture9.pdf
4. Interval estimation
<http://www.yorku.ca/ptryfos/ch5000.pdf>
5. Prior and posterior distributions
https://www.probabilitycourse.com/chapter9/9_1_1_prior_and_posterior.php

Rationale for Nature of the course

The course provides knowledge to identify various types of estimators and their properties. The student estimates the result using various methodology in estimators.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving on estimation and its properties

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Consistency – weak consistency, consistency in r^{th} mean, strong consistency, sufficient conditions for consistency	5	PPT, Chalk and Talk and Assignments
	Efficiency of estimators – Properties	5	
	Sufficient statistics – Factorization theorem, Distributions admitting sufficient statistic, procedure for finding minimal sufficient statistic.	5	
II	Unbiased estimator. Uniformly minimum variance unbiased estimator (UMUE) - necessary and sufficient conditions for an unbiased estimator to be UMVUE	4	PPT, Chalk and Talk and Assignments
	Completeness and boundedly completeness; relationship between complete statistic and minimal sufficient statistic	4	
	Rao-Blackwell theorem, Lehmann-Scheffe theorem, Basu's theorem.	4	
	Information inequality – Cramer-Rao (CR) inequality, Kiefer-Chapman-Robbins (KCR) inequality, Bhattacharya inequality.	4	
III	Methods of point estimation – Method of Moments, Method of Maximum Likelihood	3	PPT, Chalk and Talk, Assignments and seminar
	Method of scoring, EM algorithm. Method of minimum chi-square	3	
	Method of modified minimum chi-square.	3	
	Properties of these estimators (both large and small samples)	3	
IV	Interval estimation – Fundamental notions of interval estimation, applications of Chebychev's inequality.	5	PPT, Chalk andTalk, Assignments and seminar
	Shortest length confidence intervals and their construction.	4	
	Construction of confidence intervals applying maximum likelihood estimator and central limit theorem.	5	
V	Bayes estimation – concept of prior, posterior distributions.	5	PPT, Chalk and Talk, Assignments and seminar
	Conjugate and non-informative priors.	4	
	Bayes estimator under quadratic error loss function	5	
	Elementary notions of minimax estimation – application.	4	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Properties of point estimator such Consistency, Unbiasedness, Sufficiency	Up to K2
CLO-2	Obtain minimum variance unbiased estimator	Up to K3
CLO-3	Obtain estimators using methods of estimation.	Up to K3
CLO-4	Acquire the knowledge of Interval estimation and Construct Confidence Interval	Up to K4
CLO-5	Inferring the concepts of Bayes estimation in different fields of applications	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2		2	2	2	1	2
CLO-2			2	2	2	1	2
CLO-3		3	2	2	2	1	2
CLO-4	3	3	2	2	2	1	2
CLO-5	3	3	2	2	2	1	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

CIA I – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 1	Up to K2	2	K1 , K2	2	K1,K2	1	K2
2	CLO 2	Up to K3	3	K1, K2,K3	2	K2,K3	2	K3, K3
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K –Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	5	-	9	15.00	55%
K2	4	10	10	24	40.00	
K3	2	5	20	27	45.00	45%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA II – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	2	K1,K2,	2	K1,K2	1	K3
2	CLO 4	Up to K4	3	K1, K2, K3	2	K3,K4	2	K3,K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA –II :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	5	-	9	15.00	30%
K2	4	5	-	9	15.00	
K3	2	5	20	27	45.00	45%
K4	-	5	10	15	25.00	25%
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

Summative Examination – Blue Print

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

Course Designers:

1. Dr.P. Vetri Selvi
2. Dr. A. Saberunnisa

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core-6	21P2SMC6	Sampling Techniques	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

- To define the concept of population under study
- To study various sampling methods, determination of the sample size and the application of sampling techniques in various disciplines.

Unit	Description	Hours	K-level	CLO(s)
I	(Simple random sampling, stratified random sampling and systematic sampling methods. Estimation of essential population characteristics. Not for Examination for knowledge purpose only) Ratio Estimator: Approximate variance – Confidence limits – Comparison of the Ratio estimator with mean per unit – Conditions under which Ratio estimator is a BLUE – Bias term – Separate and combined ratio estimators – Unbiased Ratio Type estimator (Hartley and Ross). Regression Estimators – Regression estimates with pre assigned “b” – sample estimate of variance – Bias – Regression estimators in Stratified Sampling.	18	K3	1
II	Varying probability sampling: Cumulative total method and Lahiri’s method. Estimation in PPS sampling with replacement, and without replacement; General selection procedures, Narian’s Scheme of sample selection and Sen-Midzuno method – Ordered estimator: Des Raj, Unordered estimators: Hurwitz – Thompson estimator and Murthy’s estimator.	16	K3	2
III	Cluster Sampling: Equal cluster sampling – Estimators of mean and variance, optimum cluster size, Unequal cluster sampling – Estimators of mean and variance, varying probability cluster sampling.	12	K4	3
IV	Two stage sampling – variance of the estimated mean. Multiphase sampling: Double sampling for stratification – Optimum allocation – Estimated variance in Double sampling for stratification.	15	K4	4
V	Sources of errors in Surveys – A mathematical model of the effects of call-backs – a mathematical model of the errors of measurement – Interpenetrating subsampling method.	13	K2	5

Books for Reference:

1. Singh, D and Choudhary, F.S. (1977) Theory and Analysis of Sample Survey Designs. Wiley Eastern, New Delhi.
2. Cochran, W.G, (2007), Sampling Techniques, Third Edition, John Wiley & Sons, New Delhi.
3. Ardilly, P. and Yves T. (2006) Sampling Methods: Exercise and Solutions. Springer, New York.
4. Desraj (1976) Sampling Theory, McGraw Hill, New York.
5. Mukhopadhyay, P. (2007) Survey Sampling. Narosa, New Delhi.
6. Sukhatme, P.V. and Sukhatme, B.V. (1970) Sampling Theory Surveys with Applications, 2/e, Iowa State University Press, Iowa.
7. Kish, L. (1961) Survey Sampling, Wiley, New York.
8. Murthy, M.N (1997) Sampling Theory and methods, Statistical Publishing Society, Calcutta.
9. Thompson, S.K, (2012), Sampling, John Wiley and Sons, New York.
10. Sampath S (2001), Sampling Theory and Methods, The new age international ltd. New Delhi.

Web references:

1. sampling methods
<https://uca.edu/psychology/files/2013/08/Ch7-Sampling-Techniques.pdf>
http://iced.cag.gov.in/wp-content/uploads/C-07/SAMPLING_TECHNIQUES.pdf
2. Ratio Estimator
http://182.18.165.51/Fac_File/STUDY183@323405.pdf
3. Regression Estimators
<https://nptel.ac.in/content/storage2/courses/111104073/Module6/Lecture20.pdf>
<http://home.iitk.ac.in/~shalab/sampling/chapter6-sampling-regression-method-estimation.pdf>
4. Varying probability sampling
http://150.107.117.36/NPTEL_DISK4/NPTEL_Contents/Web_courses/Phase2_web/111104073/Module7/Lecture24.pdf
<https://nptel.ac.in/content/storage2/courses/111104073/Module7/Lecture23.pdf>
5. Cluster Sampling
<https://nptel.ac.in/content/storage2/courses/111104073/Module9/Lecture30.pdf>
<http://home.iitk.ac.in/~shalab/sampling/chapter9-sampling-cluster-sampling.pdf>
6. Two stage sampling
<http://home.iitk.ac.in/~shalab/sampling/chapter10-sampling-two-stage-sampling.pdf>
<https://nptel.ac.in/content/storage2/courses/111104073/Module10/Lecture33.pdf>
7. Sources of errors in Surveys
<http://web.hku.hk/~plhyu/7006/chap3.pdf>

Rationale for Nature of the course

Statistical Techniques provide scientific approaches to develop the domain of human knowledge largely through empirical studies.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Seminars on Data collection with issues in the field work and decision of sample size

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Simple random sampling, stratified random sampling and systematic sampling methods. Estimation of essential population characteristics.	5	PPT, Chalk and Talk and Assignments
	Ratio Estimator	3	
	Regression Estimators	4	
	Regression estimates with pre assigned “b” – sample estimate of variance – Bias	3	
	Regression estimators in Stratified Sampling	3	
II	Varying probability sampling- Cumulative total method and Lahiri’s method	4	PPT, Chalk and Talk and Assignments
	Estimation in PPS sampling with replacement, and without replacement	4	
	General selection procedures, Narian’s Scheme of sample selection and Sen-Midzuno method	4	
	Ordered estimator: Des Raj, Unordered estimators: Hurwitz – Thompson estimator and Murthy’s estimator	4	
III	Cluster Sampling: Equal cluster sampling – Estimators of mean and variance, optimum cluster size	6	PPT, Chalk and Talk, Assignments and seminar
	Unequal cluster sampling – Estimators of mean and variance, varying probability cluster sampling.	6	
IV	Two stage sampling – variance of the estimated mean.	3	PPT, Chalk andTalk,
	Multiphase sampling; Double sampling for stratification.	2	
	Optimum allocation	3	
	Estimated variance in Double sampling for stratification.		
V	Sources of errors in Surveys – A mathematical model of the effects of call-backs	2	PPT, Chalk and Talk, Assignments
	mathematical model of the errors of measurement	3	
	Interpenetrating subsampling method.	3	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO’s	Course Learning Outcomes	Knowledge
CLO-1	Use practical applications of ratio and regression method of	Up to K3
CLO-2	Apply varying probability sampling viz. PPSWR, PPSWOR including Lahiri’s method and Murthy’s estimator for survey.	Up to K3
CLO-3	Implement Cluster sampling for equal and unequal sampling	Up to K4
CLO-4	Discuss and estimate two stage sampling and multiphase sampling	Up to K4
CLO-5	Define and distinguish errors in survey	Up to K2

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	3	2	1	1	2	2
CLO-2	2	3	2			2	2
CLO-3	2	3	2	1	1	2	2
CLO-4	2	3	2			2	2
CLO-5	2	2	2			3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

CIA I – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 1	Up to K3	2	K1 , K2	2	K2, K3	1	K3
2	CLO 2	Up to K3	3	K1, K2,K3	2	K2, K3	2	K2, K3
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-I :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	46.67%
K2	4	10	10	24	40.00	
K3	2	10	20	32	53.33	53.33%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total marks	10	20	30	60		

CIA II – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	3	K1, K1, K2	2	K3,K2	2	K2, K3
2	CLO 4	Up to K4	2	K2, K3	2	K3, K4	1	K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25.00	25%
K5	-	-	-	-	-	-
Total marks	10	20	30	60	100	

Summative Examination Blue Print

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K3	2	K2& K3	1	K2	2(K2& K3)	1(K3)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K1	2(K4 & K4)	1(K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

Course Designers:

1. Dr. P. Vetri Selvi
2. Dr. A. Saberunnisa

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	C-Elective-I	21P2SME2 (A)	Reliability Theory and Survival Analysis	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. Students are able to understand the concepts of Reliability, Survival analysis and its applications.
2. Students able to apply the Survival analysis using various distributions.

Unit	Description	Hours	K-level	CLO(s)
I	Reliability concepts and measures; components and systems; coherent systems; reliability fcoherent systems; cuts and paths; modular decomposition; boundson system reliability; structural and reliability importance of components.	15	K2	1
II	Life distributions; reliability function; hazardrate; common life distributions exponential, Weibull, Gamma, etc. Estimation of parameters and tests in these models.	13	K3	2
III	Reliability growth models; probability plotting techniques; Hollander-Proschan and Deshpande tests for exponentiality – Basic idea so accelerated life testing. Concepts of time, Order and random Censoring, likelihood in these cases.	16	K3	3
IV	Life tables, failure rate, mean residual life and their elementary properties. Ageing classes and their properties, Bathtub Failure rate. Estimation of survival function Actuarial Estimator, Kaplan-Meier Estimator. Estimation under the assumption of IFR/DFR. Tests of exponentiality against non- parametric classes.Total time on test, Deshpandetest.	16	K4	4
V	Two sample problem-Gehan test, Logranktest. Mantel-Haenszeltest, Tarone Ware tests. Semi-parametric regression Cox proportional hazards model with one and several convariates. Rank test for the regression coefficients. Competing risks model, parametric and non-parametric inference for this model. Multiple decrement life table.	15	K4	5

Books for Reference:

1. Barlow R.E. and Proschan F. (1985) Statistical Theory of Reliability and Life Testing, To Begin with, Silver Spring.
2. Lawless J.F. (1982) Statistical Models and Method sof Life Time Data, Wiley, New York.
3. BainL.J. and Engelhardt, M. (1991) Statistical Analysis of Reliability and Life
4. Testing Models, Marcel Dekker, New York.
5. Nelson,W. (1982) Applied Life Data Analysis, Wiley, New York.
6. Zacks,S. (1995) Reliability Analysis, Springer, New York.
7. Miller,R.G.(1981) Survivalanalysis, Wiley, New York.Cox,D.R.andOakes,D.(1984) AnalysisofSurvivalData,Chapman&Hall,New York.
8. Gross,A.J.andClark,V.A.(1975)Survival distribution: Reliability applications in the Biomedical Sciences,Wiley, New Delhi.
9. Kalbfleisch,J.D.andPrentice,R.L.(1980)The Statistical Analysis of FailureTimeData,Wiley, New York .
10. Lawless,J.F.(1982)Statistical Models and Methods of LifeTimeData,Wiley, New York.

Web references:

1. Reliability: <https://nptel.ac.in/courses/105/108/105108128/>
2. Hazard Rate: <https://www.youtube.com/watch?v=RvWxh4Bk0lc>
3. Residuals in Reliability: <https://www.youtube.com/watch?v=yMgFHbjbAW8>
4. <https://www.youtube.com/watch?v=xnAuIbiLS8Y>
5. https://www.youtube.com/watch?v=vX3l36ptrTU&list=PLqzoL9-eJTNDdnKvvp_YHIwk2AMqHhuJ0

Rationale for Nature of the course

- The course provides the knowledge on evaluation of the life time of a product and its related distributions.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

- Problem solving on Reliability i.e. Life time of a product with suitable distributions

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Reliability concepts and measures	3	PPT, Chalk and Talk and Assignments
	components and systems	2	
	coherent systems; reliability fcoherent systems	2	
	cuts and paths	2	
	modular decomposition; boundson system reliability	3	
	structural and reliability importance of components	2	
	Real time applications	1	
II	Life distributions;;;;	2	PPT, Chalk and Talk and Assignments
	reliability function	3	
	Hazardrate	1	
	common life distributions exponential, Weibull, Gamma, etc.	4	
	Estimation of parameters and tests in these models.	3	
III	Reliability growth models	3	PPT, Chalk and Talk, Assignments
	probability plotting techniques	3	
	Hollander-Proschan and Deshpande tests for exponentiality	4	
	Basic idea so accelerated life testing	3	
	Concepts of time, Order and random Censoring, likelihood in these cases.	3	
IV	Life tables	2	PPT, Chalk and Talk, Assignments and seminar
	failure rate, mean residual life and their elementary properties	3	
	Ageing classes and their properties	3	
	Bathtub Failure rate	1	
	Estimation of survival function Actuarial Estimator, Kaplan- Meier Estimator.	2	
	Estimation under the assumption of IFR/DFR.	2	
	Tests of exponentiality against non- parametric classes.	2	
	Total time on test, Deshpandetest.	1	
V	Two sample problem-Gehan test, ,,	2	PPT, Chalk and Talk, Assignments and seminar
	Logranktest. Mantel-Haenszel test	3	
	Tarone Ware tests. Semi-parametric regression	2	
	Cox proportional hazards model with one and several convariates	3	
	Rank test for the regression coefficients.	1	
	Competing risks model	2	
	parametric and non-parametric inference for this model.	1	
	Multiple decrement lifetable.	1	

Course Learning Outcomes

On the successful completion of the course, students attain

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	To gain the knowledge on Reliability and its conceptual measures	Up to K2
CLO-2	To study the life distribution and estimation of parameters	Up to K3
CLO-3	To built the growth models with its properties	Up to K3
CLO-4	To analyze the Life tables through various estimators	Up to K4
CLO-5	To study the risk models and its applications	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	1	1		1	1	2
CLO-2	1	2	3		1	2	1
CLO-3	1	3	1		1	2	1
CLO-4	1	1	2		2	2	1
CLO-5	1	2	1		1	2	2

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA-I BLUE PRINT

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 1	Up to K2	2	K1, K2	2	K1, K2	1	K2
CLO 2	Up to K3	3	K1, K2,K3	2	K2 , K3	2	K3, K3
No. of questions to be		5		4		3	
No. of question to be		5		2		2	
Marks for each question		2		5		10	
Total marks for each		10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	5	-	9	15	55%
K2	4	10	10	24	40	
K3	2	5	20	27	45	45%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA-II Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	2	K1 , K2	2	K2, K3	2	K2, K3
2	CLO 4	Up to K4	3	K1, K2,K3	2	K3, K4	1	K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25	25%
K5	-	-	-	-	-	-
Total marks	10	20	30	60		

Summative Examination Blue Print

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K- Level			
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)	
2	CLO 2	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of section wise marks with K levels for Summative Examination

K – Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	33.33
K2	2	2	10	10	24	20.00	
K3	4	4	10	20	38	31.67	31.67
K4	2	-	20	20	42	35	35
K5	-	-		-			
Total	10	10	50	50	120	100	100

Course Designers:

1. Dr. M. Venkateswaran
2. Dr. M. Rabert

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	C – Elective - II	21P2SME2 (B)	Time Series Analysis	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To introduce the statistical techniques to evaluate processes occurring through time.
2. To teach students to understand, identify and acquire the necessary skills to create and analysis the time series data.

Unit	Description	Hours	K-level	CLO(s)
I	Models of Time Series – Additive and Multiplicative models – Analysis and forecasting – Elimination of trend – growth curve – Modified experimental curve (Method of three selected points only) - Gompertz curve- Logistic curve with examples.	12	K2	1
II	Stationary processes – Auto-covariance and autocorrelation functions and their properties – partial auto correlation function - Estimation of autocorrelation and its standard error – unit root test.	13	K3	2
III	Linear stationary models - stationary and invertability - Autoregressive and Moving average processes and their autocorrelation functions- Autoregressive moving average processes. Linear non-stationary models - Autoregressive integrated moving average processes – integrated moving average processes and Seasonal Autoregressive integrated moving average processes.	17	K3	3
IV	Box-Jenkins models: Identification techniques - Initial estimates for different processes –AR, MA, ARMA - choice between stationary and non stationary models – model diagnostic - model multiplicity - Study of residuals and diagnostic checking - Use of computer packages for the above techniques.	19	K4	4
V	Introduction to spectral analysis of weakly stationary processes - periodogram and correlogram analysis including computations based on Fourier transform. Use of spectral representation to show the existence of autoregressive processes and their representation as one-sided moving average processes.	14	K4	5

Books for Reference:

1. Anderson, T. W. (2011) The Statistical Analysis of Time Series, Wiley, New York.
2. Bloomfield, P. (2004) Fourier analysis of Time Series - An Introduction, 2/e, Wiley, New York.
3. Box, G. E. P. and Jenkins, G.M. and Reinsel, G.C. (2013) Time Series Analysis - Forecasting and Control, 4/e, Holden- Day, San Francisco.
4. Brockwell, P. J. and Davis, R. A. (2002) Introduction to Time Series and Forecasting. Taylor & Francis, San Francisco.
5. Chatfield, C. (1978) The Analysis of Time Series - Theory and Practice, 3/e Chapman & Hall, London.
6. Gupta, S. C. and Kapoor, V.K. (2007) Fundamentals of Applied Statistics, 4/e, Sultan Chand & Sons, New Delhi.
7. Hannan, E. J. (1960) Time Series Analysis, Methuen, London.
8. Kendall, M. G. and Stuart, A. (1976) The advanced Theory of Statistics, Vol.3, Charles Griffin, London.
9. Kendall, M. G. (1974) Time Series. Charles Griffin, London.
10. Koopmans, L. H. (1995) The spectral analysis of Time Series. Academic Press, New York
11. Montgomery, D. C. and Johnson, L. A. (1977) Forecasting and Time Series analysis. McGraw Hill, New York.
12. Priestley, M. B. (1981) Spectral analysis and Time Series. Griffin, London.

Web Resources:

1. Introduction to time series:
<https://www.itl.nist.gov/div898/handbook/pmc/section4/pmc4.htm>
2. Stationary process:
<https://www.youtube.com/watch?v=r98eALg-suE>
<https://towardsdatascience.com/stationarity-in-time-series-analysis-90c94f27322>
3. Seasonal ARIMA
<https://people.duke.edu/~rnau/411arim.htm>

Rationale for Nature of the course

- The course provides the knowledge on the forecasting techniques with suitable ARIMA models by analyzing the old data.
- The course identifies the best model to forecast the data

Activities having direct bearing on Skill development / Employability / Entrepreneurship

- Fitting suitable time series models to real time problems

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Models of Time Series – Additive and Multiplicative models	3	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	Analysis and forecasting – Elimination of trend	2	
	growth curve – Modified experimental curve	2	
	Gompertz curve	2	
	Logistic curve	3	
II	Stationary processes	3	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	Auto-covariance and autocorrelation functions and their properties	3	
	partial auto correlation function	3	
	Estimation of autocorrelation and its standard error – unit root test.	4	
III	Linear stationary models	2	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	stationary and invertability	3	
	Autoregressive and Moving average processes and their autocorrelation functions	2	
	Autoregressive moving average processes	3	
	Linear non-stationary models	2	
	Autoregressive integrated moving average processes	3	
	integrated moving average processes	2	
	Seasonal Autoregressive integrated moving average processes	4	
IV	Box-Jenkins models: Identification techniques	2	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	Initial estimates for different processes –AR, MA, ARMA	3	
	choice between stationary and non stationary models	2	
	model diagnostic	3	
	model multiplicity	3	
	Study of residuals and diagnostic checking	2	
	Use of computer packages for the above techniques.	2	
V	Introduction to spectral analysis of weakly stationary processes	5	PPT, Chalk and Talk, Seminar, Problem solving, Interaction
	periodogram and correlogram analysis including computations based on Fourier transform	4	
	Use of spectral representation to show the existence of autoregressive processes and their representation as one-sided moving average processes	5	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO1	Describe times series model and apply various methods of analysis and forecasting in terms of time series data.	Up to K2
CLO2	Define the concept of stationary process.	Up to K3
CLO3	Discriminate between stationary, non-stationary time series and verify mathematical consideration for analysing time series, including concept of stationary, auto covariance and auto correlation.	Up to K3
CLO4	Create suitable times series models for the given dataset by transforming standard data into time series format using software packages.	Up to K4
CLO5	Demonstrate spectral analysis of weakly stationary processes.	Up to K4

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	1	2	3	1	3	3	2
CLO-2	2	2	2	2	2	2	2
CLO-3	1	2	2	2	2	2	1
CLO-4	2	2	2	2	2	2	3
CLO-5	1	2	2	2	2	2	1

Advance application – 3; Intermediate level – 2; Basic level – 1

CIA-I :: BLUE PRINT

CLO's	K-Level	Section – A Short Answer		Section B Either / Or type		Section C Open Choice	
		No. of Questions	K Level	No. of Questions	K Level	No. of Questions	K level
CLO 1	Up to K2	3	K1, K1, K2	2	K1, K2	1	K2
CLO 2	Up to K3	2	K2, K3	2	K2 , K3	2	K3, K3
No. of questions to be asked		5		4		3	
No. of question to be answer		5		2		2	
Marks for each question		2		5		10	
Total marks for each section		10		10		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (Either/ or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	5	-	9	15.00	55%
K2	4	10	10	24	40.00	
K3	2	5	20	27	45.00	45%
K4	-	-	-	-	-	-
K5	-	-	-	-	-	-
Total Marks	10	20	30	60	100	100%

CIA-II Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
1	CLO 3	Up to K3	2	K1 , K2	2	K2, K3	1	K2
2	CLO 4	Up to K4	3	K1, K2,K3	2	K3, K4	2	K3, K4
No. of Questions to be asked			5		4		3	
No. of Questions to be answered			5		2		2	
Marks for each question			2		5		10	
Total Marks for each section			10		10		20	

CIA-II :: Distribution of section wise marks with K levels.

K Levels	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	4	-	-	4	6.67	38.33%
K2	4	5	10	19	31.66	
K3	2	10	10	22	36.67	36.67%
K4	-	5	10	15	25	25%
K5	-	-	-	-	-	-
Total marks	10	20	30	60		

Summative Examination Blue Print

S.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)	
2	CLO 2	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of Section wise marks with K levels for summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	33.33
K2	2	2	10	10	24	20.00	
K3	4	4	10	20	38	31.67	31.67
K4	2	-	20	20	42	35	35
K5	-	-		-			
Total	10	10	50	50	120	100	100

Course Designers:

1. Dr. M. Venkateswaran

2. Dr. M. Rabert

DEPARTMENT OF STATISTICS				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	NME – 2	21P2SNM2	Industrial Statistics	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. Understand the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.
2. To exposure the Sampling Inspection Plans.

Unit	Description	No of Hours	K-Levels	CLO
I	Introduction – Basic of Statistical Quality Control - assignable causes, chance causes – Definition – Benefits - Process control and Product control – control limits, specification limits and tolerance limits.	7	K2	1
II	Control charts - Major parts of control charts – 3 sigma control limits – tools for Statistical Quality Control - uses of control charts – Modified Control limits	4	K2	2
III	Control charts for variables – Steps for $\bar{X}$ and R charts - Control limits for $\bar{X}$ and R – Construction of control chart for $\bar{X}$, R (range) – Criterion for detecting lack of control in $\bar{X}$ and R– Interpretation of $\bar{X}$ and R – Control charts for standard deviation (or σ – chart)	7	K2	3
IV	Control charts for Attributes – Control charts for fraction defective (p - Charts) – Control charts for number of defectives (d - Charts) - Interpretation of p – chart - Control charts for number of defects per unit (c - chart) – control limits for c - chart – Application of c - chart	6	K2	4
V	Acceptance Sampling inspection plans – Acceptable Quality level (AQL) – Consumer's and Producer's risk – Rectifying inspection plan – Average Outgoing Quality Limit (AOQL) – OC Curve – Average Sample Number (ASN) – Sampling inspection plan for attributes - Single and Double sampling plan	6	K2	5

Books for Study :

1. Fundamental of Applied Statistics (2014), S.C.Gupta and V.K.Kapoor, Sultan Chand & Sons(P) Ltd, fourth edition

Web references:

1. Basic of Statistical Quality Control
<http://www.gdcboysang.ac.in/About/droid/uploads/contents%20of%20UNIT%20iii-20A.pdf>
2. Control charts for variables and Control charts for attributes
<https://pdhonline.com/courses/p209/p209content.pdf>
3. Acceptance Sampling inspection plans
<http://www.mbbcollege.in/db/notes/379.pdf>
<http://egyankosh.ac.in/bitstream/123456789/20768/1/Unit-5.pdf>

Rationale for Nature of the course

The course enables the students to work in almost all the sectors of the industries by applying the various statistical tools.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving on applied statistics

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Introduction – Basic of Statistical Quality Control - assignable causes, chance causes.	2	PPT, Chalk and Talk and Assignments
	Definition – Benefits - Process control and Product control	2	
	Control limits, specification limits and tolerance limits.	3	
II	Control charts - Major parts of control charts – 3 sigma control limits	2	PPT, Chalk and Talk
	tools for Statistical Quality Control - uses of control charts, Modified Control limits	2	
III	Control charts for variables – Steps for $\bar{X}$ and R charts - Control limits for $\bar{X}$ and R	3	PPT, Chalk and Talk, Assignments and seminar
	Construction of control chart for $\bar{X}$, R (range) – Criterion for detecting lack of control in $\bar{X}$ and R	2	
	Interpretation of $\bar{X}$ and R – Control charts for standard deviation (or σ – chart)	2	
IV	Control charts for Attributes – Control charts for fraction defective (p - Charts) - Interpretation of p – chart	3	PPT, Chalk andTalk, Assignments and seminar
	Control charts for number of defectives (d - Charts)	2	
	Control charts for number of defects per unit (c - chart) – Control limits for c - chart – Application of c - chart	1	
V	Acceptance Sampling inspection plans – Acceptable Quality level (AQL) – Consumer's and Producer's risk	3	PPT, Chalk and Talk, Assignments and seminar
	Rectifying inspection plan – Average Outgoing Quality Limit (AOQL) – OC Curve – Average Sample Number (ASN)	2	
	Sampling inspection plan for attributes - Single and Double sampling plan	1	

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Differentiate assignable and chance causes	Up to K2
CLO-2	Derive control limits	Up to K2
CLO-3	Demonstrate the ability to design, use, and interpret control charts for variables.	Up to K2
CLO-4	Demonstrate the ability to design, use, and interpret control charts for attributes.	Up to K2
CLO-5	Distinguish single and double sampling plan	Up to K2

MAPPING CLOs WITH PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1		2	3	2	3		3
CLO-2		2	3	2	3		3
CLO-3	2	2	3	2	3		3
CLO-4	2	2	3	2	3		3
CLO-5	2	2	3	2	3		3

Advance application – 3;

Intermediate level – 2;

Basic level - 1

CIA-I–BluePrint

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
CLO 2	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

CIA-I :: Distribution of Section-wise Marks with K levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

CIA-II – Blue Print

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
CLO 4	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

CIA-II :: Distribution of Section wise Marks with K levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

CLO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination -Blue Print

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Marks with K Level for Summative Examination

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

Course Designers:

1. Dr. P. Vetri Selvi
2. Dr.M. Venkateswaran

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Practical – 3	21P2SMP3	Statistical Practical – II (Calculated based)	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Units	Description	Hours	K-Level	CLO(s)
1	Simple random sampling methods of drawing sample, Estimation of the population total and variance estimation.	7	K2	1
2	PPSWR Hurwitz -Thompson estimator - Des Raj ordered estimator, Murthy's unordered estimator Midzuno scheme. Linear and circular systematic sampling. Stratified sampling SRS, PPSWR, PPSWOR	15	K3	2
3	Ratio Estimator (including ratio estimator for stratified sampling – separate and combined), Regression Estimator (including regression estimator for stratified sampling – separate and combined), Cluster Sampling (Cluster of Equal sizes)	15	K3	3
4	MLE and Standard error of ML estimators, MLE through the method of successive approximation, MLE for truncated distribution. Method of Moments	15	K4	4
5	Interval estimation: Confidence interval for mean, difference of means, variance and ratio of variances.	8	K4	5

Books for Reference:

1. Singh, D and Choudhary, F.S. (1977) Theory and Analysis of Sample Survey Designs. Wiley Eastern, New Delhi.
2. Cochran, W.G, (2007), Sampling Techniques, Third Edition, John Wiley & Sons, New Delhi.
3. Ardilly, P. and Yves T. (2006) Sampling Methods: Exercise and Solutions. Springer, New York.
4. Desraj (1976) Sampling Theory, McGraw Hill, New York.
5. Mukhopadhyay, P. (2007) Survey Sampling. Narosa, New Delhi.
6. Sukhatme, P.V. and Sukhatme, B.V. (1970) Sampling Theory Surveys with Applications, 2/e, Iowa State University Press, Iowa.
7. Kish, L. (1961) Survey Sampling, Wiley, New York.
8. Murthy, M.N (1997) Sampling Theory and methods, Statistical Publishing Society, Calcutta.
9. Thompson, S.K, (2012), Sampling, John Wiley and Sons, New York.
10. Sampath S (2001), Sampling Theory and Methods, The new age international ltd. New Delhi.
11. Rajagopalan M and Dhanavanthan P, (2012), Statistical Inference, PHI Learning Pvt. Ltd., New Delhi.
12. Rohatgi, V.K and Saleh, A.K.Md.E, (2011), An Introduction to Probability and Statistics Second Edition, John Wiley & Sons, New York.

13. Mukhopadhyay, P, (2002), Mathematical Statistics, Book and Allied Publishers, New Delhi.
14. Casella G and Berger R L, (2002). Statistical Inference, Second Edition, Thompson Learning, New York. (Reprint, 2007).
15. Goon, A M, Gupta M.K and Dasgupta B, (1989), An Outline of Statistical Theory, Vol. II, World Press, Kolkata.
16. Mood A.M, Graybill F.A and Boes D.C, (1974), Introduction to Theory of Statistics, Third Edition, McGraw-Hill International Edition.
17. Berger, J.O, (1985), Statistical Decision Theory and Bayesian Analysis, Second Edition, Springer Verlag, New York.
18. Kale, B.K, (2005), A First Course in Parametric Inference, Second Edition, Narosa Publishing House, New Delhi. (Reprint, 2007).
19. Kale, B.K., and Muralidharan, K, (2015), Parametric Inference, Narosa Publishing House, New Delhi.
20. Keith, K, (2000), Mathematical Statistics, Chapman and Hall/CRC, New York.
21. Rao, C.R, (2009), Linear Statistical Inference and Its Applications, Second Edition, John Wiley & Sons, New York, US.

Web references (Sampling Techniques):

1. sampling methods
<https://uca.edu/psychology/files/2013/08/Ch7-Sampling-Techniques.pdf>
http://iced.cag.gov.in/wp-content/uploads/C-07/SAMPLING_TECHNIQUES.pdf
2. Ratio Estimator
http://182.18.165.51/Fac_File/STUDY183@323405.pdf
3. Regression Estimators
<https://nptel.ac.in/content/storage2/courses/111104073/Module6/Lecture20.pdf>
<http://home.iitk.ac.in/~shalab/sampling/chapter6-sampling-regression-method-estimation.pdf>
4. Varying probability sampling
http://150.107.117.36/NPTEL_DISK4/NPTEL_Contents/Web_courses/Phase2_web/111104073/Module7/Lecture24.pdf
<https://nptel.ac.in/content/storage2/courses/111104073/Module7/Lecture23.pdf>
5. Cluster Sampling
<https://nptel.ac.in/content/storage2/courses/111104073/Module9/Lecture30.pdf>
<http://home.iitk.ac.in/~shalab/sampling/chapter9-sampling-cluster-sampling.pdf>
6. Two stage sampling
<http://home.iitk.ac.in/~shalab/sampling/chapter10-sampling-two-stage-sampling.pdf>
<https://nptel.ac.in/content/storage2/courses/111104073/Module10/Lecture33.pdf>
7. Sources of errors in Surveys
<http://web.hku.hk/~plhyu/7006/chap3.pdf>
8. Point Estimation <http://web.mit.edu/14.381/www/Estimation.pdf>
9. Unbiased estimator https://www.math.arizona.edu/~jwatkins/N_unbiased.pdf
10. Properties of Point Estimators and Methods of Estimation
http://www.utstat.toronto.edu/~olgac/sta255_2013/notes/sta255_Lecture9.pdf
11. Interval estimation <http://www.yorku.ca/ptryfos/ch5000.pdf>
12. Prior and posterior distributions
https://www.probabilitycourse.com/chapter9/9_1_1_prior_and_posterior.php

Rationale for Nature of the course

This course helps the students to learn the Statistical Techniques with real time problems and interpretation of the data on Sampling Techniques and Statistical Estimation theory.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving session using calculator will be conducted. Interpretation on the data and its analysis will be focused lot with real time problems.

Course Designers:

1. **Dr. M. Venkatewaran**
2. **Dr.M.Rabert**

DEPARTMENT OF STATISTICS				CLASS: I M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Practical – 4	21P2SMP4	Statistical Data Analysis using SPSS	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To enrich the technical skills in Data analytics through the statistical methods using software orientation towards job roles.
2. To enhance the intuition of the students towards the insights of the theoretical concepts with its application in real time domain through software.

Units	Descriptions	Hours	K-Levels	CLOs
1	Program to Data Visualization: Bar Charts ,Cluster Bar Charts , Pie Charts, Program to Data Visualization: Scatter plots , Dot plot and Box plot, Program to Data Visualization: Histogram, Program to compute Descriptive Statistics	15	K2	1
2	Program to Correlation: Simple and Multiple correlation, Program to compute Simple regression analysis, Program to compute Multiple Regression analysis	10	K3	2
3	Program to compute One sample and two Independent sample t test Program to compute Paired sample t test	10	K3	3
4	Program to compute Non-Parametric tests Program to compute Chi-Square Test	10	K4	4
5	Program to compute Analysis of Variance , MANOVA , ANCOVA, Multivariate statistical techniques - Logistic Regression and Discriminant Analysis, Factor Analysis and Cluster Analysis.	15	K4	5

Books for Study:

1. A. Rajathi and P. Chandran (2020), SPSS for you , MJP Publishers, Chennai

Webpages

1. <https://www.open.ac.uk/socialsciences/spsstutorial/files/tutorials/graphs.pdf>
2. https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_spss.pdf
3. http://www.academia.dk/BiologiskAntropologi/Epidemiologi/PDF/SPSS_Statistical_Analyse_s_using_SPSS.pdf
4. https://stat.utexas.edu/images/SSC/Site/documents/SPSS_DescriptiveStats.pdf
5. <https://www.uvm.edu/~statdhtx/fundamentals8/SPSSManual/SPSSLongerManual/SPSSChapter1.pdf>
6. <https://csass.ucsc.edu/images/spss1.pdf>

Rationale for Nature of the course

SPSS is used by market researchers, health researchers, survey companies, government entities, education researchers, marketing organizations, data miners, and many more for processing and analyzing survey data

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The goal for the lab is to provide an opportunity for you to become familiar with the SPSS software which is designed to solve problems in statistics and to analyze experimental data

Pedagogy

Demonstration and Practical session in computer lab.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the basic workings of SPSS and perform basic statistical analyses.	Up to K2
CLO-2	Presenting data using relevant tables, graphical displays, and summary statistics.	Up to K3
CLO-3	Explore relationship among variables	Up to K3
CLO-4	Perform common parametric and non-parametric tests	Up to K4
CLO-5	Perform advanced statistical analyses such as one way and two – way ANOVA, ANCOVA, simple regressions and multivariate analyses (factor and cluster)	Up to K4

Mapping close with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	1	2	1	3	1	3
CLO-2	2	1	2	2	3	1	3
CLO-3	2	3	3	3	3	2	3
CLO-4	2	3	3	3	3	2	3
CLO-5	2	3	3	3	3	2	3

Advance application – 3; Intermediate level – 2; Basic level – 1

Course Designer:

1. Dr. P. Vetri Selvi
2. Dr. A. Saberunnisa

DEPARTMENT OF STATISTICS				Certificate courses (PG students)				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate Course		Cluster analysis with R	2	30	50	50	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

The main objectives of this course are to:

1. Comfortably perform basics operations in R
2. Understand cluster analysis concepts
3. Explore and execute the cluster analysis concepts for real time data using R

Unit	Description	Hours
1	Basic of R: Introduction to R – Installing R software – loading packages – Getting Help – importing your data into R – data Preparation - Package R required.	6
2	Clustering Distance measure: Method for measuring distances – Choosing distance measure – data standardization – Distance matrix computation – visualizing distance matrices.	6
3	Partitioning Clustering: K – Means Clustering – basic – algorithm – Computing K – means clustering in R – Advantages and disadvantages – K-Medoids – CLARA.	6
4	Hierarchical Clustering: Agglomerative Clustering - Comparing dendrograms – visualizing dendrograms – Headmaps.	6
5	Cluster validation: Assessing cluster tendency – determining the optimal number of cluster – Cluster validation statistics – choosing the best clustering algorithms – computing P-values for Hierarchical clustering.	6
	Total number of hours	30

Books for study:

1. AlboukadelKassambara (2017), MultivariateAnalysis – I:Practical Guide To Cluster Analysis in R Unsupervised Machine learning, STHDA.

Book for references:

1. Giordani, paolo, Ferraro mariabrigida, Martella, Francesca (2019),An Introduction to Clustering with R, Springer.
2. Brain S. Evertti, Sabine Landu, MorvenLeese and Daniel Stahl (2011), John Wiley and Sons Ltd, 5th editions, United Kingdom.

DEPARTMENT OF STATISTICS				Certificate courses (PG students)				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate Course		Statistics for Clinical Trials	2	30	50	50	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Unit	Description	Hours
1	Introduction to clinical trials : the need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials, overview of Phase I-IV trials, multi-center trials.	6
2	Data management : data definitions, case report forms, database design, data collection systems for good clinical practice	6
3	Design of clinical trials : parallel vs. cross-over designs, cross-sectional vs. longitudinal designs, review of factorial designs, objectives and endpoints of clinical trials, design of Phase I trials, design of single-stage and multi-stage Phase II trials, design and monitoring of Phase III trials with sequential stopping, design of bioequivalence trials	6
4	Reporting and analysis : analysis of categorical outcomes from Phase I - III trials, analysis of survival data from clinical trials. Surrogate endpoints : selection and design of trials with surrogate endpoints, analysis of surrogate endpoint data.	6
5	Meta-analysis of clinical trials	6

References:

1. S. Piantadosi (1997). Clinical Trials : A Methodologic Perspective. Wiley and Sons.
2. C. Jennison and B. W. Turnbull (1999). Group Sequential Methods with Applications to Clinical Trials, CRC Press.
3. L. M. Friedman, C. Furburg, D. L. Demets (1998). Fundamentals of Clinical Trials, Springer Verlag.
4. J. L. Fleiss (1989). The Design and Analysis of Clinical Experiments. Wiley and Sons.
5. E. Marubeni and M. G. Valsecchi (1994). Analyzing Survival Data from Clinical Trials and Observational Studies, Wiley and Sons.

I UG Ratifications

Course Code	Course Title	Nature of the course	Rationale	Activities having direct bearing on Skill development / Employability /Entrepreneurship
20U1SAC1	ANCILLARY STATISTICS - I	Knowledge & Skill	The main role of mean, median, mode and deviation in statistics to solve a variety of tangible life problems. This course provides the vital in various probabilities and also develops skills to apply tangible life problems.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U1SMC1	DESCRIPTIVE STATISTICS	Knowledge & Skill	Numeric data collected in a research project can be analyzed quantitatively using statistical tools in two different ways. Descriptive analysis refers to statistically describing, aggregating, and presenting the constructs of interest or associations between these constructs. Inferential analysis refers to the statistical testing of hypotheses. In this paper, we will examine statistical techniques used for descriptive analysis, and will examine statistical techniques for inferential analysis.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U1SMC2	PROBABILITY THEORY	Knowledge & Skill	Probability theory plays a vital role to solve a variety of real life problems and it is extremely useful in many branches of Mathematics. This course provides the fundamental knowledge in Probability theory and also develop skills to apply it in real life problems.	This course imparts Problem Solving Skills to the students by the following activities such as Exercise, Assignment and Quiz.

20U2SAC2	ANCILLARY STATISTICS - II	Knowledge & Skill	The role of Distributions, Testing of Hypothesis is very essential in Statistics to solve a variety of real life problems. This course provides the fundamental knowledge in various Discrete, Continuous and sampling distributions and also develop skills to apply it in real life problems.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U2SMC3	PROBABILITY DISTRIBUTIONS	Knowledge & Skill	The role of Probability Distributions is very important and essential in Statistics as well as Mathematics. It is extremely useful in solving a variety of real life situations. This course provides the fundamental knowledge in various Discrete and Continuous probability distributions and also develop skills to apply it in real life problems.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.
20U2SMC4	MATRIX THEORY	Knowledge & Skill	The Matrix Theory is to present the chronological and logical connections between the applications in mathematics, statistics and many fields. Matrix theory is foundational to many of the core concepts in introductory linear algebra. Along the way, Students know about the various types of matrices and solving the procedures for matrices. Additionally, Students know about the applications of matrix theory in system of linear equations.	This course imparts problem solving skills to the students by the following activities such as Exercise, Assignment and Quiz.

Department of Physics

Revised Curriculum

(Choice Based Credit system with Outcome Based Education)

Academic Year 2020-2021 onwards

III and IV Semesters (B.Sc. Physics)

I and II Semesters (M.Sc. Physics)

Certificate Courses



The Madura College (Autonomous), Madurai – 625011

Department of Physics

Curriculum structure for BSc Physics (Major) to be implemented from 2020 – 2021

Sem	Course	Subject Code	Course title	Contact hours /week	Credits
I	Part – I : Lang – I	20U1TLA1	Tamil – I/Sanskrit – I/Hindi – I	6	3
	Part – II : English – I	20U1NEN1	English – I	6	3
	VE & PE	20U1VEN1	Value Education & Professional Ethics	3	3
	Part III: Allied – I	20U1MAC1	Allied Mathematics – I	6	5
	Major Core – 1	20U1PMC1	Properties of matter & Sound	3	3
	Major Core – 2	20U1PMC2	Mechanics	3	3
	Major Core Practical	20U1PMP1	Major Practical – I	3	2
Total				30	22
II	Part – I : Lang – II	20U2TLA2	Tamil – II/Sanskrit – II/Hindi – II	6	3
	Part – II : English – II	20U2NEN2	English – II	6	3
	E & G S	20U2EVS1	Environment & Gender studies	3	3
	Part III :Allied – II	20U2MAC2	Allied Mathematics – II	6	5
	Major Core – 3	20U2PMC3	Heat & Thermodynamics	3	3
	Major Core – 4	20U2PMC4	Optics	3	3
	Major Core Practical	20U2PMP2	Major Practical – II	3	2
	Extension (AEEP)			– –	1
Total				30	23
III	Part – I : Lang – III	20U3TLA3	Tamil – III/Sanskrit – III/Hindi – III	6	3
	Part – II : English – III	20U3NEN3	English – III	6	3
	Non Major Elective (NME – I)	20U3PNM1	Discovering Physics / Communication system	2	2
	Skill based Elective (SBE – I)	20U3PSM1	Mathematical methods	2	2
	Part III:Allied – I	20U3CAC1	Allied Chemistry – I	4	4
	Allied Practical	20U3CAP1	Allied Chemistry Practical -I	2	1
	Major Core – 5	20U3PMC5	Electricity & Magnetism	5	5
	Major Core Practical	20U3PMP3	Major Practical – III	3	2
Total				30	22
IV	Part – I : Lang – IV	20U4TLA4	Tamil – IV/Sanskrit – IV/Hindi – IV	6	3
	Part – II : English – IV	20U4NEN4	English – IV	6	3
	Non Major Elective (NME – II)	20U4PNM2	Discovering Physics / Communication system	2	2
	Skill based Elective (SBE – II)	20U4PSM2	Basic Instrumentation Skill	2	2
	Part III:Allied – II	20U4CAC2	Allied Chemistry – II	4	4
	Allied Practical	20U4CAP2	Allied Chemistry Practical – II	2	1
	Major Core – 6	20U4PMC6	Classical & Statistical Mechanics	5	5
	Major Core Practical	20U4PMP4	Major Practical – IV	3	2
Total				30	22

V	Skill based Elective (SBE – III)	20U5PSM3	PYTHON	2	2
	Major Core – 7	20U5PMC7	Analog Electronics	5	5
	Major Core – 8	20U5PMC8	Quantum Mechanics & Spectroscopy	5	5
	Major Core – 9	20U5PMC9	Atomic Physics & Relativity	5	5
	Major Core Practical	20U6PMP3	Major Practical – V	3	2
	Major Core Practical	20U6PMP4	Major Practical – VI	3	2
	Major Elective – I	20U5PME1	Biomedical instrumentation	4	3
	Major Elective – II	20U5PME2	Energy Physics	3	2
Total				30	26
VI	Skill based Elective (SBE – IV)	20U6PSM4	Observational Astronomy	2	2
	Major Core – 10	20U6PMC10	Nuclear Physics	5	5
	Major Core – 11	20U6PMC11	Solid State Physics	5	5
	Major Core – 12	20U6PMC12	Digital & Communication Electronics	5	5
	Major Core Practical	20U6PMP3	Major Practicals – VII	3	2
	Major Core Practical	20U6PMP4	Major Practicals – VIII	3	2
	Major Elective – III	20U6PME3	Microprocessor fundamentals	4	3
	Major Elective – IV	20U6PME4	Nano Physics	3	2
Total				30	26

ELECTIVES OFFERED

1. Biomedical instrumentation
2. Geomagnetic Physics
3. Energy Physics
4. Soil Physics
5. Microprocessor fundamentals
6. Weather Forecasting
7. Nano Physics
8. Crystallography, Thin film, Spectroscopy & Computational Physics

Add-on and self study courses offered from the department

Sem	Course	Subject Code	Course title	Contact hours/week	Credits
III	Add – on Course	21U3PADD1	How stuff works	2	2
IV	Add – on Course	21U4PADD2	Problem solving in Physics in selected topics	2	2
IV	Self – study	21U4PSS1	Laser Physics	2	2

DEPARTMENT OF PHYSICS				CLASS: II B.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III & IV	Non-Major Elective (NME)	17U3PNM1/ 17U4PNM2	Discovering physics	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

- To introduce the students (other than physics major) to the amazing world of physics and the time evolution of the theories and ideas.
- To introduce the students to the various popular phenomena happening around us and to appreciate the physics behind those phenomena.

Unit	Description	Hours	K-level	CLO
I	Introduction to Physics Introduction – Measurements at various scales – Scientific contributions (Galileo, Copernicus and Newton) – Falling apple – Newton’s gravitational equation – Technology and scientific principles behind them.	6	Up to K2	1
II	Colors, Rainbows and the blue sky Why do we see colors? – Idea of Rutherford – Contributions of Planck and Bohr – How does sun make light? (Einstein’s mass-energy relation) – Formation of rainbow.	6	Up to K2	2
III	Objects in Motion Aristotle’s philosophy of motion – Galileo’s contribution – Inertia and Newton’s first law of motion- Newton’s second law of motion – Newton’s third law of motion – Kepler’s laws of planetary motion.	6	Up to K2	3
IV	Expanding Universe Hubble’s law – Dark energy – Doppler’s red shift – Big bang theory – Einstein’s theory of relativity – Outcome of Michelson-Morley experiment.	6	Up to K2	4
V	World of atoms Atoms and charges – Plum-pudding model – Alpha particle scattering experiment – Bohr’s picture of atom – Heisenberg’s uncertainty principle.	6	Up to K2	5

Book for Study:

(1). Vedang Sati, Let Us discover physics, Create space Independent Publishers, (2014).

Unit I : Chapter 1

Unit II : Chapter 2

Unit III: Chapter 3

Unit IV: Chapter 4,7

Unit V : Chapter 6.

Books for reference:

1) Sear's and Zemansky's "University Physics with Modern Physics ", Hugh D.Young and Roger A. Freedman, 14th edition , 2017 Pearson India Education Services Pvt.Ltd.

2) Paul G. Hewitt *CONCEPTUAL PHYSICS*, tenth edition, 2015 , Pearson Education, Inc. and Dorling Kindersley Publishing Inc.

3) Concepts of Physics Volume I and II – H.C. Varma, BharatiBhawan Publishers, New Delhi, 2015

Web Resources:

1. Introduction to Physics: <https://peda.net/kenya/ass/subjects2/physics>
2. Colors, Rainbows and the blue sky & Objects in Motion :
: <https://www.physicsclassroom.com/class/light/Lesson-2/Blue-Skies-and-Red-Sunsets>
3. Expanding Universe : <https://skyserver.sdss.org/dr1/en/astro/universe/universe.asp>
4. World of atoms : <http://resources.schoolscience.co.uk/stfc/14-16/index.html>

Course Designer(s):

1. Mr.S.SivaramKrishnan
2. Dr.J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction – Measurements at various scales – Scientific contributions	2	PPT, Chalk and talk, Quiz and assignment
	Falling apple – Newton's gravitational equation	2	
	Technology and scientific principles behind them.	2	
Unit II	Why do we see colors? – Idea of Rutherford	2	Chalk and talk, Quiz and assignment
	Contributions of Planck and Bohr	2	
	How does sun make light? (Einstein's mass-energy relation) – Formation of rainbow	2	
Unit III	Aristotle's philosophy of motion – Galileo's contribution	2	Chalk and talk, Quiz, assignment and seminar
	Inertia and Newton's first law of motion-Newton's second law of motion – Newton's third law of motion	2	
	Kepler's laws of planetary motion.	2	
Unit IV	Hubble's law – Dark energy	2	Chalk and talk, quiz, Group discussion
	Doppler's red shift – Big bang theory	2	
	Einstein's theory of relativity – Outcome of Michelson-Morley experiment.	2	

Unit V	Atoms and charges- Plum-pudding model	2	PPT, Chalk and talk, Quiz and Interaction
	Alpha particle scattering experiment	2	
	Bohr's picture of atom – Heisenberg's uncertainty principle	2	

Pedagogy :Chalk and talk , materials, PPT, Quiz, Assignment , Seminar , Problem solving , Group discussion ,and interactions.

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLO	Course Learning Outcomes	Knowledge Level
CLO – 1	Understand the basic concepts of physics like Newton's gravitational equation	Up to K2
CLO – 2	Explain the physics of natural phenomenon such as appearance of colors and rainbow	Up to K2
CLO – 3	Understand the laws of motion and planetary motion	Up to K2
CLO – 4	Describe the Expanding Universe and theory of relativity	Up to K2
CLO – 5	Infer Atom models and uncertainty principle	Up to K2

Mapping with CLOs with PSOs

#	PSO – 1	PSO – 2	PSO – 3	PSO – 4	PSO – 5	PSO – 6	PSO – 7
CLO – 1	3	2					1
CLO – 2	3	3					1
CLO – 3	3	2					1
CLO – 4	3	3					1
CLO – 5	3	3					1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	2			
CLO2	3	1			
CLO3	3	1			
CLO4	3	2			
CLO5	3	2			

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – (CIA-I & II)
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO x	Up to K2	1	K1	1	K2/K2	1	K1
CLO y	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

Distribution of Section-wise Marks with K Levels (CIA I & II)

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

Learning Outcome Based Education & Assessment (LOBE)
Blue Print
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Skill based Elective (SBE-I)	20U3PSM1	Mathematical Methods	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

- To expose the students to various numerical techniques in order to find solution to problems which do not have exact solutions.
- To develop the ability of students to find solution for algebraic equations, differential equations and to estimate the derivatives of given function by means of given values of that function using an appropriate numerical technique.
- To compute the inverse of a matrix and also to calculate the interpolated value of a given function by means of table of values of that function.

Unit	Description	Hours	K-level	CLO
I	Errors and Root of Equations Introduction - Significant digits - Inherent errors - Data error - Conversion error - Numerical errors - round off and truncation errors - Roots of equations-Solution of algebraic and transcendental equations - Bisection method - Regulafalsi method- Problems. Self-study: Newton-Raphson method – Problems.	6	Up to K2	1
II	Linear Equations and Matrix methods Introduction - Solutions of linear algebraic equations- Gauss elimination method - Gauss Jordan elimination method- Matrix inversion method. Self-study: Gauss Seidal iteration method	6	Up to K3	2
III	Interpolation and Approximation Lagrange's interpolation formula for unequal intervals- Divided difference table - Divided difference formula - Newton's forward interpolation formula.	6	Up to K3	3
IV	Numerical Differentiation and Curve Fitting Numerical differentiation - Forward difference formula to compute the derivatives – Linear law – Laws reducible to linear law– Principles of least squares – Straight line, parabola and exponential fitting.	6	Up to K3	4
V	Differential Equations Introduction-Euler's method - Improved Euler's method- Runge-kuttamethods - 2 nd order method - 4 th order method (excluding 3 rd order) Self-study: Modified Euler's method.	6	Up to K4	5

Books for study:

1.E.Balagurusamy, Numerical methods, 8th reprint 2002, TMH edition.

Unit I: 4.1-4.4

2. A.Singaravelu, Numerical methods, Revised edition 2017, Meenakshi Agency.

Unit II: 1.41-1.60, 1.65-1.114

Unit III: 2.1-2.15,2.20-2.39

Unit IV: 3.1, 3.3-3.16, 3.24-3.25

Unit V: 4.1, 4.25-4.43, 4.43-4.65

3. P. Kandasamy, K. Thilagavathy and K. Gunavathy, Numerical methods, S. Chand & Co. (2002)

Unit I: 3.1, 3.1.1, 3.3, 3.3.1, 3.4, 3.4.1

Unit IV: 1-3, 19-29, 31-35 (Pages)

Books for reference:

1. S.S. Sastry, Introductory methods of numerical analysis, Prentice Hall of India, New Delhi (2000)

2. R. Murugesan, Mechanics and Mathematical methods, S. Chand & Co, NewDelhi (1999)

3. M.k. Venkataraman, Numerical methods in science and engineering, National publishing company 5th edition,(1999)

Course Designer(s):

1. Prof. T.Vivekanandan

2. Prof.V.Seenivasan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction – Significant digits – Inherent errors – Data error – Conversion error – Numerical errors – round off error – Truncation error	3	Chalk and talk, Quiz and assignment
	Roots of equations - Solution of algebraic and transcendental equations - Bisection method - Regula-falsi method – Problems.	3	
Unit II	Introduction – Solutions of linear algebraic equations - Gauss elimination method	3	PPT, Chalk and talk, and Group discussion
	Gauss Jordan elimination method - Matrix inversion method	3	
Unit III	Lagrange's interpolation formula for unequal intervals - Divided difference table	3	PPT, Chalk and talk, Quiz and Group discussion
	Divided difference formula - Newton's forward interpolation formula.	3	
Unit IV	Numerical differentiation - Forward difference formula to compute the derivatives	2	PPT, Chalk and talk, Assignment
	Linear law – Laws reducible to linear law	1	
	Principles of least squares – Straight line, parabola and exponential fitting	3	
Unit V	Introduction - Euler's method - Improved Euler's method	3	Chalk and talk, Quiz and Interaction
	Runge-Kutta methods - 2 nd order method - 4 th order method (excluding 3 rd order)	3	

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving .

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Differentiate numerical errors from inherent errors	Up to K2
CLO-2	Apply Gauss elimination and Gauss-Jordan elimination methods in solving simultaneous linear equations and in finding inverse of a matrix.	Up to K3
CLO-3	Calculate the population of a city during a particular period from the table of population given for a number of decades in succession using Newton's interpolation formula and such similar problems.	Up to K3
CLO-4	Develop linear, parabolic and exponential empirical equations based on the given table of data having two variables.	Up to K3
CLO-5	To solve 1 st order differential equations using 2 nd order and 4 th order Runge-Kutta methods and to compare the results obtained for the given initial condition and stepsize.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	1	2	2	1	3	2	1
CLO-2	1	2	2	1	3	2	1
CLO-3	1	2	2	1	3	2	2
CLO-4	1	2	2	1	3	2	2
CLO-5	1	2	2	1	3	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	2	1	2		1
CLO2	2	1	2		1
CLO3	2	2	2	1	1
CLO4	2	2	2	1	1
CLO5	2	2	2	1	1

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print - Model

(Mapping with Course Learning Outcomes(CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core-5	20U3PMC5	Electricity and Electromagnetism	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

- To provide comprehensive knowledge and understanding of the basics of Electricity and Magnetism.
- To enhance understanding of fundamental concepts and various phenomena on thermo electricity and its applications.
- To impart knowledge on the working of electrolytic cells
- To enhance the knowledge on phenomena, self-induction and mutual-induction and use it in devices
- To analyse the property of impedance and its role in a tuner circuits.
- To describe the generation of electromagnetic waves and to use dielectrics.

Unit	Description	Hours	K-level	CLO
I	Magnetic effect of electric current : Magnetic flux and magnetic induction- Biot-Savart law- magnetic induction at a point due to a straight conductor carrying current - magnetic induction at a point on the axis of a circular coil carrying current- amperes circuital law magnetic field inside a long solenoid –toroid- Lorentz force on a moving charge- direction of force- torque on a current loop in a uniform magnetic field - Moving coil Ballistic galvanometer-theory -experiment to find charge sensitivity and absolute capacity of a capacitor. Self-study : De-sauty's bridge	15	Up to K3	1
II	Thermal and chemical effect of electric current : Thermoelectricity- Seebeck effect- laws of thermo e.m.f— measurement of thermo e.m.f using potentiometer- Peltier effect-demonstration—Thomson effect-demonstration - thermodynamics of thermo couple –thermo electric diagram –uses (any 3) Faradays laws of electrolysis- electrical conductivity of an electrolyte-specific conductivity- Kohlrausch's bridge method of determining the specific conductivity of an electrolyte - Arrhenius theory of electrolytic dissociation- –mobility of ions- Secondary cells- Gibbs –Helmholtz equation for a reversible cell. Self-study : applications-thermopile Audit : Boy's radio micrometre –thermo-milli ammeter	15	Up to K3	2

III	Electromagnetic induction: Faraday's laws of electromagnetic induction-self induction –self inductance of a long solenoid –toroidal solenoid-determination of L by Anderson's and Rayleigh's methods-Owen's bridge-mutual induction-mutual inductance between two co-axial solenoids-experimental determination of mutual inductance –co-efficient of coupling- energy stored in a coil- eddy currentsuses - Earth inductor-uses-search coil. Self-study :induction coil and its uses	16	Up to K3	3
IV	AC AND DC CIRCUITS Growth and decay of current in LC,LR and CR circuits with d.c.voltages - determination of high resistance by leakage –growth and decay of charge in LCR circuit-conditions for the discharge to be oscillatory – frequency of oscillation. Alternating Current- j operator method –use of j operator in the study of AC circuits-Resistance in an AC circuit-Inductance in an AC circuit-Capacitance in an AC circuit- LCR series resonance circuit -sharpness of resonance-parallel resonance circuit -power in an AC circuit-power factor. Self-study :AC through an inductance and resistance in series- capacitance and resistance in series	18	Up to K4	4
V	Maxwell's equation & dielectrics Introduction- Maxwell's equations- -Displacement current- Poynting vector Electromagnetic waves in free space- velocity of light - Hertz experiment for production and detection of EM waves. Introduction of dielectrics-dielectric constant-polarisation of dielectric-relation between polarisation vector and density of polarisation of charge- Gauss's law in dielectrics- electric displacement D – electric susceptibility-Dielectric in an electric field.	11	Up to K2	5

Books for study:

1. R. Murugesan, Electricity and Magnetism (2008) S Chand & Co, New Delhi
 Unit-1 - 10.1-10.4,10.7,10.9-10.11,10.13,10.14,10.17,10.20,10.21,19.4
 Unit -2 – 8.1-8.8,9.1-9.5,9.7
 Unit -3 – 11.1 – 11.12
 Unit – 4 – 12.1 – 12.6,13.2,13.4,13.5
 Unit – 5 – 16.1 – 16.6,17.1-17.5,17.11
2. BrijLal&Subramanyam, Electricity and Magnetism,(2005)
 Unit-4 – 20.18-20.22

Books for Reference:

1. Electricity and Magnetism -D.N.Vasudeva (Twelfth revised edition)
2. Electricity and Magnetism - K.K.Tiwari (S.Chand&Co.)
3. Electricity and Magnetism -E.M.Pourcel,Berkley Physics Course, Vol.2 (Mc Graw-Hill)
4. Electricity and Magnetism -Tayal (Himalalaya Publishing Co.)
5. D.Halliday, R.Resnick and J.Walker, Fundamentals of Physics – Electricity and Magnetism (2011), Wiley India,Pvt Ltd
6. David J. Griffith, Introduction to Electrodynamics, (2012) PHI, New Delhi

Web Resources**Unit-I & Unit-III**

1. <https://www.electronicshub.org/electromagnetic-induction/>,
2. https://www.ck12.org/c/physics/electromagnetic-induction/lesson/Electromagnetic-Induction-PPC/?referrer=concept_details)
3. <https://nanohub.org/resources/31456>
4. <http://edge.rit.edu/edge/P07440/public/Home>
5. <https://www.askiitians.com/iit-jee-chemistry/physical-chemistry/electrolysis-and-electrolytic-cell.aspx#electrolytic-cells>)
6. <https://www.animations.physics.unsw.edu.au/jw/AC.html>
7. <https://openstax.org/books/college-physics/pages/23-12-rlc-series-ac-circuits>
8. <https://web.stanford.edu/class/archive/engr/engr40m.1178/slides/transient.pdf>)
9. http://galileoandeinstein.physics.virginia.edu/more_stuff/Maxwell_Eq.html,
<http://www.maxwells-equations.com/>
10. <https://physics.info/dielectrics/>
11. http://academy.cba.mit.edu/classes/input_devices/meas.pdf

Note: 1. A maximum of Up to 10% (7.5 marks) of the questions may be asked from self – study part of the syllabus in the summative examination.

2. The questions in the Audit part of the syllabus shall not be asked in the summative examination.

Course Designer:

Dr. J. Suresh, Associate Prof & Principal

Lecture Schedule

Unit	Topics	Hours	Mode
Unit-I (15)	Magnetic flux and magnetic induction- Biot–Savart law	2	PPT,Chalk & Talk, Quiz, Assignment and Experiments
	Magnetic induction at a point due to a straight conductor carrying current	1	
	Magnetic induction at a point on the axis of a circular coil carrying current	1	
	Amperes circuital law magnetic field inside a long solenoid	2	
	Toroid- Lorent’z force on a moving charge	2	
	Direction of force-torque on a current loop in a uniform magnetic field	2	
	Moving coil Ballistic galvanometer-theory	2	
	Experiment to find charge sensitivity and absolute capacity of a capacitor	2	
	De-sauty’s bridge	1	
Unit-II (15)	Thermoelectricity- Seebeck effect- laws of thermo e.m.f	2	PPT, Chalk & Talk, Quiz, Assignment
	Measurement of thermo e.m.f using potentiometer	2	
	Peltier effect-demonstration- Thomson effect-demonstration	2	
	Thermodynamics of thermo couple- Thermo electric diagram –uses-applications-	3	
	Thermopile-Boy’s radio micrometre –thermo-milli ammeter	1	
	Faradays laws of electrolysis- electrical conductivity of an electrolyte-specific conductivity- Kohlrausch’s bridge method of determining the specific conductivity of an electrolyte	1	
	Arrhenius theory of electrolytic dissociation- Mobility of ions- Secondary cells- Gibbs –Helmholtz equation for a reversible cell	4	
Unit-III (16)	Faraday’s laws of electromagnetic induction	2	PPT, Chalk & Talk, Quiz, Assignment and Experiments
	Self -inductance of a long solenoid- Self induction - Toroidal solenoid	3	
	Determination of L by Anderson’s method and Rayleigh’s method	2	
	Owen’s bridge	1	
	Mutual induction-mutual inductance between two co-axial solenoids- Experimental determination of mutual inductance	3	
	Co-efficient of coupling- Energy stored in a coil- Eddy currents uses- Earth inductor-uses	5	
Unit-IV (18)	Growth and decay of current in LC,LR and CR circuits with d.c.voltages -	3	PPT, Chalk & Talk, Quiz, Assignment and Experiments
	Alternating Current- j operator method –use of j operator in the study of AC circuits-	3	
	Resistance in an AC circuit-Inductance in an AC	4	

Unit	Topics	Hours	Mode
	circuit- Capacitance in an AC circuit-AC through an inductance and resistance in series- capacitance and resistance in series LCR series resonance circuit –sharpness of resonance-parallel resonance circuit –power in an AC circuit-power factor.	4	
	Determination of high resistance by leakage –growth and decay of charge in LCR circuit-conditions for the discharge to be oscillatory –frequency of oscillation.	4	
Unit-V (11)	Introduction- Maxwell's equations- -Displacement current- Poynting vector Electromagnetic waves in free space-Hertz experiment for production and detection of EM waves.	5	PPT, Chalk & Talk, Quiz, Assignment
	Introduction of dielectrics- dielectric constant- polarisation of dielectric-relation between polarisation vector and density of polarisation of charge- Gauss's law in dielectrics- electric displacement D – electric susceptibility-Dielectric in an electric field.	6	

Pedagogy : Chalk and talk, PPT, Quiz, Assignment, Seminar, Problem Solving, Learning by doing.

Course Learning Outcomes

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Demonstrate the behaviour of current carrying conductor placed in a magnetic field	Up to K3
CLO-2	Interpret thermoelectric effect and apply the principle of electrolysis	Up to K3
CLO-3	Apply self-induction and mutual-induction and demonstrate eddy currents	Up to K3
CLO-4	Analyse LCR circuits	Up to K4
CLO-5	Infer the production of electromagnetic wave and the dielectric nature of materials	Up to K2

Course Learning Outcomes

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	2	2			1
CLO-2	3	3	2	3			1
CLO-3	3	2	2	2			1
CLO-4	3	3	2	3			1
CLO-5	3	2	2	2	+		1

Mapping of CLOs with POs

#	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	2	2		
CLO-2	3	2	2	1	1
CLO-3	3	1	1	1	1
CLO-4	3	3	3	1	2
CLO-5	3	1	1		

Summative – Blue-Print-Model (Mapping with CLOs)

Units	CLOs	K-Level	Section-A		Section-B		Sec-C (E OR C)	Sec-d Open Choice
			MCQs.		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
2	CLO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CLO3	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CLO4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CLO5	Up to K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Skill based Elective-II	20U4PSM2	Basic Instrumentation Skill	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

- To Learn errors in measurements and also to understand the construction of multi-meter. Acquire the skill in using multi-meter to measure various ranges of current, voltage and resistance
- To understand the construction of CRO. To acquire the skill in using CRO for various physical measurements.
- To understand the working of various generators the skill in using Q-meter
- To learn the bridge circuit and to acquire the skill in measuring R L C values.
- To understand the working of various types of recorders and acquire the skill of selecting a best recorder for particular system.

Unit	Description	Hours	K-level	CLO
I	Basics of Measurement: Performance characteristics – Static Characteristics – Error in measurement – Types of Static error. Multimeter: DC Ammeter – multirange ammeters – DC voltmeter – Multirange voltmeter – Loading – AC voltmeter using rectifiers – multirange AC voltmeter – ohmmeter – Digital Voltmeter – Ramp technique Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Self Study/Audit : Digital Voltmeter	6	Up to K4	1
II	Cathode Ray Oscilloscope: Introduction – Basic Principle- CRT features- Basic Principle of signal display - Block diagram of oscilloscope(Explanation only– no mathematical treatment),. Applications of Oscilloscope – Voltage measurements – Period and frequency measurements.	6	Up to K3	2
III	Signal Generators and Analysis Instruments: Signal generators – introduction- basic standard signal generators – function generator – square and pulse generators – basic wave analyser - - harmonic distortion analyser – resonance bridge – Q meter.	6	Up to K3	3

IV	Impedance Bridges: Wheatstone's bridge – sensitivity-unbalanced bridge applications – AC bridges – capacitance comparison bridge – Schering's bridge - inductance comparison bridge – Maxwell's bridge – precautions to be taken when using a bridge.	6	Up to K2	4
V	Recorders: Introduction – Graphic recorders – Strip Chart recorder - Galvanometer type recorders Potentiometric type recorders – Bridge type recorders magnetic recorders – Recorder Selections for particular applications – Recorder specifications - applications of strip chart recorders. Self Study/Audit : Strip Chart Recorders.	6	Up to K3	5

Books for study:

1. H.S. Kalsi, Electronic Instrumentation (Technical Education Serie) Fourth reprint (2002) Tata McGraw Hill New Delhi
Unit-1 –1.2-1.5,3.2,3.3,4.2-4.4,4.6,4.12,4.15, 4.21, 5.1,5.2
Unit -2 –7.1-7.4,7.30
Unit -3 – 8.4, 8.5, 8.8, 8.9, 9.2, 9.5, 10.7
Unit – 4 –11.2,11.2.1,11.2.4, 11.8-11.11, 11.13,11.18
Unit – 5 – 12.1-12.4.2, 12.7, 12.11,12.12, 12.15

Books for Reference:

1. Electronic Devices and circuits, S. Salivahanan, N. S.Kumar, & A. Vallavaraja 11th reprint, 2010, Tata Mc-Graw Hill
2. A text book in Electrical Technology - B L Theraja - S Chand and Co.
3. Performance and design of AC machines - M G Say ELBS Edn.
4. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
5. Logic circuit design, Shimon P. Vingron, 2012, Springer.
6. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.

Web Resources

1. <https://www.elprocus.com/what-are-errors-in-measurement-types-of-errors-with-calculation/>
2. <https://www.yourelectricalguide.com/2017/01/multimeter-construction-working.html>
3. <https://www.elprocus.com/cro-cathode-ray-oscilloscope-working-and-application/#:~:text=The%20CRO%20recruit%20the%20cathode,electron%20beam%20strikes%20with%20it>
4. <https://www.electricalengineeringinfo.com/2016/03/cathode-ray-oscilloscope-cro-construction-of-cathode-ray-oscilloscope-cro.html>
5. <https://www.electronics-notes.com/articles/test-methods/signal-generators/what-is-a-signal-generator.php#:~:text=A%20signal%20generator%20is%20piece,used%20with%20other%20test%20instruments.>
6. https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_signal_generators.htm

7. <https://electronicscoach.com/ac-bridges.html>,
https://dkpandey.weebly.com/uploads/1/3/5/3/13534845/lecture6-8_dkp.pdf
8. http://www.darshan.ac.in/Upload/DIET/Documents/EE/EMMI_Ch%206_13092018_031526AM.pdf, <https://instrumentationtools.com/recorders/>

Note: 1. A maximum of Up to 10% (7.5 marks) of the questions may be asked from self study of the syllabus in the summative examination.

2. The questions in the Audit part of the syllabus shall not be asked in the summative examination.

Course Designer

Dr. J. Suresh, Associate Prof & Principal

Lecture Schedule

Unit	Topics	Hours	Mode
Unit-I (6)	Performance characteristics – Static Characteristics – Error in measurement – Types of Static error.	2	PPT, Chalk & Talk, Quiz, Assignment and Experiments
	Multimeter: DC Ammeter – multirange ammeters – DC voltmeter- Multirange voltmeter – Loading	2	
	AC voltmeter using rectifiers – multirange AC voltmeter – Digital Voltmeter – Ramp technique Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance	2	
Unit-II (6)	Introduction – Basic Principle- CRT features	2	PPT, Chalk & Talk, Quiz, Assignment and Experiments
	Basic Principle of signal display	2	
	Block diagram of oscilloscope-Applications of Oscilloscope – Voltage measurements – Period and frequency measurements.	2	
Unit-III (6)	Signal generators – introduction- basic standard signal generators – function generator	2	PPT, Chalk & Talk, Quiz, Assignment and Experiments
	square and pulse generators – basic wave analyser	2	
	harmonic distortion analyser – resonance bridge – Q meter	2	
Unit-IV (6)	Wheatstone's bridge – sensitivity-unbalanced bridge applications	2	PPT, Chalk & Talk, Quiz, Assignment and Experiments
	AC bridges – capacitance comparison bridge – Schering's bridge - inductance comparison bridge	2	
	Maxwell's bridge – precautions to be taken when using a bridge.	2	
Unit-V (6)	Introduction – Graphic recorders – Strip Chart recorder - Galvanometer type recorders Potentiometric type recorders	3	PPT, Chalk & Talk, Quiz, Assignment
	Bridge type recorders magnetic recorders – Recorder Selections for particular applications – Recorder specifications - applications of strip chart recorders	3	

Pedagogy

Chalk and talk, PPT, Quiz, Assignment, Seminar, Problem Solving, Learning by doing.

Rationale for Nature of the course:

The student will be able to use effectively Multimeter, CRO for electrical parameter measurements. Understand the working of bridges and use them for electrical component measurements. May design and manufacture simple multimeter of his own.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Students will perform experiments using devices like ammeter, voltmeter, CRO etc

Course Learning Outcomes

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Analyze construction and operational aspects of different measuring instruments along with their application domains.	Up to K4
CLO-2	Apply the fundamental measurement method of resistance, capacitance, inductance, etc. by using various a.c bridges and other techniques.	Up to K3
CLO-3	Apply the impact of electrical measurement methods and use modern sophisticated instruments/systems for human utilities and industrial application	Up to K3
CLO-4	Understand the various devices for recording values	Up to K2
CLO-5	Solve problems relating to ranging of level instruments	Up to K3

Course Learning Outcomes**Mapping of CLOs with PSOs**

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	3	3	2			1
CLO-2	3	3	2	2			1
CLO-3	3	2	2	2			1
CLO-4	3	3	2	1			1
CLO-5	3	2	2	1			1

Mapping of CLOs with POs

#	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	2	2		1
CLO-2	3	2	2		1
CLO-3	3	1	1		
CLO-4	3	2	3		
CLO-5	3	2	1		1

**Summative – Blue-Print-Model
(Mapping with CLOs)**

Units	CLOs	K-Level	Section-A		Section-B		Sec-C (Either OR)	Sec-D Open Choice
			MCQs.		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
2	CLO2	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CLO3	Up to K3	2	K1&K2	1	K2	2(K1&K1)	1(K3)
4	CLO4	Up to K2	2	K1&K2	1	K1	2(K2&K2)	1(K2)
5	CLO5	Up to K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Core-6	20U4PMC6	Classical and Statistical Mechanics	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

- To acquire knowledge about the mechanics of systems of particles and their equations of motion.
- To understand Lagrangian and Hamilton's formulation and apply them to solve problems in mechanics.
- To be exposed to the concept of statistics of molecules.
- To understand the statistical energy distribution laws of molecules.

Unit	Description	Hours	K-level	CLO
I	Mechanics of a System of Particles : External and internal forces – Centre of mass – Conservation of linear momentum – Centre of mass-frame of reference – Conservation of angular momentum – Conservation of energy – Box train – particle moving under a central force – Coordinate system – degrees of freedom – Constraints – Types of constraints – Constraints in a rigid body – Generalized coordinates – Generalized velocities – Generalized momentum. Self Study: work– energy theorem.	15	Up to K2	1
II	Lagrangian Formulations: Principle of virtual work – D'Alembert's principle – Lagrange's equation from D'Alembert's principle – Lagrange's equation of motion for conservative system – Lagrangian equations of motion for simple pendulum – Atwood's machine – Compound pendulum – Hamilton's principle – Deduction of Lagrange's equation of motion from Hamilton's principle. Self Study: Lagrangian equation of motion for non conservative system.	15	Up to K3	2
III	Hamiltonian Formulations Generalized Momentum and Cyclic Coordinates – The Hamiltonian function H – Physical significance of H – Hamilton's Canonical equation of motion – Hamilton's equation in Cartesian coordinates – Hamilton's equation for one dimensional harmonic oscillator – Compound pendulum – Projectile motion – Modified Hamilton's principle – Deduction of Hamilton's equation from a Variational principle. Self Study: Hamilton's equation of motion in polar coordinates.	15	Up to K4	3

IV	Classical Statistics Statistical Basis – Micro and macro states – Thermodynamic probability – Phase space – The μ - space and γ space – Fundamental postulates of statistical mechanics – Ensembles – Different types of ensembles – Maxwell-Boltzmann statistics – Maxwell-Boltzmann energy distributive law	15	Up to K3	4
V	Quantum Statistics Development of Quantum statistics – Bose-Einstein Distribution law – Derivation of Planck's radiation formula from Bose-Einstein statistics – Fermi-Dirac Distribution law – Free electrons in metal – Electron gas – Difference between classical and quantum statistics – Comparison of M-B, B-E and F-D Statistics.	15	Up to K3	5

Text books:

- J.C.Upadhyaya, Classical Mechanics, Published by Himalaya Publishing House Pvt. Ltd. (2018).
Unit 1: 1.7.1 – 1.7.5, 1.7.8 (a)–(c), 1.7.8 (1 and 5), 2.2– 2.3.3.1, 2.4.
Unit II: 2.5–2.7, Examples (2.8–2, 3, 5), 2.11.
Unit III: 3.2, 3.4, 3.5, 3.6.1, 3.7(1, 4), Examples (4), 5.4, 5.5.
- Brijlal & Subrahmanyam, Heat Thermodynamics and Statistical Physics, S. Chand & Company Pvt.Ltd. Reprint (2016).
Unit IV: 9.1, 9.7, 9.8. 10.4, 10.5, 10.8, 10.10. 11.2, 11.3.
Unit V: 12.2, 12.5, 12.7–12.9, 12.16.

Reference:

- Classical mechanics – Herbert Goldstein, 2nd Edition, New Delhi, Narosa Publishing House (2001).
- Classical Mechanics, Gupta, Kumar, Sharma, PragatiPrakashan Publ., Meerut(2005).
- Statistical mechanics – S.L.Gupta& V. Kumar –PragatiPrakashan educational publishers , twenty fifth edition (2012).
- ‘Statistical Physics’, Agarwal,S.Chand & co New Delhi (1996).

Web Resources:

- <https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/>
- <https://nptel.ac.in/courses/115/105/115105098/>
- [https://phys.libretexts.org/Bookshelves/Classical_Mechanics/Book%3A_Classical_Mechanics_\(Tatum\)/14%3A_Hamiltonian_Mechanics/14.04%3A_Hamiltonian_Mec](https://phys.libretexts.org/Bookshelves/Classical_Mechanics/Book%3A_Classical_Mechanics_(Tatum)/14%3A_Hamiltonian_Mechanics/14.04%3A_Hamiltonian_Mec)
- <https://static1.squarespace.com/static/570e7b14e707ebd28d391286/t/58038e8a414fb5e45ce883e0/1476628109652/classical-7.pdf>
- https://ps.uci.edu/~cyu/p115A/LectureNotes/Lecture9/html_version/
- <https://www.physics.rutgers.edu/~shapiro/507/book3.pdf>
- https://www.researchgate.net/publication/325637998_Application_of_Hamilton_Principle_in_the_control_of_Tethered_Satellite_System_Pendular_Motion

Course Designers:

- Dr.M.Prema Rani
- Mr.S.RamaKrishnan

Lecture Schedule

Unit	Topics	Hrs	Mode
I	External and internal forces – Centre of mass	1	Chalk and talk, Quiz and assignment
	Conservation of linear momentum– Centre of mass frame of Reference	1	
	Conservation of angular momentum – Conservation of energy	2	
	Box train	1	
	particle moving under a central force	1	
	Coordinate system	1	
	degrees of freedom	1	
	Constraints – Types of constraints	2	
	constraints in a rigid body	2	
	Generalized coordinates	1	
	Generalized velocities	1	
	Generalized momentum	1	
II	Principle of virtual work	1	PPT, Chalk and talk, and Group discussion
	D'Alembert's principle	2	
	Lagrange's equation from D'Alembert's Principle	2	
	Lagrange's equation of motion for conservative system	1	
	Simple applications–Atwood's machine	2	
	simple pendulum	2	
	Compound pendulum	2	
	Hamilton's principle	1	
	Deduction of Lagrange's equation of motion from Hamilton's principle	2	
III	Generalized Momentum and Cyclic Coordinates	2	PPT, Chalk and talk, Quiz and Group discussion
	The Hamiltonian function H – Physical significance of H	2	
	Hamilton's Canonical equation of motion	2	
	Hamilton's equation in Cartesian coordinate	1	
	Modified Hamilton's principle	1	
	Deduction of Hamilton's equation from a Variational principle	2	
	Applications–Harmonic oscillator	2	
	Compound pendulum	1	
	Projectile motion	2	
IV	Statistical Basis–Micro and macro states	2	PPT, Chalk and talk, Assignment
	thermodynamic probability	2	
	Phase space–The mu–space and gamma space	2	
	fundamental postulates of statistical mechanics	1	
	Ensembles–different types	2	
	Maxwell–Boltzmann statistics	3	
	Maxwell–Boltzmann energy distributive law	3	
V	Development of Quantum statistics	2	PPT, Chalk and talk, Quiz and Group discussion
	Bose – Einstein Distribution law	3	
	Derivation of Planck's radiation formula from Bose – Einstein statistics	3	
	Fermi – Dirac Distribution law	3	
	Free electrons in metal– Electron gas	2	
	Difference between classical and quantum statistics	1	
	Comparison of M-B, B-E and F-D Statistics	1	

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course learning Outcomes: On the successful completion of the course, students will be able to

CLO's	Course Learning Outcomes	Knowledge level
CLO-1	Comprehend the concepts of conservation of energy and momentum and apply them to basic problems.	Up to K2
CLO-2	Develop Lagrangian's equation of motion to real life applications.	Up to K3
CLO-3	Formulate Hamilton's equation of motion in different coordinate systems and for orbital trajectories near the surface of the earth.	Up to K4
CLO-4	Infer the basic concepts of statistical mechanics and apply them to derive the distribution law of molecules.	Up to K3
CLO-5	Apply statistical energy distribution laws to analyse various properties of molecules and their applications in different fields.	Up to K3

Mapping with CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	1	1			1
CLO-2	3	2	2	2			1
CLO-3	3	2	3	2			1
CLO-4	3	1	2	1			1
CLO-5	3	1	1	2			1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	1	1		
CLO2	3	2	2		1
CLO3	3	2	3		1
CLO4	3	1	1		
CLO5	3	2	2		2

Advance application- 3;

Intermediate level-2;

Basic level-1

Blue print - Summative Examinations
(Mapping with Course Learning Outcomes (CLOs))

Unit	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K3 & K3)	1 (K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K2	2 (K4& K4)	1 (K4)
4	CLO 4	Up to K3	2	K1 &K2	1	K2	2 (K3& K3)	1 (K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II B.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III and IV	Non – Major Elective (NME)	17U3PNM1/ 17U4PNM2	Communication systems	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

(i). To make the students understand the various principles involved in radio communication systems, TV communication, etc. (ii). To make the students understand various measuring systems like voltmeter, ammeter, multimeter, etc.

Unit	Description	Hours	K – level	CLO
I	Radio Communication EM spectrum – Radio wave – Microwave – Wavelengths – Uses.	6	Up to K2	1
II	Modulation Signal wave – Carrier wave – Amplitude modulation – Frequency modulation.	6	Up to K2	2
III	TV transmission TV transmission and reception –Picture tube – Analog communication –Digital communication.	6	Up to K2	3
IV	Communication electronics RADAR – Principle – Uses – Satellite communication.	6	Up to K2	4
V	Electronic measuring systems CRO – Principle – Voltmeter – Ammeter – Multimeter – Applications (Only one application for each).	6	Up to K2	5

Book(s) for reference:

1. Basic electronics: Solid state, B.L. Theraja, S.Chand Publishing Co., New Delhi, (2006).
2. Electronic communication systems, George Kennedy, Bernard Davis, S.R.M. Prasanna, Mc Graw Hill education, (2011).

Web Resources:

1. EM spectrum : <https://earthsky.org/space/what-is-the-electromagnetic-spectrum#:~:text=The%20electromagnetic%20spectrum%20is%20the,alternating%20electric%20and%20magnetic%20fields.>

2. Modulation: <https://searchnetworking.techtarget.com/definition/modulation#:~:text=Modulation%20is%20the%20process%20of,%2C%20or%20amplitude%2C%20and%20frequency.>
3. TV transmission: <https://www.tecnicontrol.pt/en/the-various-methods-of-tv-transmission/>
4. RADAR: <https://www.elprocus.com/radar-basics-types-and-applications/>
5. Electronic measuring systems: <https://www.tutorialspoint.com/electronic-measuring-instruments/measuring-instruments.htm>

Course Designer(s):

1. Dr.J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	EM spectrum	2	PPT, Chalk and talk, Quiz and assignment
	Radio wave, Microwave	2	
	Wavelengths , Uses	2	
Unit II	Signal wave , Carrier wave	2	Chalk and talk, Quiz and assignment
	Amplitude modulation	2	
	Frequency modulation	2	
Unit III	TV transmission and reception	2	Chalk and talk, Quiz, assignment and
	Picture tube, Analog communication	2	
	Digital communication	2	
Unit IV	RADAR	2	Chalk and talk, quiz, Group discussion
	Principle & Uses	2	
	Satellite communication	2	
Unit V	CRO Principle	2	PPT, Chalk and talk, Quiz and Interaction
	Voltmeter , Ammeter	2	
	Multimeter , Applications	2	

Pedagogy: Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Group discussion and interactions.

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLO	Course Learning Outcomes	Knowledge Level
CLO –1	Understand the basic concepts of EM spectrum mainly about Radio wave and Microwave	Up to K2
CLO –2	Judge the effects Amplitude modulation and Frequency modulation in the radio frequency	Up to K2
CLO –3	Distinguish Analog communication and Digital communication	Up to K2
CLO –4	Describe the uses of RADAR in Satellite communication	Up to K2
CLO –5	Solve the simple problems in electrical circuits using Voltmeter , Ammeter and Multimeter	Up to K2

Mapping with CLOs with PSOs

#	PSO –1	PSO –2	PSO –3	PSO –4	PSO –5	PSO –6	PSO –7
CLO –1	3	2					1
CLO –2	3	3					1
CLO –3	3	2					1
CLO –4	3	2					1
CLO –5	3	3	3				1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	2			
CLO2	3	1			
CLO3	3	1			
CLO4	3	2			
CLO5	3	2	3		1

Advance application – 3;

Intermediate level –2;

Basic level –1

Learning Outcome Based Education & Assessment (LOBE)**Blue Print – (CIA-I & II)****Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)**

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO x	Up to K2	1	K1	1	K2/K2	1	K1
CLO y	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

Distribution of Section-wise Marks with K Levels (CIA I & II)

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

Learning Outcome Based Education & Assessment (LOBE)

Blue Print

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

DEPARTMENT OF PHYSICS				CLASS: II B.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Practical	20U3PMP3	Major Practical - III	2	3	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

List of Experiments (Any six/semester)

Objectives:

- To expose the students to experiments in the areas of optics and electricity. This Experimental physics course provides hands– on learning experience in measuring the concepts that are learnt theoretically.
- Laboratory techniques with accuracy in measurements and data analysis enhances effective comprehension of physics concepts.

No.	Experiment
1	A.C. SONOMETER
2	E.C.E. OF COPPER
3	POTENTIOMETER-LOW RANGE VOLTMETER
4	AIR WEDGE
5	CONCAVE LENS
6	De SAUTY'S BRIDGE
7	CAREY-FOSTER'S BRIDGE
8	M.G- FIGURE OF MERIT
9	LCR- SERIES RESONANCE CIRCUIT
10	POLARIMETER-MEASUREMENT OF SPECIFIC ROTATORY POWER-SUGAR SOLUTION
11	SPECTROMETER – i-d CURVE

Books for Reference:

- M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
- Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2011, Kitab Mahal Agencies, New Delhi. .
- S.R. Govinda Rajan, T. Murugaiyan, S. Sundara Rajan, Practical Physics, 2007, Rochouse & Sons.
- Relevant reference from web Sources.

Course Designer(s):

- Mr.T.Vivekanandan
- Mr.V.Meenakshi Sundaram
- Mr.V.Seenivasan

Pedagogy : Demonstration and practical session.

Course Learning Outcomes (CLO)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level	Marks
1	Understand the basic laws of physics that can be used to determine the various physical parameters.	Up to K2	10
2	Apply knowledge of physics and able to construct the relevant circuits.	Up to K3	10
3	Complete the experiment and the relevant data can be recorded.	Up to K3	15
4	Analyse the collected data from the experiment and relevant graphs can be drawn.	Up to K4	20
5	Interpret the results and proper views can be expressed.	Up to K2	5

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	2		3		2	3
CLO2	3	3	3	3		3	2
CLO3	3	2		3		2	3
CLO4	3	3	2	3		2	2
CLO5	3	2	1	3		2	3

Mapping of CLO's with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	1	3			
CLO2	1	3	2		
CLO3		3	1		
CLO4	1	3	2		
CLO5		3	2		

Advance application –3, Intermediate level –2 , Basic level

DEPARTMENT OF PHYSICS				CLASS: II B.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Practical	20U4PMP4	Major Practical - IV	2	3	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

List of Experiments (Any six/semester)

Objectives:

- To expose the students to experiments in the areas of optics, electricity and magnetism. This Experimental physics course provides hands– on learning experience in measuring the concepts that are learnt theoretically.
- Laboratory techniques with accuracy in measurements and data analysis enhances effective comprehension of physics concepts.

No.	Experiment
1	FIELD COIL-EARTH'S HORIZONTAL MAGNETIC INDUCTION
2	GRATING - DETERMINATION OF WAVELENGTH
3	M.G- THERMOCOUPLE
4	Determination of coefficient of mutual inductance - ANDERSON'S BRIDGE
5	Determination of coefficient of mutual inductance - OWEN'S BRIDGE
6	TAN-C
7	CRO- MEASUREMENT OF ELECTRICAL PARAMETERS
8	LCR- PARALLEL RESONANCE CIRCUIT
9	POTENTIOMETER – AMMETER CALIBRATION
10	POTENTIOMETER – RESISTANCE MEASUREMENT
11	CONVERSION OF 'G' INTO 'V'

Books for Reference:

- M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
- Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2011, Kitab Mahal Agencies, New Delhi. .
- S.R. Govinda Rajan, T. Murugaiyan, S. Sundara Rajan, Practical Physics, 2007, Rochouse & Sons.
- Relevant reference from web Sources.

Course Designer(s):

- Mr.T.Vivekanandan
- Mr.V.Meenakshi Sundaram
- Mr.V.Seenivasan

Pedagogy : Demonstration and practical session.

Course Learning Outcomes (CLO)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level	Marks
1	Understand the basic laws of physics that can be used to determine the various physical parameters.	Up to K2	10
2	Apply knowledge of physics and able to construct the relevant circuits.	Up to K3	10
3	Complete the experiment and the relevant data can be recorded.	Up to K3	15
4	Analyse the collected data from the experiment and relevant graphs can be drawn.	Up to K4	20
5	Interpret the results and proper views can be expressed.	Up to K2	5

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	2		3		2	3
CLO2	3	3	3	3		3	2
CLO3	3	2		3		2	3
CLO4	3	3	2	3		2	2
CLO5	3	2	1	3		2	3

Mapping of CLO's with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	1	3			
CLO2	1	3	2		
CLO3		3	1		
CLO4	1	3	2		
CLO5		3	2		

Advance application –3, Intermediate level –2 , Basic level–1

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Add-on	21U3PADD1	How Stuff Works	2	2	50	50	100

Unit I : House hold Appliances

Airconditioner –Air-conditioning basics- The parts of an Air Conditioner – Window and split-system AC Units – Chilled water and cooling tower AC units – BTU and EER – Energy efficient cooling systems- Water Filter –Water filter basics – Choosing a water filter – Water filter troubleshooting – Other ways to purify water - Reverse Osmosis- Osmosis down, Flip it and reverse it –Usage of reverse osmosis – smaller scale applications of reverse osmosis – Disadvantage of reverse osmosis - Washing Machine – cleaning clothes – Inside a washing machine – Plumbing – Pump – Drive mechanism – Inside the gearbox – Controls.

Unit II: Kitchen Appliances

Refrigerator- The purpose of refrigeration – Parts of a refrigerator – Understanding Refrigeration – the refrigeration cycle – Gas and propane refrigerators – Electric and solar coolers – Cold packs - Microwave oven- Blender – Blender mechanics – Types of blenders – Shopping for blenders.

Unit III: Medical Diagnostics

Pulseoximeter – Introductoion – Oxygen saturation – Physical properties used in pulse oximetry – Calibration - Pulse oximeters measure pulsatile arterial blood -Signal is very small– Plethysmographic trace (pleth)- Light source – Coping with ambient light - Poblems associated with using pulse oximeters - Ultrasound - Introduction to sound and ultrasound- Sending and receiving ultrasound - Interaction of ultrasound with body tissues- Scanning modes : A scan, B scan - Frequency, Wavelength, Resolution, and Depth - Doppler Effect– MRI - Strange world of quantum physics and spin - Detection of hydrogen nuclei - How the MRI machine is able to target different areas of the body - Receiver coils - Magnet and Quenching - Noise : The ” Gradient Coil Guitar “ - Anesthesia and MRI.

Unit IV: Digital Photocopying Devices

Photocopier –The basics – Photoreceptor drum – Corona wires – Lamp and Lenses – Toner - Scanner – Anatomy of a scanner – The scanning process – Resolution and interpolation – Image transfer - Fax Machine – Basic Idea behind fax machines – Modern fax machines – Receiving a fax – How to use a fax machine – fax machine troubleshooting – portable fax machines– Printer – The basics of Sattic electricity , drum, fuser – The controller : the conversation, the language , setting up the page – The laser assembly – Writing the page – Toner basics – Applying the toner – Color printers – Advantage of a laser printer.

Unit V: Electrical Safety

Electric shock - Resistive heating - Spark ignition sources – Guarding – Grounding - Circuit Protection Devices - Safe work practices.

Web resources:**Unit I :**

Airconditioner

<https://home.howstuffworks.com/ac.htm/printable>

Water Filter

<https://adventure.howstuffworks.com/outdoor-activities/hiking/water-filter.htm>

Reverse Osmosis

<https://science.howstuffworks.com/reverse-osmosis.htm>

Washing Machine

<https://home.howstuffworks.com/washer.htm/printable>

Unit II :

Refrigerator

<https://home.howstuffworks.com/refrigerator.htm/printable>

Microwave oven

<https://home.howstuffworks.com/microwave1.htm>

Blenders

<https://home.howstuffworks.com/blender.htm/printable>

Unit III :

Pulse oximeter

https://www.howequipmentworks.com/pulse_oximeter/

Ultrasound

https://www.howequipmentworks.com/ultrasound_basics/

MRI

https://www.howequipmentworks.com/mri_basics/

Unit IV :

Photocopier

<https://home.howstuffworks.com/photocopier.htm/printable>

Scanner

<https://computer.howstuffworks.com/scanner.htm/printable>

Fax Machine

<https://electronics.howstuffworks.com/gadgets/fax/fax-machine.htm/printable>

Printer

<https://computer.howstuffworks.com/laser-printer.htm/printable>

Unit V:

Electrical Safety

<https://fens.sabanciuniv.edu/en/preventing-electrical-hazards>

https://www.howequipmentworks.com/electrical_safety/

Course designers:

Dr.M.Prema Rani

Mr.S.SivaramaKrishnan

Dr.R.VishnuPriya

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Add-on	21U4PADD2	Problem solving in Physics in selected topics	2	2	50	50	100

Unit 1: Mechanics

Force, mass and acceleration – friction – projectile motion – circular motion – law of universal gravitation– work done by a force.

Unit 2: Heat and Thermodynamics

Conduction, convection and radiation – the mole concept – the ideal gas law – first law of thermodynamics – second law of thermodynamics – heat engines – entropy.

Unit 3: Electricity and magnetism

Coulomb's law – electric field – electric flux and Gauss law – potential due to point charge and charge distribution – capacitors in combination – resistors in combination – force on a moving charge – law of Biot & Savart – susceptibility and relative permeability – inductance.

Unit 4: Optics

Reflection and refraction – dispersion – thin lenses – lens maker's equation – optical instruments – interference, diffraction and polarization.

Unit 5: Modern physics

Special relativity – length contraction – time dilation – mass-energy relation – photons and photoelectric effect – Compton scattering (X-rays) – de Broglie waves and uncertainty principle – the Bohr atom – particle accelerator.

Book for study:

1.Schaum's 3000 solved problems in Physics, Alvin Halpern, TMH ed., 1989, Singapore.

Unit 1:Problems: 4.1, 4.3, 4.5, 4.39, 4.44, 4.45, 5.1, 5.4, 5.5, 6.1, 6.2, 6.3, 6.27, 6.31,6.42,7.4, 7.7, 7.10.

Unit II: Problems: 19.2, 19.30, 19.38, 20.1, 20.2, 20.7, 20.10, 20.14, 20.15, 21.18, 21.21, 21.22, 21.25, 21.29, 21.46, 22.11, 22.18, 22.23.

Unit III: Problems: 25.12, 25.13, 25.16, 25.26, 25.32, 25.64, 26.10, 26.70, 26.90, 27.40, 28.3, 28.4, 28.26, 28.91, 28.92, 29.18, 29.30, 31.59.

Unit IV: Problems: 34.5, 34.13, 34.27, 34.72, 34.76, 34.79, 35.60, 35.64, 35.71, 35.82, 35.103, 35.105, 36.8, 36.12, 36.43, 36.45, 36.54, 36.60, 36.68

Unit V: Problems: 37.13, 37.21, 37.50, 37.53, 37.53, 37.54, 37.56, 37.58, 38.2,38.19,3.8.23, 38.23, 38.30, 38.41, 34.42, 38.43, 38.43, 38.44, 38.45, 38.54,38.66, 39.4, 39.46.

Course designer: Mr.T.Vivekanandan

Evaluation pattern for Add-on courses

Internal evaluation : 50 % marks

External evaluation : 50 % marks

Continuous Internal Assessment components	Marks
Periodic Assignment (3 nos)/mini project	20 %
Paper presentation/seminar	15 %
Quiz/Viva-voce (related to the paper) / Innovative experiment modeling	15 %
Total	50%

External examination duration : 2 hours

Question paper pattern:

Part-A (Multiple choice type) (10 x 1 = 10 marks)

Part- B (Descriptive type) (4 out of 7 questions to be answered) (4 x 10 = 40 marks)

Evaluation pattern for Self-study courses

Assessment components	Marks
Assignments (minimum 2)	25%
Project/innovative experimental design	25%
Paper presentation/ viva voce	25%
Internal test	25%
Total	100%

DEPARTMENT OF PHYSICS				CLASS: II B.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Self Study	21U4PSS1	LASER PHYSICS	2	-	50	50	100

Objective:

To introduce the physical and engineering principles of laser operation and their applications.

Unit 1: Fundamentals of LASER

Spontaneous emission – Stimulated emission – Meta stable state –Population inversion – Pumping – Laser Characteristics .

Unit 2: Production of LASER

Helium – Neon Laser – Ruby Laser – CO₂ Laser – Semiconductor Laser

Unit 3: Industrial Applications of LASER

Laser cutting – Welding – Drilling – Hologram – Recording and reconstruction of hologram

Unit 4: Lasers in Medicine

Lasers in Surgery – Lasers in ophthalmology – Lasers in cancer treatment

Unit 5: Lasers in Communication

Optic fibre communication – Total internal reflection – Block diagram of fibre optic communication system – Advantages of fibre optic communication.

Books for study:

1. N. Avadhanulu , *An introduction to LASERS*, S. Chand & Company,2001.

Books for References:

1. William T. Silfvast, *Laser fundamentals*, University Press, Published in South Asia by Foundation books, New Delhi, 1998
2. K. Thyagarajan and A.K. Ghatak, *LASER Theory and Application*, Mc Millan, India Ltd, 1984.

Course designer:

Mr.V.MeenakshiSundaram

DEPARTMENT OF PHYSICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course		The Science of Telescope Making	2	30	50	50	100

Objective:

To create enthusiasm for the students to construct one of the fascinating instrument in the subject of optics “The Telescope”.

Learning Outcomes:

After the successful completion of the course students will be able to,

- ❖ Work with the traditional way of mirror making process of the telescopes.
- ❖ Construct the Newtonian form of telescopes.
- ❖ Explore objects of the sky by using their own telescopes.

Unit - I: Basic Optics and Telescopes

Geometrical optics – Aspherical surfaces – Refraction at spherical surfaces – Mirrors – Planar mirrors – Aspherical mirrors – Spherical mirrors – Definition of a perfect objective – The Rayleigh criterion – Principal types of telescopes – Refractor Vs. Reflector as the amateur’s telescope.

Unit - II: Tools and Accessories

The mirror blank and Tool – Abrasives – Polishing materials – The Polishing lap – Making the lap – Advantages of a telescope window – Choice of glass – Role of the eyepiece and its selection – The Barlow lens – Finders.

Unit - III: Making the Mirror

Form of the main mirror in the Newtonian telescope – Working of optical surfaces and theories concerning polishing – Preparing the mirror disk – Rough grinding – Fine grinding and Smoothing – Polishing conditions and requirements – The polishing operation – Parabolizing – The plane diagonal mirror – Form and dimensions of the diagonal mirror – The diagonal mirror blank - Resurfacing the flat mirror – Cutting the mirror – Reflective mirror coatings – Chemical silvering.

Unit - IV: Optical Testing

Review of possible test methods – Nature of the Foucault test – Foucault test apparatus – Making the Foucault test – The Couder screen – Interference test for flat mirrors – Making the interference test.

Unit - V: Mechanical Structure

Choice of a standard design – Important details – The altazimuth mounting – Principles of design – The equatorial mounting – General discussion.

Books for study:

1. Eugene Hecht, Optics, 5th edition, Pearson Education Limited.
2. Jean Texereau, How to make a telescope, 2nd edition, Willmann-Bell, Inc.

Books for reference:

1. N. E. Howard, Standard handbook for telescope making, Thomas Y. Crowell company.
2. Albert G. Ingalls, Amateur telescope making volume 1, Willmann-Bell, Inc.

Course designer: Mr.V.Seenivasan

DEPARTMENT OF PHYSICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course		Energy Audit	2	30	50	50	100

Objective:

- To improve energy performance and minimize the environmental impacts of the organization's operations.
- To identify behavioral change opportunities by evaluating current operations and maintenance practices.
- To identify technical opportunities by evaluating significant process energy-using components or utilities including boilers, refrigeration plant, ventilation systems, building performance and fleet efficiency.

Learning Outcomes:

- Enable the students to have clear financial information regarding energy savings opportunities in order to priorities these items for the organization's decision-making process.
- Enable the students to identify potential for using renewable energy supply technologies.
- Enable the students to contribute to the process for certification to a formal energy management system, as set out in ISO 50001

Unit – I Basic of Energy and its various forms

Introduction – Work, Energy, and Power – Electricity Basics – Energy Units – Conversions.

Unit –II Undertaking an Energy Audit

Energy audit – Energy audit work – Preparation – Initial Preparation - Pre – analysis and Planning – Conducting the site visit.

Unit –III Technical Assessment

Buildings and building fabric such as glazing and insulation - Lighting - Heating, controls and boilers - Heating ventilation and air conditioning (HVAC) – Pumps - Transport fleet, telematics - Refrigeration - Industrial processes - Wastewater treatment plants - Compressed air.

Unit – IV Financial Analysis of Opportunities

Choice of financial analysis tool - Validated calculations -Financial analysis methods

Unit – V Identifying and Prioritizing Opportunities

Identify opportunities forImprovement - Generate register of opportunities – Methods to identify opportunities - Prioritize opportunities - Reporting the Results.

Text Book:

1. Energy Sources & Policies in India 2011, Rishi Muni Dwivedi.
2. Energy Audit Handbook, Sustainable Energy Authority of Ireland (SEAI).

Course designer: Dr.M.Pandi

DEPARTMENT OF PHYSICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course		Nanomaterials and Nanotechnology	2	2	50	50	100

Objectives:

- To make the students understand the basic concepts of nanomaterials and nanotechnology.
- To impart the knowledge on the synthesis of nanomaterials and various characterization techniques employed in analyzing their properties.
- To realize the applications in various technological fields and environment.

Learning Outcomes:

1. Enable the students to comprehend the properties of nano materials.
2. Apply the learned knowledge to synthesis nanomaterials and analyse their properties useful for various technological fields.

UNIT-I: Nano materials

Definition of nanometer, nanomaterial and nanotechnology-classification of nanomaterials-examples of nano structured materials-increased surface area of nanomaterials.

UNIT-II: Synthesis of nanomaterials

Intoduction- sol-gel method-hydrothermal growth-thin film growth-phsicalvapour deposition- chemical vapour deposition.

UNIT-III: Nano structure

Introduction-shape and structures of nanomaterials-size effect on shape of materials- size effect on electronic properties-nanorods,nanocone,nano tetra pods, nano particles-nanocombes and nano walls.

UNIT-IV: Nano materials characterization techniques

X-ray diffraction and scherrer method- scanning electron microscopy- electron interaction with matter-transmission electron microscopy-atomic force microscopy-diffuse reflectance spectra.

UNIT-V: Application of nano technology

Application: Material science-biology and medicine-bio compatibility and toxicity in nanomaterials-energy and environment-magnetic nano particle.

Books for study:

1. M.S Ramachandra Rao and shubrasingh,Nano science and nanotechnology,Reprint edition 2014,Wiley publication.

Sections: **Unit-1:** 1.2, 1.3,1.3.1,1.3.2 **Unit-2:**4.1,4.4,4.4.1.1,4.4.1.2,4.4.1.3,
Unit-3:5.1,5.2.1,5.2.2,5.2.3,5.2.4 **Unit-4:**8.2,8.3,8.4,8.7,8.12
Unit-5:10.2,10.3,10.3.1,10.4,10.5,10.9.4

BOOKS FOR REFERENCE:

1. Renewal Energy Resources -John Twideu and Tony Weir, BSP Publications,2006.
2. Energy Resources: Conventional & Non-Conventional -M.V.R. KoteswaraRao, BSP Publications,2006.
3. Non-conventional Energy Resources -D.S. Chauhan, New AgeInternational.
4. Renewal Energy Technologies: A Practical Guide forBeginners C.S. Solanki-PHI Learning

Course designers:

Prof.G.Gowri
Dr.M.Kavitha

DEPARTMENT OF PHYSICS				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course		MATLAB Programming using OCTAVE	2	30	50	50	100

Course Objectives:

- To understand and write the scripts and functions of MATLAB program using OCTAVE software.
- To impart the knowledge of MATLAB constants, variables and expressions in the scientific calculations.
- To expose the students to the knowledge of vectors, scalars and its basic operations
- To perform different operations on polynomials and evaluate with matrix arguments
- To learn the basic feature of plotting a 2-D and 3-D graph in MATLAB graphics.

UNIT-1: Introduction to MATLAB

Introduction – Major components of MATLAB environment – Help browser and help command – Different types of files used in MATLAB – Various platforms – Some useful MATLAB commands

UNIT -2: Constants, variables and expressions

Character set – Data types – Constants and variables – Operators – Hierarchy of operations – Built in functions – Assignment statement

UNIT-3 : Vectors and matrices

Scalars and vectors – Entering data in matrices – Line continuation – Matrix subscripts/indices – Multidimensional matrices and arrays – Matrix manipulations – Generation of special matrices – Some useful commands related to matrices – Matrix and array operations – Functions with array inputs – Structure arrays – Cell arrays – Some useful commands of structures and cells.

UNIT-4: Polynomials

Entering a polynomial – Polynomial evaluation – Roots of a polynomial – Polynomial addition and subtraction – Polynomial multiplication – Polynomial division – Formulation of polynomial equation – Characteristic polynomial of a matrix – Polynomial differentiation – Polynomial integration – Polynomial curve fitting – Evaluation of polynomials with matrix arguments

UNIT-5 : MATLAB graphics

Two dimensional plots – Multiple plots – Style options – Legend command – Sub plots – Specialized two-dimensional plots – Three dimensional plots.

Text book:

[1] MATLAB and its Applications in Engineering, Rajkumar Bansal, Ashok Kumar Goel and Manoj Kumar Sharma, Pearson Education, 2008.

Course designer: Prof.M.Megala

I UG Ratifications

Course Code	Course title	Nature of the course	Rationale	Activities having direct bearing on Skill development/ Employability/ Entrepreneurship
20U1PMC1	Properties of matter and sound	Knowledge and skill	The core paper aims to expose the students to the knowledge of materials suitable for construction of buildings based on their moduli of elasticity. The student will gain knowledge on properties of liquids and understand the physics of sound through different experimental techniques.	Experimental based activities in the lab to understand moduli of elasticity and properties of liquids. Seminar presentation. Problem solving.
20U1PMC2	Mechanics	Knowledge and skill	Core paper on Mechanics focuses on the fundamental ideas on conservation laws of motion and its applications. The students will learn the basic ideas of rotational and vibrational motion of rigid bodies. Also they will be exposed to the concepts of Gravitational fields.	Solving problems. Experimental based activities related to gravitational laws, moment of inertia.
20U2PMC3	Heat and thermodynamics	Knowledge and skill	The core paper aims to make the students understand the phenomena connected with measurement of temperature, concept of specific heat capacities of matter and transmission of heat.	Problem solving, Experimental activities in the lab.
20U2PMC4	Optics	Knowledge and skill	The core paper focuses on the concepts of rectilinear propagation of light and the student will gain knowledge in the basics of the dispersions in prisms and aberrations in lenses and the wave properties of light .	Problem solving, Experimental activities in the lab.
20U1PAC1 / 20U3PAC1	Allied Physics – I	Knowledge and skill	Allied paper aims to make the students to understand the concept of strength of materials and viscous properties of liquids. Students would gain knowledge in the basic properties of light such as interference and diffraction.	Seminar presentation, Problem solving.
20U2PAC2 / 20U4PAC2	Allied Physics - II	Knowledge and skill	Allied paper aims to make the students to understand the concepts of resistance of materials and capacity of conductors and the	Experimental activities in the lab related to semiconductor

			process of alternating current. Students would also gain knowledge about atom models and the basic ideas of semiconductor diodes, transistor and logic gates.	materials, Problem solving.
20U1PMP1	Practical - I	Knowledge and skill Skill Oriented	The core lab practicals aim to expose the students to perform experiments in the areas of Mechanics, Properties of matter, Heat and Sound. The students would understand the Physics concepts that are learnt theoretically.	Individual experimental activity. Hands – on training. Analysis and interpretation of results.
20U2PMP2	Practical - II	Knowledge and skill Skill Oriented	The core lab practicals aims to expose the students to perform experiments in Mechanics, Properties of matter, Heat and Optics. Students would effectively comprehend the concepts of Physics from laboratory techniques with accuracy in measurements and data analysis.	Individual experimental activity. Hands – on training. Analysis and interpretation of results
20U1PAP1 / 20U3PAP1	Allied Practical-I	Knowledge and skill Skill Oriented	The Allied practicals focus to expose the students to experiments in the areas of Properties of matter, Thermal physics. Students would effectively comprehend the concepts of Physics from laboratory techniques with accuracy in measurements and data analysis.	Individual experimental activity. Hands – on training. Analysis and interpretation of results
20U2PAP2 / 20U4PAP2	Allied practical - II		The Allied practicals focus to expose the students to experiments in the areas of Electricity & Magnetism, Optics and Electronics. Students would effectively understand the basic laws of physics that can be used to determine the various physical parameters	Individual experimental activity. Hands – on training. Analysis and interpretation of results

The Madura College (Autonomous)

**Re-accredited (3rd cycle) with “A” grade by NAAC
Vidya Nagar, TPK road, Madurai-625011**



Research Centre & PG Department of Physics

Curriculum – M.Sc. Physics

(To be implemented from the academic year 2021–2022)

PSOs	Programme specific learning outcomes	Graduate Attributes
PSO1	Demonstrate a fundamental/systematic or coherent understanding of the academic field of physics its different core learning areas like Classical, Statistical and Quantum mechanics, Electro Magnetic theory, Modern optics, Condensed Matter Physics, Nuclear and Particle Physics and also in applied areas like spectroscopy, Instrumentation, Electronics and Communication and also in non domain areas of interest to the students.	Knowledge in core competency
PSO2	Apply the principles of mathematical modelling and the power of computation to describing the physical world.	Problem analysis
PSO3	Plan and execute physics related experiments or investigations analyze and interpret data/information collected using appropriate methods including the use of appropriate software such as programming languages and purpose – written packages, and report accurately the findings of the experiments/investigations while relating the conclusion/findings to relevant theories of physics.	Design and development of solution for complex problems
PSO4	Apply skills in areas related to his specialization within the disciplinary area of physics and also in current and emerging developments in the field of physics.	Modern tool usage
PSO5	Demonstrate relevant generic skills and global competencies such as (i) problem solving skills that are required to solve different types of physics –related problems with well defined solutions and tackle open-ended problems that belong to the disciplinary-area boundaries; (ii) Investigate skills, including skills of independent investigation of physics-related issues and problems; (iii) Communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature; (iv) Analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to physics and ability to translate them with popular language when needed; (v) ICT skills; (vi) Personal skills such as the ability to work both independently and in a group.	Individual and team work, project management, communication, Life long learning

PROGRAMME EDUCATION OBJECTIVES

- PEO1.** To produce graduates with ethical values and professional skills who excel in the competencies in the rapidly evolving global community and contribute to the development of the society.
- PEO2.** To motivate the students to prepare for competitive examinations and pursue higher education in the reputed institutions globally with focus on research and development.
- PEO3.** To endow the students with critical and analytical thinking, problem solving skills which will equip them to become entrepreneurs.
- PEO4.** To promote capacity to work effectively in diverse teams in classroom, and in laboratory.
- PEO5.** To enhance the digital efficiency to use computation and appropriate softwares, e-library to retrieve and evaluate Physics information.

PG SYLLABI STRUCTURE

Sem.	Course	Subject Code	Course title	Contact hours/ week	Credits
I	Core-1	21P1PMC1	Mathematical Physics- I	5	4
	Core-2	21P1PMC2	Classical Mechanics	5	4
	Core-3	21P1PMC3	Advanced Electronics	5	4
	Core-Elective-I	21P1PME1	Physics of Non conventional Energy resources	5	4
		21P1PME2	Medical Physics		
	NME-I	21P1PNM1	Astrobiology	2	2
	Practicals-I	21P1PMP1	Practicals– I	4	2
	Practicals II	21P1PMP2	Practicals – II	4	2
Credits					22
II	Core-4	21P2PMC4	Mathematical Physics – II	5	4
	Core-5	21P2PMC5	Quantum Mechanics –I	5	4
	Core-6	21P2PMC6	Electromagnetic Theory	5	4
	Core-Elective-II	21P2PME3	Instrumentation and methods	5	4
		21P2PME4	Computational Physics		
	NME-II	21P2PNM2	Universe	2	2
	Practicals-III	21P2PMP3	Practicals–III	4	2
	Practicals-IV	21P2PMP4	Practicals–IV	4	2
Credits					22
III	Core-7	21P3PMC7	Condensed Matter Physics-I	5	4
	Core-8	21P3PMC8	Quantum Mechanics –II	5	4
	Core-9	21P3PMC9	Thermodynamics & Statistical Mechanics	6	4
	Core-Elective-III	21P3PME5	Advanced Microprocessor	6	4
		21P3PME6	Crystal growth and thin film techniques		
	Practicals-V	21P3PMP5	Practicals–V	4	2
	Practicals-VI	21P3PMP6	Practicals–VI	4	2
Credits					20
IV	Core-10	21P4PMC10	Condensed Matter Physics – II	5	4
	Core-11	21P4PMC11	Molecular Spectroscopy	5	4
	Core-12	21P4PMC12	Nuclear and Elementary Particle Physics	6	4
	Core-Elective-IV	21P4PME7	Modern Optics	6	4
		21P4PME8	Nano Physics		
	Practicals-VII	21P4PMP7	Practicals–VII	4	2
	Practicals-VIII	21P4PMP8	Practicals–VIII	4	2
	Project	21P4PMR		0	6
Credits					26
Total Credits					90

Learning Outcome Based Education (LOBE) & Assessment Formative – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		Section B(Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Question	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2,K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Components of Formative Assessment	K-Level	Marks
Internal Test (Average of two tests)	-	10
Assignment	K5	5
Quiz	K4	5
Seminar	K4	5
Total		25

- ✓ Centralised system of Internal Assessment Tests
- ✓ There will be a two internal assessment tests
- ✓ Duration of Internal assessment test will be 2 hours
- ✓ Students shall write retest on the genuine grounds if they are absent in either Test I or Test II with the approval of HOD and the Principal

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core-1	21P1PMC1	Mathematical Physics – I	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

- To highlight the relationship of mathematical tools to understanding the dynamics of the physical world we live in.
- To impart knowledge on mathematical tools and techniques that could model real life physical systems.
- To demonstrate the use of vectors, matrices, transforms and special functions spanning areas like Electromagnetic theory, Quantum Mechanical systems, communication electronics and optics.

Course Content:

Unit	Description	Hours	K-level	CLO
I	Vectors : Line integrals – Conservative vectors field – Surface integral – Volume integral – Stoke's theorem – Green's theorem in a plane – Gauss divergence theorem – Applications of Gauss theorem – Curvilinear coordinates – Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.	15	Up to K3	1
II	Matrices : Linear vector space – Linear dependent and independent vectors – Basics – Schmidt orthonormalization – Matrices as linear transformations – Eigen values and eigen vectors – Cayley Hamilton theorem and its applications – Diagonalisation – Similarity transformations – Special matrices – Orthogonal, Hermitian, Skew-Hermitian and Unitary matrices – Orthogonal and unitary transformations.	15	Up to K3	2
III	Fourier Transforms: Fourier transform – Infinite Fourier sine and cosine transforms – Properties of Fourier transforms – Linearity theorem – Similarity theorem – Shifting property – Modulation theorem – Convolution theorem – Parseval's Theorem – Derivative of Fourier transform – Fourier transform of a derivative.	15	Up to K4	3
IV	Special functions - I : Beta function: Symmetry property – Evaluation – Other forms – Gamma Function : Evaluation – other forms – Relation between beta and gamma functions – Miscellaneous propositions - Legendre differential equation – Generating function - Physical basis in Electrostatics - Linear electric multipoles - Rodrigues' formula – orthogonal property – Recurrence formulae - gravitational potential due to spheroidicity of earth.	15	Up to K4	4

V	Special Functions - II : Bessel's differential equation (No power series solution) – Recurrence formulae – Generating function – Orthonormality of Bessel functions – Application of Bessel's function to Fraunhofer diffraction using circular aperture - Hermite polynomials (no power series solution) – generating function – recurrence formulae – Rodrigue's formula – orthonormality of Hermite polynomials.	15	Up to K3	5

Books for study:

1. Vectors analysis, M. R. Spiegel, Schaum's outline series, MHI, 1974.
Unit I: Chapter 5, 6 and 7.
2. Engineering mathematics, M. K. Venkataraman, VthEdn., National Pub., 1999.
Unit II: 4.1, 4.2, 4.5, 4.7, 5.1, 5.3, 6.2, 6.3, 7.1-7.6, 7.8.
3. Mathematical Physics with Classical Mechanics, Satya Prakash, VthEdn., Sultan Chand & Sons, 2007.
Unit III: 10.1 to 10.5
Unit IV: 4.1 to 4.7, 4.9, 4.10, 7.11 to 7.15
Unit V: 7.21, 7.25, 7.26, 7.29, 7.33 to 7.37
4. Mathematical Methods for Physicists, Arfken & Weber, VI Edition, Elsevier, 2011
Unit IV : 12.1 (Pages 744 to 748), Example 7.3.1 (Page 758)
Unit V : Example 11.1.1 (Page 680)

Books for References:

1. Mathematical methods in Physical Sciences, Mary L Boas, Wiley Eastern, III Edition, 2006
2. Mathematical methods for Physicists and Engineers, Riley, Hobson and Bence, Cambridge University Press, III Edition, 2018.

Web Resources:

1. https://oer.uoch.edu.pk/home/watch_lecture/1373/70674
2. [https://math.libretexts.org/Bookshelves/Differential_Equations/Book%3A_Partial_Differential_Equations_\(Walet\)/10%3A_Bessel_Functions_and_Two-Dimensional_Problems](https://math.libretexts.org/Bookshelves/Differential_Equations/Book%3A_Partial_Differential_Equations_(Walet)/10%3A_Bessel_Functions_and_Two-Dimensional_Problems)
3. <https://www.physics.uoguelph.ca/chapter-3-legendre-polynomials>
4. <https://online.stat.psu.edu/stat505/lesson/4/4.5>

Pedagogy :

Chalk and talk, Presentation, Quiz, Seminar, Assignment

Course Designers :

S. Sivaramakrishnan
Dr. K. Neyvasagam

Course Plan:

Unit	Topics	Hrs	Mode
Unit I	Line integrals – Conservative vectors field - Surface integral – Volume integral	3	Chalk and talk, Presentation, Quiz and assignment
	Stoke's theorem	3	
	Green's theorem in a plane	3	
	Gauss divergence theorem – Applications of Gauss theorem	3	
	Curvilinear coordinates – Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.	3	
Unit II	Linear vector space – Linear dependent and independent vectors – Basics – Schmidt orthonormalization	3	Chalk and talk, Quiz and assignment
	Matrices as linear transformations – Eigen values and eigen vectors	3	
	Cayley Hamilton theorem and its applications – Diagonalisation – Similarity transformations	3	
	Special matrices – Orthogonal, Hermitian, Skew-Hermitian and Unitary matrices	3	
	Orthogonal and unitary transformations	3	
Unit III	Fourier transform – Infinite Fourier sine and cosine transforms	3	Chalk and talk, Quiz, assignment and seminar
	Linearity theorem – Similarity theorem – Shifting property – Modulation theorem – Convolution theorem – Parseval's Theorem	5	
	Derivative of Fourier transform	4	
	Fourier transform of a derivative	3	
Unit IV	Beta function: Symmetry property – Evaluation – Other forms	3	Chalk and talk, quiz, Seminar
	Gamma Function : Evaluation – other forms - Relation between beta and gamma functions – Miscellaneous propositions	3	
	Legendre differential equation	3	
	Generating function - Physical basis in Electrostatics - Linear electric multipoles	1	
	Rodrigues' formula	1	
	orthogonal property - gravitational potential due to spheroidicity of earth	2	
	Recurrence formulae	2	
Unit V	Bessel's differential equation (No power series solution) – Recurrence formulae	3	Chalk and talk, Quiz, Presentation, Seminar
	Generating function	2	
	Orthonormality of Bessel functions – Application of Bessel's function to Fraunhofer diffraction using circular aperture	3	
	Hermite polynomials (no power series solution) – generating function – recurrence formulae – Rodrigue's formula – orthonormality of Hermite polynomials	7	

Course learning Outcomes:

On the successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply the concept of vector calculus to solve the real world problem in Physics.	Up to K3
CLO-2	Solve Eigen value problems and appreciate its application to the field of Quantum Mechanics.	Up to K3
CLO-3	Analyse diffraction data and power spectrum of electronics circuits using Fourier transforms.	Up to K4
CLO-4	Analyse physical problems like electric monopoles, dipoles and analyzing the gravitational potential of the earth due to its spheroidicity by modeling the systems using Legendre Polynomials. Also solve Eulerian integrals as beta and gamma functions.	Up to K4
CLO-5	Apply Bessel's functions to Fraunhofer diffraction through a circular aperture. Also study the properties of Hermite polynomials.	Up to K3

Mapping of CLOs with PSOs :

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3		2	1
CLO2	3	3		2	1
CLO3	3	3		2	1
CLO4	3	3		2	1
CLO5	3	3		2	1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1& K1	1	K1	2 (K3&K3)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2 (K1&K1)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K1	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core-2	21P1PMC2	Classical Mechanics	4	5	25	75	100

Nature of Course			
Knowledge and skill	✓		Employability oriented
Skill oriented			Entrepreneurship oriented

Objectives:

- To enhance the knowledge of mechanics of particles
- To solve the equation of motion using Lagrangian, Hamilton and Hamilton – Jacobi equations.
- To study the kinematics of the rigid body through Euler equation.
- To acquire knowledge in equations of motion for systems with small oscillations.

Unit	Description	Hours	K-level	CLO
I	Lagrangian Formulation: Generalized coordinates – Principle of virtual work – D'Alembert's Principle – Lagrange's equation of motion from D'Alembert's Principle – Procedure for formation of Lagrange's equation – Lagrange's equation in presence of non conservative forces – Generalized potential – Lagrangian for a charged particle moving in a Electromagnetic field.	15	Up to K2	1
II	Hamilton's Equations : Generalized momentum and Cyclic coordinates – Hamiltonian function – Hamilton's canonical equations – Hamilton's equation in different coordinate systems (Cartesian, polar and cylindrical) – Examples – Harmonic Oscillator – Charged Particle moving in an electromagnetic field – Modified Hamilton's Principle – Hamilton's equations from Variational principle – Δ Variation – Principle of Least action – other forms of least action.	15	Up to K3	2
III	Canonical Transformation : Canonical transformations – Legendre transformation – Generating functions – Condition for canonical transformations – Examples – Bilinear Invariant Condition – Poisson brackets and its properties – Lagrange bracket – Relation between Poisson and Lagrange Brackets – Angular momentum and Poisson Brackets – Invariance of Poisson brackets under canonical Transformations.	15	Up to K3	3

IV	Hamilton – Jacobi theory & Small oscillations : Hamilton – Jacobi equation – Solution of Harmonic oscillator problem by Hamilton – Jacobi method – Hamilton’s characteristic function – Kepler’s problem by Hamilton – Jacobi Method – Action and angle variables – Small Oscillations – General theory – Eigen value equation – Two coupled pendulum – Vibrations of linear tri atomic molecule.	15	Up to K4	4
V	Kinematics of Rigid body & Central force problem: Generalized coordinates of a rigid body – Euler angle – infinitesimal rotations – Angular momentum and inertia tensor – Euler’s equations of motion for a rigid body derived from Lagrange’s method –Torque free motion of a rigid body – Reduction of the two - body central force to the equivalent one body problem – Equation of motion under central force and first integrals – Differential equation for an orbit – Inverse square law– Kepler’s laws of planetary motion and their deduction – Virial theorem – Scattering in a central force field.	15	Up to K4	5

Book for study:

1. J.C. Upadhyaya, 2018, Classical Mechanics, Published by Himalaya Publishing House Pvt. Ltd.

Unit 1: 2.4 – 2.10.

Unit II: 3.2, 3.4, 3.5, 3.6, 3.7.1, 3.7.3, 5.4, 5.5, 5.10, 5.11, 5.12

Unit III: 6.1, 6.2, 6.3, 6.5, 6.6, 7.2 – 7.7.

Unit IV: 8.2 – 8.6, 9.4 – 9.6.

Unit V: 10.1, 10.3, 10.4, 10.6, 10.11.2, 10.12.1, 4.1, 4.3 – 4.6, 4.9, 4.10.

Books for reference:

1. Classical Mechanics – H. Goldstein, C. Poole and J. Safko, Pearson Education Asia, New Delhi, Third Edition, 2002.

2. Classical Mechanics – G. Aruldas, PHI Learning Private Limited, New Delhi, 2015.

3. Classical Mechanics – S. L. Gupta, V. Kumar and H.V. Sharma, Pragati Prakashan, Meerut, 2016.

4. Classical Mechanics of Particles and Rigid Bodies – K.C. Gupta, New Age International Publishers, New Delhi, Third edition, 2018.

Web Resources:

1. https://worldscientific.com/doi/10.1142/9789814551496_0031

2. <https://nptel.ac.in/courses/115/105/115105098/>

3. <https://www.iiserpune.ac.in/~santh/course/phy311 – cm/phy311 – cm.html>

4. https://galileoandeinstein.phys.virginia.edu/7010/CM_10_Canonical_Transformations.html

5. http://www.scholarpedia.org/article/Hamilton – Jacobi_equation

6. <https://rotations.berkeley.edu/kinematics – of – rigid – bodies/>

Rationale for Nature of the course

In this course, Classical Mechanics which is the study of macroscopic mechanical systems is considered from different perspectives of Lagrangian and Hamiltonian methods. Practical applications of these general principles towards simple problems of oscillatory systems, rigid bodies would enhance comprehension of the principles of Classical Mechanics and develop the skills necessary to analyze the behavior of the mechanical systems based on variety of mathematical methods of Classical Mechanics.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Lagrangian and Hamiltonian equations of motion derived for different systems develops the application of mathematical and simulation skills to understand various practical applications involving macroscopic and microscopic objects in motion.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designers

1. Dr.M.Prema Rani
2. Mr.S.Ramakrishnan

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcome	Knowledge level
CLO 1	Infer basic concepts of mechanics to describe the Lagrangian equations of motion to simple systems.	Up to K2
CLO 2	Develop Hamilton's equation of motion to real life applications.	Up to K3
CLO 3	Apply generating functions and Poisson brackets to solve problems in Canonical transformations	Up to K3
CLO 4	Analyse and evaluate equations of motion for coupled systems having small oscillations.	Up to K4
CLO 5	Formulate equations of motion for rigid bodies using Euler's equations.	Up to K4

Mapping with CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	1	2	2
CLO-2	3	2	1	2	2
CLO-3	3	2	1	2	2
CLO-4	3	2	1	2	2
CLO-5	3	2	1	2	2

Advance application- 3; Intermediate level-2;

Basic level-1

Course plan

Unit	Topics	Hrs	Mode
I	System of particles – Degrees of freedom	2	PPT, Chalk and talk, and Group discussion
	Constraints – Types of constraints	2	
	constraints in a rigid body	2	
	Generalized coordinates	1	
	Principle of virtual work	1	
	D'Alembert's Principle –	2	
	Lagrange's equation of motion from D'Alembert's Principle	3	
	Free particle in space	1	
	Atwood's machine.	1	
II	Generalized momentum and Cyclic coordinates	1	PPT, Chalk and talk, and Group discussion
	Hamiltonian function – Hamilton's canonical equations	1	
	Hamilton's equation in different coordinate systems (Cartesian, polar and	3	
	Examples – Harmonic Oscillator, Charged Particle moving in an	2	
	Modified Hamilton's Principle	1	
	Hamilton's equations from Variational principle	2	
	△ Variation	1	
	Principle of Least action	2	
	Other forms of least action.	2	
III	Canonical transformations	1	PPT, Chalk and talk, Quiz and Group discussion
	Legendre transformation	1	
	Generating functions	3	
	Condition for canonical transformations – Examples –	2	
	Bilinear Invariant Condition –	1	
	Poisson brackets and its properties	2	
	Lagrange bracket – Relation between Poisson and Lagrange Brackets	2	
	Angular momentum and Poisson Brackets –	1	
	Invariance of Poisson brackets under canonical Transformations.	2	
IV	Hamilton – Jacobi equation	1	PPT, Chalk and talk, Assignment
	Harmonic oscillator problem by Hamilton – Jacobi method	2	
	Hamilton's characteristic function	2	
	Kepler's problem by Hamilton – Jacobi Method –	2	
	Action and angle variables	1	
	General theory of small oscillations	2	
	Eigen value equation –	1	
	Two coupled pendulum	2	
	Vibrations of linear tri atomic molecule.	2	
V	Generalised coordinates of a rigid body	1	PPT, Chalk and talk, Quiz and Group
	Euler angle – infinitesimal rotations	1	
	Angular momentum and inertia tensor	1	
	Euler's equations of motion for a rigid body derived from Lagrange's	2	

	Torque free motion of a rigid body	1	discussion
	Reduction of the two – body central force to the equivalent one body	1	
	Equation of motion under central force and first integrals	1	
	Differential equation for an orbit	1	
	Inverse square law	1	
	Kepler's laws of planetary motion and their deduction	2	
	Virial theorem	1	
	Scattering in a central force field.	2	

Learning Outcome Based Education (LOBE) & Assessment

Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		SectionB		Section C (Either/OR)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core-3	21P1PMC3	ADVANCED ELECTRONICS	4	5	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives:

The objective of the course is

- To impart depth knowledge about Semiconductors, diodes, Transistors, Operational Amplifiers, Memories and digital devices, converters etc., to the students.
- To introduce the basics of Minimizing Booleans functions by using K-Map and techniques of realizing corresponding Logic circuits. The theoretical knowledge gained in the class room can be experimented in the practical classes.
- To make students understand and experiment the combinational logic circuits (OP-AMP) which serve as Arithmetic circuits in analog computers.
- To make them understand the working of various Flip- Flops, Register types, Counters, ADC/DAC and their applications

Unit	Description	Hours	K-level	CLO
I	Semiconductor Diodes Introduction to Semiconductor- Zener diode- Gunn diode- Tunnel diode-Varactor diode-schottky diode- Characteristics and Applications. Transistor Characteristics (CE only)-Transistor biasing and stabilization- The D.C.Operating Point and Load line-Simpler way of drawing a D.C. Load line – Q-Point and Maximum undistorted output– Factors affecting stability of Q-point – Stability factor- Voltage Divider Bias – Stability of Voltage Divider Bias- Stability factor of Voltage Divider Bias- Basic Construction of UJT - UJT Operation - UJT Application-SCR-SCR Biasing- SCR Operation.	15	Up to K2	1
II	Operational Amplifier Applications Operational Amplifier- CMRR-Slew rate -Instrumentation amplifier - Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits – Adder- Subtractor-Differentiator- Integrator- Electronic analog Computation solving simultaneous and differential equation –. Schmitt Trigger – Triangular wave generator – Square wave generator – Active filters: Low, High and Band pass filters.	15	Up to K3	2

III	Combinational Logic and sequential circuits Minterms - Solving digital problems using maps – SOP & POS reduction (Up to 5-variable) – Incompletely specified functions – Flip-flops – Ripple counters- synchronous counters – Type T and JK design	15	Up to K4	3
IV	A/D and D/A Converter DAC- variable resistor networks - Binary Ladder network –D/A accuracy and resolution - ADC – simultaneous conversion – counter method – continuous A/D conversion - successive approximation, A/D accuracy and resolution.	15	Up to K4	4
V	Memories, Registers Memory – Basic terms and ideas- Memory Read and Write – ROMs, PROMs and EPROMs-7489-74S201-DRAMs-Programmable Array Logic, Programmable Logic Arrays- Shift Registers- siso-sipo-piso and pipo registers	15	Up to K2	5

Books for Study

1. Applied Electronics by R.S.Sheda

Unit – I : 13.1-13.3, 13.6-13.9, 13.11-13.12, 13.14-13.16, 15.6-15.8, 22.2-22.6, 22.17-22.19-17.20,17.23-17.25,

2. Electronics (Classical and Modern) by Kar

Unit – II : 9.1, 9.2, 9.3, 9.4, 9.5 (Excluding 9.5.5), 9.6, 9.7(Excluding 9.7.2),9.9

3. Digital Electronics – An Introduction to Theory and Practice – William H. Gothman (2nd Edition)-PHI

Unit – III: 6.1-6.6, 6.8,7.1-7.4, 7.6

4. Digital Principles and Applications – D. P. Leach, A.P. Malvino, G. Saha (8th Edition) McGraw Hill

Unit-IV: 12.1.,12.2,12.4,12.5-12.8,12.10

Unit –V : 13.1,13.2,13.4,13.5,4.11,4.12,9.1-9.5

Books for References

1. Modern Digital Electronics – R.P. Jain – Tata McGraw Hill, 2007.

2. Op-Amp and linear integrated circuits - R.F. Coughlin and F.F, Driscoll, Prentice Hall of India, New Delhi, 1996.

3. Op-Amps and Linear Integrated Circuits -Ramakant A. Gayakwad, Pearson Education: Fourth Edition, 2015.

4. Electronic Principles- Albert Malvino, David J Bates, 7th Edition, McGraw Hill, 2007.

5. Principles of Electronics- V.K.Mehta, 6th Revised Edition, S.Chand and Company, 2001.

6. Electronic Devices and Circuits- David A. Bell, 4th Edition, Prentice Hall. 2007.

Web Resources

1. <https://circuitglobe.com/semiconductor-diode.html>

2. https://www.electronics-notes.com/articles/electronic_components/semiconductor-ic-memory/memory-types-technologies.php

3. <https://dewesoft.com/daq/types-of-adc-converters>

Rationale for Nature of the course

This course will enable the students to comprehend the theory, concepts, characteristics and working principles of electronic devices like Combinational Logic and sequential circuit's semiconductor diodes and their applications in electronic circuits.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge of various devices acquired by the students will help them to design, test, troubleshoot and repair semiconductor diodes, DAC/ADC Converter, OPAMP.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designers:

1. Dr.J.Suresh
2. Dr.R.VishnuPriya

Lecture Schedule

Unit	Topics	Hours	Mode
Unit I	Introduction to Semiconductor- Zener diode- Gunn diode- Tunnel diode	3	Chalk and talk, Quiz and assignment
	Varactor diode-schottky diode --Characteristics and Applications.	3	
	Transistor Characteristics (CE only)-Transistor biasing and stabilization-	3	
	Need for biasing-operating point	3	
	Bias stability- UJT- SCR	3	
Unit II	Operational Amplifier- CMRR-Slew rate -Instrumentation amplifier	3	PPT, Chalk and talk, and Group discussion
	Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits	3	
	Adder- Subtractor-Differentiator- Integrator	3	
	Electronic analog Computation solving simultaneous and differential equation -. Schmitt Trigger	3	
	Triangular wave generator – Square wave generator – Active filters: Low, High and Band pass filters.	3	
Unit III	Minterms - Solving digital problems using maps	3	PPT, Chalk and talk, Quiz and Group discussion
	SOP & POS reduction (Up to 5-variable)	3	
	Incompletely specified functions – Flip-flops	3	
	Ripple counters- synchronous counters	3	
	Type T and JK design	3	
Unit IV	DAC- variable resistor networks - Binary Ladder network	3	PPT, Chalk and talk, Assignment
	D/A accuracy and resolution	3	
	ADC – simultaneous conversion- counter method	3	
	Continuous a/d conversion - successive approximation,	3	
	A/D accuracy and resolution.	3	
Unit V	Memory – Basic terms and ideas	3	Chalk and talk, Quiz and Interaction
	Memory Read and Write – ROMs, PROMs and EPROMs- 7489-74S201-DRAMS	3	
	Programmable Array Logic	3	
	Shift Registers- siso-sipo-piso and pipo registers	3	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Differentiate various semiconducting diodes by comparing their principles and working and its applications.	Up to K2
CLO-2	Apply and analyze various operating modes of Op-amp, its linear/non-linear applications.	Up to K3
CLO-3	Realize the combinational and sequential logic circuits by using various logical blocks.	Up to K4
CLO-4	Compare and contrast the concept ADC, DAC blocks required for data conversion.	Up to K4
CLO-5	Classify various types of memories and shift registers	Up to K2

Mapping with CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	1	2	1	1
CLO-2	3	1	2	1	1
CLO-3	3	1		1	1
CLO-4	3	1	2	1	1
CLO-5	3	1	2	1	

Advance application- 3; Intermediate level-2;

Basic level-1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K1	1	K1	2 (K3&K3)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2 (K1&K1)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K1	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problem

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major-Elective-I	21P1PME1	PHYSICS OF NON-CONVENTIONAL ENERGY RESOURCES	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To develop the human resources in non conventional Energy resources is needed.
2. To create the people who will teach the science of non conventional Energy resources, this will be also helpful for the promotion of Research in this field.
3. To create several self-employment opportunities in renewable energy and energy efficiency sectors for modestly-trained and self-trained human resources exist in all geographic locations of the country.
4. It will help to develop the skills required in renewable energy and energy management fields.

Unit	Description	Hours	K-level	CLO
I	Energy Sources: Introduction- Energy resources and their availability- classification –conventional energy sources- non-conventional sources. Solar energy-Electricity from solar energy-world renewable energy sources - Solar radiation geometry. Theory of solar cell, solar cell material, limitations-Solar radiation at the earth's surface.	15	Up to K2	1
II	Solar Thermal energy: Solar Thermal Energy: Introduction- flat plate collectors –solar air heaters-application-advantages-solar energy storage-introduction-thermal storage system-sensible heat storage-water storage-packed bed exchanger storage-latent heat storage-application of solar energy-introduction-solar heating-active based heating system- Solar cooling-absorption air conditioning-LiBr-H ₂ O system-solar heating-passive heating system- Solar cooling-NH ₃ -H ₂ O coolers-Advantages and disadvantages of concentrating collectors over flat plate types collectors.	15	Up to K4	2

III	Wind Energy: Introduction-The power of the Wind - site selection consideration-wind energy conversion systems. Classification of WEC systems-advantages and disadvantages of WECS-Performance of wind machines-Application of wind energy.	15	Up to K3	3
IV	Geothermal Energy Introduction- Geothermal sources-hydrothermal resources-Interconnection of geothermal fossil systems-Geothermal energy conversion- impulse machine-Advantage and disadvantage of geothermal energy-application of geothermal energy-Magneto-hydrodynamics (MHD): Principle of working of MHD system-Advantage of MHD systems- Estimates of geothermal power-advantages of geothermal field-Hydrothermal resources-vapour dominated systems-geothermal energy conversion-positive displacement machines.	15	Up to K4	4
V	Bio-Mass and ocean Energy Bio-mass: bio-mass conversion technology. Ocean Thermal Energy Conversion (OTEC): Introduction-methods of Ocean thermal electricity power generation-open cycle OTEC system. Wave and Tidal Wave: Basic Principle of Tidal power-operation methods of utilization of tidal energy-advantage and limitation of tidal power generation-utilization of biogas, OTEC Utilization, component of tidal power-Hybrid cycle, prospects of OTEC, Prospects of tidal energy.	15	Up to K4	5

BOOKS FOR STUDY:

1. Non-Conventional Energy Sources – G.D.Rai- Khanna publication(reprint-2018)

Sections:

UNIT I: Chapter-1: 1.4, 1.6, pg(30-31)

Chapter-2:2.4

UNIT II: Chapter-3:3.3,(B) pg(63-67)

Chapter-4:4.1,4.2pg(97-100)

Chapter-5:5.1,5.2,5.3pg(120-122),5.4(126-128)

UNIT III: Chapter-6:6.2,6.2.2,6.4,6.5,6.6,6.7

UNIT IV: Chapter-8:8.1,8.4,8.5,8.5.1,8.10,pg(354-356),8.11,8.11.3,8.12,8.13

Chapter-12:12.1,12.2,12.5

UNIT V: Chapter-7:7.2

Chapter-9:9.2,9.2.1,9.3.1,9.3.2,9.3.4,9.3.9

BOOKS FOR REFERENCE:

1. Renewal Energy Resources -John Twideu and Tony Weir, BSP Publications, 2006.
2. Energy Resources: Conventional & Non-Conventional -M.V.R. KoteswaraRao, BSP Publications, 2006.
3. Non-conventional Energy Resources -D.S. Chauhan, New Age International.
4. Renewal Energy Technologies: A Practical Guide for Beginners, C.S. Solanki-PHI Learning.

Web Resources:

1. <https://www.pveducation.org/pvcdrom/properties-of-sunlight/solar-radiation-at-the-earths-surface>.
2. <https://hal-mines-paristech.archives-ouvertes.fr/hal-01676634/document>.
3. <https://public.wmo.int/en/sun%E2%80%99s-impact-earth>.
4. <https://alteredenergy.com/types-of-concentrated-solar-collectors-and-their-advantages-disadvantages/>.
5. <https://askinglot.com/which-is-a-disadvantage-of-concentrating-solar-thermal-systems>.
6. <https://www.sciencedirect.com/topics/engineering/geothermal-power-plant>.
7. <https://www.osti.gov/servlets/purl/6125875>.
8. https://www.najah.edu/media/cms_page_media/759/Wind_Energy.pdf.
9. <https://www.e-education.psu.edu/eme807/node/713>.
10. https://www.researchgate.net/publication/339985429_Prospects_of_ocean-based_renewable_energy_for_West_Africa's_sustainable_energy_future.
11. https://en.wikipedia.org/wiki/Ocean_thermal_energy_conversion.

Rationale for Nature of the course

This course is mainly occupational skill and essential for many work in the renewable energy are delivered.

Activities having direct bearing on skill development/ Employability / Entrepreneurship

The activity is mainly efficient knowledge to work and go in to the further learning of energy resources.

Pedagogy: Chalk and talk, materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Course Designers:

1. Dr.M.Kavitha
2. Dr.J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, Energy resources and their availability	3	PPT, Chalk and talk, Quiz and assignment
	Non-conventional sources. Solar energy	3	
	Electricity from solar energy-world renewable energy sources	3	
	Classification –conventional energy sources- non-conventional sources.	4	
	Solar radiation geometry, solar cell material.	2	
Unit II	Solar Thermal Energy: Introduction- flat plate collectors	3	Chalk and talk, Quiz and assignment
	solar air heaters-application-advantages- solar energy storage	3	
	Introduction-thermal storage system-sensible heat storage-water storage-packed bed exchanger storage	3	
	latent heat storage-application of solar energy-introduction-solar heating	2	
	Active based heating system- Solar cooling-absorption air conditioning-LiBr-H ₂ O system.	4	
Unit III	Introduction, The power of the Wind energy	4	Chalk and talk, Quiz, assignment and seminar
	wind energy conversion systems	2	
	Classification of WEC systems-advantages and disadvantages of WECS.	4	
	Performance of wind machines, Application of wind energy.	3	
	Wind energy, site selection consideration	2	
Unit IV	Geothermal Energy, Introduction, Geothermal sources	3	Chalk and talk, quiz, Group discussion
	hydrothermal resources-Interconnection of geothermal fossil systems	2	
	Geothermal energy conversion- impulse machine-Advantage and disadvantage of geothermal energy	4	
	hydrodynamics (MHD): Principle of working of MHD system- Advantage of MHD systems	2	
	Hydrothermal resources-vapour dominated systems-geothermal energy conversion-positive displacement machines	4	
Unit V	Bio-mass: bio-mass conversion technology. Ocean Thermal Energy Conversion	4	PPT, Chalk and talk, Quiz and Interaction
	(OTEC): Introduction-methods of Ocean thermal electricity power generation	2	
	open cycle OTEC system. Wave and Tidal Wave	3	
	Basic Principle of Tidal power-operation methods of utilization of tidal energy-advantage and limitation of tidal power generation.	4	
	utilization of biogas,OTEC Utilization, component of tidal power.	2	

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Discuss about the energy system and resources available in the world	Up to K2
CLO 2	Categorize the thermal storage collection and its application	Up to K4
CLO 3	Apply the real life application and study its uniqueness of wind energy	Up to K3
CLO 4	classify sustainable geothermal application	Up to K4
CLO 5	Compare the design and working principle of the wind, wave and ocean energies	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	2	2	2
CLO2	3		2	3	2
CLO3	3	2	2	3	
CLO4	3		2	2	2
CLO5	3	2	2	3	2

Advance application –3, Intermediate level –2, Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K4	2	K2 & K3	1	K3	2 (K4&K4)	1 (K3)
3	CLO 3	Up to K3	2	K3 & K4	1	K1	2 (K2&K2)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major-Elective-2	21P1PME2	Medical Physics	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To understand the general concepts in radiation and its interaction and dose measurement.
2. To apply the physics concepts in clinical trials.
3. To educate scientifically the principles of radiation and its effect in the medical field.
4. To emphasize the significance of various medical techniques and therapy.

Unit	Description	Hours	K-level	CLO
I	Basic concepts in Radiation Dosimetry: Definitions of Dosimetric Quantities-units and relationship between DQ- linear energy transfer- tissue weighting factor-charged particle equilibrium-biological effects of radiation.	15	Up to K2	1
II	Interaction of gamma rays and X-rays with matter: Introduction-types of interaction with matter – over all interaction of photons with matter.	15	Up to K3	2
III	Treatment planning in radiation therapy: photon beam treatment planning-electron beam treatment planning.	15	Up to K3	3
IV	Image-Guided radiation therapy: Introduction – Rationale of IGRT- current available IG techniques – traditional IGRT technologies –real time tracking systems – image registration and correction strategies – image guided Adaptive treatment (IG-ART) - management of respiratory motion.	15	Up to K3	4
V	Magnetic Resonance Imaging (MRI): MRI – contrasts in MRI – Physiological and functional MRI – MRI safety – future MRI applications. CT and MRI Radiotherapy: CT based treatment simulation and planning – MRI in Radiotherapy.	15	Up to K4	5

BOOKS FOR STUDY:

1. Introduction to Medical Physics – Muhammad Maqbool – Springer International Publishing (2017).

BOOKS FOR REFERENCE:

1. Attix FH (1986) An introduction to radiological physics and radiation dosimetry, Wiley.
Bortfeld T, Birkelbach J, Boesecke R, Schlegel W (1990a) Methods of image reconstruction from projections applied to conformation radiotherapy. Phys Med Biol 35(10):1423–1434.
2. Adler JR Jr et al (1997) The Cyberknife: a frameless robotic system for radio Surgery Stereotact Funct Neurosurg 69:124–128.
3. Antonuk LE et al (1996) Megavoltage imaging with a large-area, flat-panel, amorphous silicon imager. Int J Radiat Oncol Biol Phys 36:661–672.
4. Baltzer PA, Dietzel M, Kaiser WA (2012) MR-spectroscopy at 1.5 tesla and 3 tesla. A systematic review and meta-analysis. Eur J Radiol 81(Suppl 1):S6–S9
5. Hendee WR, Ritenour ER (2002) Medical imaging physics, 4th edn. Wiley-Liss. xix, New York.

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/books/NBK230653/>
2. <https://en.wikipedia.org/wiki/Dosimetry>
3. <http://www-naweb.iaea.org/nahu/DMRP/documents/Chapter2.pdf>
4. <https://www.britannica.com/technology/radiation-measurement/Interactions-of-gamma-rays-and-X-rays>
5. <http://www.sprawls.org/ppmi2/INTERACT/>
6. <https://www.itnonline.com/article/introduction-current-radiation-therapy-treatment-planning-systems>
7. <https://pubmed.ncbi.nlm.nih.gov/1908420/>
8. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3532745/>
9. <https://www.sciencedirect.com/science/article/pii/S0936655520303691>
10. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4435985/>
11. <https://aapm.onlinelibrary.wiley.com/doi/pdf/10.1118/1.4894495>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6404845/>

Rationale for Nature of the course

This course is mainly work-related skill and essential technically the principles of radiation and its achieve in the medical field.

Activities having direct bearing on skill development/Employability / Entrepreneurship

Knowledge is to extend and highlighting the practical skill of medical field.

Pedagogy: Chalk and talk , materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Course Designers:

1. Dr.M.Kavitha
2. Dr.J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Basic concepts in Radiation Dosimetry: Definitions of Dosimetric Quantities	3	PPT, Chalk and talk, Quiz and assignment
	units and relationship between DQ	3	
	linear energy transfer- tissue weighting factor	3	
	Charged particle equilibrium-biological effects of radiation.	4	
	Definitions of radiation and Quantities	2	
Unit II	Interaction of gamma rays and X-rays with matter	3	Chalk and talk, Quiz and assignment
	Introduction- types of interaction with matter	3	
	gamma rays and X-rays	3	
	Photons interaction	2	
	All interaction of photons with matter.	4	
Unit III	Treatment planning in radiation therapy	4	Chalk and talk, Quiz, assignment and seminar
	photon beam treatment planning	2	
	electron beam treatment planning.	4	
	Types of interaction with matter	3	
	X-rays with matter	2	
Unit IV	Image-Guided radiation therapy	3	Chalk and talk, quiz, Group discussion
	(IG-ART) - management of respiratory motion.	2	
	Introduction – Rationale of IGRT- current available IG techniques	4	
	traditional IGRT technologies –real time tracking systems	2	
	image registration and correction strategies – image guided Adaptive treatment (IG-ART)	4	
Unit V	Introduction-Magnetic Resonance Imaging (MRI)	4	PPT, Chalk and talk, Quiz and Interaction
	MRI – contrasts in MRI – Physiological and functional	2	
	MRI – MRI safety – future MRI applications	3	
	MRI applications. CT and MRI Radiotherapy:	2	
	CT based treatment simulation and planning – MRI in Radiotherapy.	4	

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Physics aspects of Interaction of Radiation Quantities and Units	Up to K2
CLO 2	Acquire knowledge on x –ray interaction and production.	Up to K3
CLO 3	Apply the real life application and study its radiation therapy	Up to K3
CLO 4	Discuss about the different types of particle accelerators and their medical application	Up to K3
CLO 5	Explain the different types Electromagnetic Radiation and their sources/properties	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3		2	1	3
CLO2	3			1	2
CLO3	3		2	1	2
CLO4	3	2		1	2
CLO5	3	1	2	1	3

Advance application –3, Intermediate level –2, Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Uni ts	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2(K2&K2)	1 (K3)
3	CLO 3	Up to K3	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K3	2	K3 & K4	1	K1	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	NME	21P1PNM1	Astrobiology	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives :

- To introduce the students to the interdisciplinary field of Astrobiology.
- To make the students appreciate the scope of astrobiology in light of our understanding of life, as we know it in the present form and the on the basis of discovery of exoplanets in the habitable zone.
- To appreciate the origin of life and environment of our earth and extrapolate the findings to our solar system.

Course Content :

Unit	Description	Hours	K-level	CLO
I	Astronomy and Astrobiology : Introduction - Life from the perspective of physics - the bare necessities of life - Basic astronomy - Formation of stars and galaxies - nucleosynthesis - HR diagram - spectral classification of stars - theory of formation of planets - the age of earth and moon.	7	Up to K2	1
II	Origin of life and environment : The early earth - origin of life - signs of earliest life - role of atmosphere - the great oxidation event - advent of animal life - snowball earth - occurrence of advanced life	8	Up to K2	2
III	Life in the solar system : Habitable bodies in the solar system - Sunlight's effect on habitability of inner planets - Life on venus - early atmosphere and climate on mars - Interest on europa and titan	6	Up to K2	3
IV	Life outside solar system : Hunt for exoplanets (astrometry, stellar doppler shift, transit telemetry, gravitational microlensing) - the habitable zone - biosignatures	5	Up to K2	4
V	Extraterrestrial Intelligence : Drake's equation - SETI - Fermi's paradox - Rare earth hypothesis	4	Up to K2	5

Books for study :

1. Astrobiology : A Very short introduction, David C. Catling, Oxford University Press, 2013.

Unit I : Chapter 1 : Pages 1-2, 6-12; Chapter 2 : 14-27

Unit II : Chapter 3 : Pages 28 - 37, 39-43; Chapter 4 : 44-59

Unit III : Chapter 6 : Pages 82-88, 94-96, 100-106

Unit IV ; Chapter 7 : Pages 110 - 119

Unit V : Chapter 7 : 120-124, Chapter 8 : 125-127

Web Resources:

1. https://www.terc.edu/terc_products/astrobiology-an-integrated-science-approach/

2. <https://guides.lib.uw.edu/c.php?g=341353&p=2303542>

3. <http://astrobiology.com/>

Pedagogy :

Chalk and talk, Presentation, Quiz, Seminar, Assignment

Course Designers :

S. Sivaramakrishnan

Course Plan :

Unit	Topics	Hrs	Mode
I	Introduction - Life from the perspective of physics - the bare necessities of life	2	Chalk and talk, Presentation, Quiz and assignment
	Basic astronomy - Formation of stars and galaxies - nucleosynthesis - HR diagram - spectral classification of stars - theory of formation of planets - the age of earth and moon.	3	
		2	
II	The early earth	2	Chalk and talk, Quiz and assignment
	origin of life - signs of earliest life	3	
	role of atmosphere - the great oxidation event - advent of animal life - snowball earth - occurrence of advanced life	3	
III	Habitable bodies in the solar system - Sunlight's effect on habitability of inner planets	2	Chalk and talk, Quiz,
	Life on venus - early atmosphere and climate on mars -	2	
	Interest on europa and titan	2	
IV	Hunt for exoplanets	3	Chalk and talk, quiz, Seminar
	the habitable zone - biosignatures	2	
V	Extraterrestrial Intelligence	3	Chalk and talk, Quiz,
	Rare earth hypothesis	1	

Course learning Outcomes:

On the successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the origin of universe and its evolution	Up to K2
CLO-2	Explain the early universe and appreciate the factors that led to the occurrence of advanced life on earth.	Up to K2
CLO-3	Comprehend the idea of habitability and identify objects in the solar system that can / could have harboured life.	Up to K2
CLO-4	Understand the techniques used to detect exoplanets and look for biosignatures.	Up to K2
CLO-5	Understand Drake's equation and its implication to extra terrestrial intelligent life forms.	Up to K2

Mapping of CLOs with PSOs :

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3				1
CLO2	3				1
CLO3	3				1
CLO4	3				1
CLO5	3				1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education & Assessment (LOBE)
Blue Print
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Practical	21P1PMP1	Practical I	4	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: To expose the students to experiments in the Mathematical modelling, Optics, properties of matter

Practical - I - (Any six only/semester)

No.	Experiments (General Physics)
1	Elliptical Fringes
2	Laser diffraction (rectangular aperture)
3	Arc Spectrum
4	Solar Spectrum – Fraunhofer lines
5	Anderson's Bridge
6	Cauchy's constant
7	Refractive index of liquid using Hollow prism
	Any experiment related to general Physics

Books for reference:

1. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
2. Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2008, Kitab Mahal Agencies
3. S.R. GovindaRajan, T. Murugaiyan, S. SundaraRajan, Practical Physics, 2006, Rochouse & Sons
4. Relevant reference from web Sources.

Course Designer(s):

1. Dr.M. Prema Rani
2. Mr.S.Sivaramakrishnan
3. Dr.R.Vishnu Priya

Pedagogy : Demonstration and practical session.

Course Learning Outcomes (CLOs)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level	Marks
1	Understand the given problem in terms of domain knowledge in the field of physics.	Up to K2	10
2	Design appropriate Experiment /Test for the given problem.	Up to K3	10
3	Demonstrate skill in doing the experiment by choosing the appropriate technique and instruments and record data.	Up to K3	15
4	Analyze the data collected and infer the outcome and represent the analysis in meaningful form.	Up to K4	20
5	Communicate the findings in appropriate scientific terminology.	Up to K2	5

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3		1
CLO2	3	1	3		
CLO3	3	1	3	1	
CLO4	3	1	3		
CLO5	3	1	3		1

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Practical	21P1PMP2	Practical II	4	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: To expose the students to experiments in Electronics.

Practicals – II (Any six / semester)

No.	Experiments (Electronics)
Electronics	
1	UJT Characteristics& UJT Relaxation Oscillator
2	Low pass, Band pass, High pass filters
3	555 timer-Astable Multivibrator
4	Karnaugh Map
5	Binary Ladder network
6	Voltage Regulator- Dual Power Supply
7	Amplitude Modulation
	Any experiment related to Electronics

Books for reference:

1. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
2. Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2008, Kitab Mahal Agencies
3. S.R. GovindaRajan, T. Murugaiyan, S. SundaraRajan, Practical Physics, 2006, Rochouse & Sons
4. Relevant reference from web Sources.

Course Designer(s):

1. Dr.M. Prema Rani
2. Mr.S.Sivaramakrishnan
3. Dr.R.Vishnu Priya

Pedagogy : Demonstration and practical session.

Course Learning Outcomes (CLOs)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level	Marks
1	Understand the given problem in terms of domain knowledge in the field of physics.	Up to K2	10
2	Design appropriate Experiment /Test for the given problem.	Up to K3	10
3	Demonstrate skill in doing the experiment by choosing the appropriate technique and instruments and record data.	Up to K3	15
4	Analyze the data collected and infer the outcome and represent the analysis in meaningful form.	Up to K4	20
5	Communicate the findings in appropriate scientific terminology.	Up to K2	5

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3		1
CLO2	3	1	3		
CLO3	3	1	3	1	
CLO4	3	1	3		
CLO5	3	1	3		1

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core-4	21P2PMC4	Mathematical Physics - II	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives :

- To highlight the relationship of mathematical tools to understanding the dynamics of the physical world we live in.
- To impart knowledge on mathematical tools and techniques that could model real life physical systems.
- To demonstrate the use of Complex analysis and integration, tensor analysis and group theory in areas like Electromagnetic theory, Quantum Mechanical systems and crystallographic systems.

Course Content:

Unit	Description	Hours	K-level	CLO
I	Complex variables-I : Analytic function – Cauchy Reiman equations – CR in polar form – Complex line integral – Cauchy integral theorem (simple proof) – cauchy integral formula – Derivative of an analytic function (n^{th} derivative) – Expansion of an analytic function.	15	Up to K3	1
II	Complex variables-II : Singular point – Isolated singularity – Removal singularity – Cauchy-Residue theorem – Residue – Calculation of residue at simple poles and poles of higher order – Evaluation of definitive integrals – Integration around unit circle – Jordan lemma – Semicircular contours – Poles on the real axis.	15	Up to K4	2
III	Tensors : Scalar, vector and tensors – difference between a tensor and a transformation matrix – second rank tensor – Definition – Examples – Contra variant, covariant and mixed tensors – Tensors – Equality and null tensors- addition, subtraction, outer product and inner product-metric tensor-Tensors in EM theory	15	Up to K2	3
IV	Crystal symmetry and Abstract Group theory : Crystal symmetry operators – The crystallographic point groups – stereographic projection of simple point groups – classification of point groups according to crystal systems – Definition of groups – Group multiplication table – Multiplication tables for C_{2v} , C_{3v} , C_3 , C_4 , C_2 point groups – Rearrangement theorem – Cyclic groups –	15	Up to K4	4

	Subgroups – Cosets – Example groups of finite order – Conjugate elements and class structure – physical interpretation of class structure – Normal divisors and factor groups – isomorphy and homomorphy – class multiplication.			
V	Theory of Group Representations and construction of character tables : Definitions – reducible and irreducible representations – Lemma I, II and III with proof – Great orthogonal theorem – Character of a representation – Construction of character tables – Decomposition of regular representations.	15	Up to K3	5

Books for study :

1. Mathematical Physics with Classical Mechanics, Satyaprakash, Sultan Chand & sons, New Delhi, Vth edition, 2009 – Unit I: 6.9, 6.10, 6.12, 6.14, 6.16, 6.17.
2. Mathematical Physics with Classical Mechanics, Satyaprakash, Sultan Chand & sons, New Delhi, Vth edition, 2009 – Unit II: 6.22, 6.23, 6.24, 6.25(a), 6.25(b), 6.25(c), 6.25(d).
3. Vector analysis and Tensor analysis – M.R. Spiegel, Schaum's outline series, MH, 1974
Unit III – chapter 8.
4. Group theory and quantum mechanics, Michael Tinkam, 2003.
Unit IV – Chapter 2.1-2.9, 4.1, 4.2; Unit V – Chapter 3.1-3.5.

Books for reference :

1. Chemical Applications of Group theory, Albert F Cotton, Wiley Inc., III Edition, 2008
2. Mathematical Methods for Physicists, Arfken & Weber, VI Edition, Elsevier, 2011
3. Mathematical methods in Physical Sciences, Mary L Boas, Wiley Eastern, III Edition, 2006
4. Mathematical methods for Physicists and Engineers, Riley, Hobson and Bence, Cambridge University Press, III Edition, 2018.

Web Resources :

1. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Group_Theory/Group_Theory_and_its_Application_to_Chemistry](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Group_Theory/Group_Theory_and_its_Application_to_Chemistry)
2. <https://ocw.mit.edu/resources/res-3-004-visualizing-materials-science-fall-2017/student-projects-by-year/EPFL2017/crystallographic-point-groups/a-visualisation-of-crystallographic-point-groups/>
3. <https://www.sjsu.edu/faculty/watkins/tensor1.htm>
4. <https://nptel.ac.in/courses/111/103/111103070/>

Pedagogy :

Chalk and talk, Presentation, Quiz, Seminar, Assignment

Course Designers :

S. Sivaramakrishnan

Dr. K. Neyvasagam

Course Plan :

Unit	Topics	Hrs	Mode
Unit I	Analytic function	3	Chalk and talk, Presentation, Quiz and assignment
	Cauchy Reiman equations – CR in polar form –	3	
	Complex line integral – Cauchy integral theorem (simple proof)	3	
	cauchy integral formula – Derivative of an analytic function (n^{th} derivative) – Expansion of an analytic function	3	
	cauchy integral formula – Derivative of an analytic function (n^{th} derivative) – Expansion of an analytic function	3	
Unit II	Singular point – Isolated singularity – Removal singularity	3	Chalk and talk, Quiz and assignment
	Cauchy-Residue theorem – Residue – Calculation of residue at simple poles and poles of higher order	3	
	Evaluation of definitive integrals – Integration around unit circle	3	
	Jordan lemma	3	
	Semicircular contours – Poles on the real axis	3	
Unit III	Scalar, vector and tensors	3	Chalk and talk, Quiz, assignment and seminar
	Difference between a tensor and a transformation matrix – second rank tensor – Definition – Examples	5	
	Contra variant, covariant and mixed tensors – Tensors – Equality and null tensors- addition, subtraction, outer product and inner product-metric tensor	4	
	Tensors in EM theory	3	
Unit IV	Crystal symmetry operators	3	Chalk and talk, quiz, Seminar
	The crystallographic point groups – stereographic projection of simple point groups – classification of point groups according to crystal systems	3	
	Definition of groups – Group multiplication table – Multiplication tables for C_{2v} , C_{3v} , C_3 , C_4 , C_2 point groups	3	
	Rearrangement theorem – Cyclic groups – Subgroups	1	
	Cosets – Example groups of finite order	1	
	Conjugate elements and class structure – physical interpretation of class structure – Normal divisors and factor groups	2	
	Isomorphy and homomorphy – class multiplication.	2	
Unit V	Definitions – reducible and irreducible representations	2	Chalk and talk, Quiz, Presentation, Seminar
	Lemma I, II and III with proof – Great orthogonal theorem	5	
	Character of a representation	2	
	Construction of character tables – Decomposition of regular representations.	6	

Course learning Outcomes:

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply Cauchy-Riemann equation and Cauchy's integral theorem to analytic function.	Up to K3
CLO-2	Analyze poles and residues using concepts of contour integration.	Up to K4
CLO-3	Understanding the application of tensors in Physics.	Up to K2
CLO-4	Classify molecules among various crystallographic point groups by applying principles of group theory.	Up to K4
CLO-5	Apply the Great Orthogonality theorem to crystallographic point groups and construct character tables.	Up to K3

Mapping of CLOs with PSOs :

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3		2	1
CLO2	3	3		2	1
CLO3	3	3		2	1
CLO4	3	3		2	1
CLO5	3	3		2	1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K3& K3	1	K3	2 (K3&K3)	1 (K2)
2	CLO 2	Up to K4	2	K2 & K3	1	K4	2 (K1&K1)	1 (K3)
3	CLO 3	Up to K2	2	K1 & K1	1	K1	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K4 & K4	1	K4	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core –5	21P2PMC5	Quantum Mechanics-I	5	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

- To recognize basic terms in Quantum physics.
- To instruct about Schrodinger wave equation and its applications to quantum mechanical problems.
- To impart knowledge on the matrix formulation of quantum mechanics and its usefulness in the equation of motion.

Unit	Description	Hour	K-level	CLO
I	The Schrodinger wave equation: Need for wave equation – The one dimensional wave equation – Extension to three dimensions – Interpretation of the wave function – Statistical interpretation – Normalization of the wave function – Probability – Current density – Expectation values – Ehrenfest theorem. Eigen energy function: Significance of separation constant E – Boundary conditions at large distances – Continuity conditions – One dimensional square well potential – Perfectly rigid walls – Finite potential step – Energy level parity. Self study: Separation of wave equation. Audit: Tunneling through a rectangular potential barrier	15	Up to K3	1
II	Eigen function and Eigen values: Postulates – Dynamical variables as operators – Expansion in Eigen function – Ortho normality of energy Eigen functions – Reality of energy eigen values – Momentum Eigen functions – Box normalization – Dirac normalization – Minimal uncertainty product – Form of the minimum wave packet – Schrodinger equation in momentum representation. Self study: Schwartz inequality Audit: Probability function and expectation value	15	Up to K2	2
III	Discrete Eigenvalues : Bound States: One dimensional linear harmonic oscillator – Energy levels – Degeneracy – Zero-point energy – Wave functions – Correspondence with classical theory – Rigid rotor – Eigen values and Eigen functions – Spherically symmetric potential –	15	Up to K4	3

	Spherical harmonics – Three- dimensional square well potential – Solutions for $l=0$ and arbitrary l values – Interior and exterior solutions – Schroedinger equation for the hydrogen atom – Solution for s-state only. Self study: Three-dimensional linear harmonic oscillator. Audit: The ground state wave function of the H atom.			
IV	Matrix formulation of quantum mechanics: Matrix algebra – Types of matrices – Hermitian and unitary matrices – Hilbert space – Dirac bra-ket notation –Projection operator – Physical meaning of matrix elements – Equation of motion in Schroedinger, Heisenberg and Interaction pictures – Evaluation of commutator brackets — Matrix theory of harmonic oscillator. Self study: Virial theorem Audit: Motion of a charged particle in an EM field.	15	Up to K4	4
V	Identical particles and spin, Angular momentum: Physical meaning of identity – Symmetric and antisymmetric wave functions –Exchange degeneracy – Pauli's exclusion principle – Spin and statistics – Pauli's spin matrices. Orbital angular momentum – Spin angular momentum – Commutation relations of J^2, J_z, J_+ and J_- – Eigen values and matrix representation of J_+ and J_- – Angular momentum matrices – Addition of angular momenta: CG coefficients – Construction of resultant wave function ($j_1=1/2$ and $j_2=1/2$ only) Self study: Construction of resultant wave function ($j_1=1$ and $j_2=1/2$) Audit: Eigen values and matrix representation of J^2, J_z.	15	Up to K4	5

Books for study:

- 1) L. I. Schiff, Quantum mechanics Third edition, 1968, Tata McGraw Hill Publishing Company.

Unit I : Chap. 2: 6,7, 8,9

Unit II : Chap. 3: 10, 11, 12

Unit III : Chap. 4: 13,14, 15, 16

Unit IV : Chap. 6: 22, 23, 24, 25

- 2) Satya Prakash, Advanced Quantum Mechanics, Fifth edition, 2016, Kedar Nath Ram Nath and Co. Publications.

Unit I: Chap. 2: 2.4

Unit III:Chap. 2: 2.10; Chap. 3: 3.3

Unit V: Chap.6: 6.2, 6.3, 6.4, 6.7, 6.10; Chap. 7: 7.1, 7.3, 7.4, 7.5, 7.6, 7.7, 7.9,7.11, 7.12, 7.13

Books for Reference :

- 1) P.M. Mathews & K. Venkatesan, A Text book of Quantum Mechanics, Second edition, 2010, McGraw Hill Publishing Company.
- 2) G.Aruldas, Quantum Mechanics, Second edition, 2009, PHI Learning private limited.
- 3) V. K. Thankappan, Quantum Mechanics, Second Edition, 2003, New Age International (P) Ltd.
- 4) A. K. Ghatak and Lokanathan, Quantum Mechanics – Theory and Applications, Fifth Edition, 2015, Macmillan India Ltd.

Web Resources:

1. Quantum Mechanics– An Introduction
(Link: <http://www.digimat.in/nptel/courses/video/115106066/L01.html>)
2. The wave function
Link: <https://www.youtube.com/watch?v=Ei8CFin00PY>
3. Wave-particle duality
Link: https://en.wikipedia.org/wiki/Wave-particle_duality
4. Uncertainty principle
(Link: <https://www.britannica.com/science/uncertainty-principle>)
5. Schroedinger Wave Equation
(Link: <https://youtu.be/2ejyr-E7q2M>)
6. Dirac delta function and & Fourier transforms, Linear harmonic oscillator, Simple applications of Schroedinger wave equation, Hydrogen atom and other two body problem, Dirac bra and ket algebra, Angular momentum
(Link: <https://nptel.ac.in/courses/115/102/115102023/>)
7. Bound states in one dimension
(Link: <https://courses.physics.illinois.edu/phys485/fa2015/web/bound.pdf>)
8. Mathematical formulation of quantum mechanics
(Link: https://en.wikipedia.org/wiki/Mathematical_formulation_of_quantum_mechanics)
9. Angular momentum
(Link: https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture-notes/MIT8_05F13_Chap_09.pdf)
10. Applications of quantum mechanics
(Link: <https://www.britannica.com/science/quantum-mechanics-physics/Applications-of-quantum-mechanics>)
Link: <https://www.forbes.com/sites/chadorzel/2018/12/04/three-ways-quantum-physics-affects-your-daily-life/?sh=17053b6844b7>)

Note: 1. A maximum of Up to 10% (7.5 marks) of the questions may be asked from self – study part of the syllabus in the summative examination.

2. The questions in the Audit part of the syllabus shall not be asked in the summative examination.

Rationale for Nature of the course

This course will help to learn quantum mechanics and build problem solving skill and quantitative reasoning skill using quantum mechanical principles/concepts.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

One dimensional and three dimensional wave equation for quantum mechanical systems will be solved to explain the behaviour of atoms and sub-atomic particles.

Pedagogy : Chalk and talk, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion and interaction.

Course Designer(s):

1. Prof. G.Gowri

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction – Need for wave equation – The one dimensional wave equation – Extension to three dimension.	3	Chalk and talk, Quiz and assignment
	Interpretation of the wave function – Statistical interpretation – Normalization of the wave function – Probability – Current density	2	
	Expectation values – Ehrenfest theorem.	2	
	Eigen energy function: Significance of separation constant E – Boundary conditions at large distances – Continuity conditions	2	
	One dimensional square well potential – Perfectly rigid walls – Finite potential step – Energy level parity.	4	
	Problems discussion	2	
Unit II	Postulates – Dynamical variables as operators – Expansion in Eigen function.	3	PPT, Chalk and talk, Quiz and Group discussion
	Ortho normality of energy Eigen functions – Reality of energy eigen values.	2	
	Momentum Eigen functions – Box normalization – Dirac normalization.	4	
	Minimal uncertainty product – Form of the minimum wave packet – Schroedinger equation in momentum representation.	4	
	Problems discussion.	2	
Unit III	One dimensional linear harmonic oscillator – Energy levels – Degeneracy – Zero-point energy – Wave functions –Correspondence with classical theory	4	Chalk and talk, Quiz, assignment and seminar
	Rigid rotor – Eigen values and and Eigen functions	2	
	Spherically symmetric potential – Spherical harmonics	2	
	Three- dimensional square well potential – Solutions for $l=0$ and arbitrary l values – Interior and exterior solutions	3	
	Schroedinger equation for the hydrogen atom – Solution for s-state only – Problems discussion	4	
Unit IV	Matrix algebra – Types of matrices – Hermitian and unitary matrices – Hilbert space – Dirac bra-ket notation	3	PPT Chalk and talk, quiz, Group discussion
	Projection operator and its properties – Physical meaning of matrix elements	2	
	Equation of motion in Schroedinger and Heisenberg and Interaction pictures	4	
	Evaluation of commutator brackets	2	
	Matrix theory of harmonic oscillator –Problems discussion.	4	
Unit V	Physical meaning of identity – Symmetric and antisymmetric wave functions – Exchange degeneracy.	2	PPT, Chalk and talk, Quiz and Interaction
	Pauli's exclusion principle – Spin and statistics – Pauli's spin matrices – problems discussion.	4	
	Orbital angular momentum – Spin angular momentum.	1	
	Commutation relations of J^2 , J_z , J_+ and J_- – Eigen values and matrix representation of J_+ and J_- .	3	
	Angular momentum matrices.	2	
	Addition of angular momenta: CG coefficients – Construction of resultant wave function ($j_1=1/2$ and $j_2=1/2$ only).	3	

Course Learning Outcomes:

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Recognize the basic terms in Quantum mechanics and apply the Schrodinger wave equation to simple quantum mechanical problems.	Up to K3
CLO 2	Outline postulates of quantum mechanics and use them to a discussion of the total energy and momentum of a particle and to an illustrative problem.	Up to K2
CLO 3	Set up Schrodinger wave equation to one dimensional and three dimensional problems and solve as well as analyze the results	Up to K4
CLO 4	Comprehend the important properties of matrices and then the matrix formulation in quantum mechanics and also apply it to examine the equation of motion.	Up to K4
CLO 5	Construct angular momentum matrices and evaluate CG coefficients for system with two or more angular momentum parts	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	1	1	
CLO2	3		1	1	
CLO3	3	2	2	1	1
CLO4	3	2	1	2	
CLO5	3	1	1		

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K2&K3	1	K1	2(K2&K2)	1(K3)
2	CLO 2	Up to K2	2	K1&K1	1	K1	2(K1&K1)	1(K2)
3	CLO 3	Up to K4	2	K3&K4	1	K3	2(K4&K4)	1(K4)
4	CLO 4	Up to K4	2	K2&K3	1	K2	2(K3&K3)	1(K3)
5	CLO 5	Up to K4	2	K3&K4	1	K2	2(K4&K4)	1(K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core-6	21P2PMC6	Electromagnetic Theory	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To develop theoretical knowledge in electromagnetism.
2. To develop skills on solving analytical problems in electromagnetism.
3. To give basics of defining the complete electromagnetic response of complex systems.

Unit	Description	Hours	K-level	CLO
I	Electrostatics: Coulomb's law; the electric field – line, flux and Gauss's Law in differential form - the divergence of E - application of Gauss's law – curl of E - Poisson's equation; Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors. Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics-Laplace equation in three dimensions, Boundary condition and uniqueness theorems, conductors and the second uniqueness theorem-Electric potential, Multipole expansion, monopole and dipole, The electric field of a dipole, Linear dielectric.	15	Up to K2	1
II	Magnetostatics: Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergence and curl of B – Ampere's Law –comparison of magnetostatics and electrostatics – Magnetic vector potential-effect of magnetic field on atomic orbit- Magnetization-Ampere's Law in magnetized materials – ferromagnetism-magnetic field of a steady current, multiple expansion of the vector potential-Boundary condition in magnetostatics.	15	Up to K3	2

III	Electromotive force: Ohm's Law – electromotive force – motional emf – Faraday's Law – induced electric field – inductance – energy in magnetic field – Maxwell's equation in matter-boundary condition- the continuity equation-Poynting theorem-Maxwell equation, magnetic charge-boundary condition in two different conducting media, Newton's third law in electrodynamics.	15	Up to K4	3
IV	Electromagnetic waves Waves in one dimension – wave equation – sinusoidal waves – reflection and transmission– Polarization. Electromagnetic waves in vacuum: The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – propagation in linear media – reflection and transmission at normal incidence- reflection and transmission at oblique incidence-electromagnetic wave in conductors-Boundary conditions at the surface of discontinuity-Fresnel's equation -Brewster's law– Total internal reflection	15	Up to K4	4
V	Applications of electromagnetic waves : Wave guides–TE waves in rectangular wave guides – the co-axial transmission line- Potentials formulation: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potentialform-retarded potentials- lienard-wiechert potentials-electric dipole radiation, magnetic dipole radiation.	15	Up to K3	5

BOOK FOR STUDY:

1. Introduction to Electrodynamics – David J. Griffiths, 4th Edition, Pearson.

UNIT-I: Chapter2: 1.2,1.3,2.1,2.2,2.3,2.4,3.3,4.1,4.2,4.3,5.2,5.4.

Chapter3: 3, 1.1, 1.2, 1.3.

Chapter4: 1.1, 1.2, 3.1.

UNIT-II: Chapter5: 1.1, 1.2, 1.3, 2.1,3.1,3.2, 3.3, 4.4.1

Chapter6: 1.3, 1.4, 3.1, 4.2

UNIT-III: Chapter7:1.1,1.2,1.3,2.1,2.2,2.3,2.4,3.3,3.5,3.6.

Chapter8: 1.1, 1.2

UNIT-IV: Chapter9:1.1,1.2,1.3,1.4,2.1,2.2,2.3,3.1,3.2,3.3,4.1.

UNIT-V: Chapter9:5.1, 5.2, 5.3.

Chapter12: 1.1, 1.2, 1.3, 1.4, 2.1.

BOOKS FOR REFERENCE:

1. Electromagnetic Theory and Electrodynamics, Sathya Prakash, Kedar Nath, Ram Nath and Co,2017.
2. Electromagnetics, B.B Laud, Wiley Eastern Company,2000.
3. Fundamentals of Electromagnetic, Wazed Miah, Tata Mc Graw Hill,1980.

4. Basic Electromagnetics with Application, Narayana rao, (EEE) Prentice Hall,1997.
5. Fundamentals of Electromagnetic Theory, Third edition, Narosa Publishing House, New Delhi – John R.Reitz, Frederick J Milford and Robert W.Christy,1998.
6. Classical Electrodynamics – J.D. Jackson, II Edition, Wiley Eastern Limited,1993.
7. Electromagnetic Fields and Waves – P.Lorrain andD.Corson.
8. Electromagnetic, B.B Laud, Wiley Eastern Company,2000.

Web Resources:

1. https://en.wikipedia.org/wiki/Gauss%27s_law
2. [https://eng.libretexts.org/Bookshelves/Electrical_Engineering/Electro-Optics/Book%3A_Electromagnetics_I_\(Ellingson\)/05%3A_Electrostatics/5.15%3A_Poisson%E2%80%99s_and_Laplace%E2%80%99s_Equations](https://eng.libretexts.org/Bookshelves/Electrical_Engineering/Electro-Optics/Book%3A_Electromagnetics_I_(Ellingson)/05%3A_Electrostatics/5.15%3A_Poisson%E2%80%99s_and_Laplace%E2%80%99s_Equations)
3. https://getmyuni.azureedge.net/assets/main/study-material/notes/electronics-communication_engineering_electromagnetic-field-theory_poisson-s-and-laplace-equation_notes.pdf
4. <http://www.maths.dur.ac.uk/~dma0sfr/EM/Handouts/EMnotes-epiphany.pdf>
5. https://en.wikipedia.org/wiki/Biot%E2%80%93Savart_law
6. <https://www2.ph.ed.ac.uk/~mevans/em/lec8.pdf>
7. https://en.wikipedia.org/wiki/Maxwell%27s_equations
8. http://www.phys.virginia.edu/classes/109N/more_stuff/Maxwell_Eq.html
9. <https://mdashf.org/2018/11/01/boundary-conditions-on-electric-and-magnetic-fields/>
10. <http://www.phys.nthu.edu.tw/~thschang/notes/EM09.pdf>
11. <http://indico.ictp.it/event/7592/session/6/contribution/23/material/slides/0.pptx>
12. <http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/coursenotes/modules/guide13.pdf>
13. <http://www.physics.sfsu.edu/~lea/courses/ugrad/460notes5.PDF>
14. <https://www.mdpi.com/2079-9292/9/5/808/pdf>
15. <https://www.elprocus.com/electromagnetic-spectrum-em-spectrum-working-its-applications/>

Rationale for Nature of the course

The course is the learning of essential basis for understanding the theoretical methods and system used for electrical energy and power relies on key concepts from electromagnetic theory.

Activities having direct bearing on skill development/Employability / Entrepreneurship

The test of all knowledge is theoretical results are illustrated by matching the experimental data in the activities and uses of electromagnetic theory.

Pedagogy: Chalk and talk , materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Course Designers:

Dr.M.Kavitha

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Coulomb's law; the electric field , line, flux and Gauss's Law in differential form	2	PPT, Chalk and talk, Quiz and assignment
	The divergence of E ,application of Gauss's law, curl of E, Poisson's equation; Laplace's equation	3	
	work and energy in electrostatics, energy of a point charge distribution, energy of continuous charge distribution, induced charges	4	
	Laplace equation in one dimension and two dimensions, Dielectrics, induced dipoles, Gauss's Law in the presence of dielectrics.	4	
	Electric potential, Multipole expansion, monopole and dipole	2	
Unit II	Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law	4	Chalk and talk, Quiz and assignment
	Divergence and curl of B ,Ampere's Law ,comparison of magnetostatics and electrostatics	4	
	Magnetic vector potential-effect of magnetic field on atomic orbit	2	
	Magnetization-Ampere's Law in magnetized materials – ferromagnetism.	3	
	magnetic field of a steady current, multiple expansion of the vector potential.	2	
Unit III	Ohm's Law , electromotive force, motional emf , Faraday's Law	3	Chalk and talk, Quiz, assignment and seminar
	Induced electric field , inductance, energy in magnetic field, Maxwell's equation in matter-boundary condition	4	
	The continuity equation, Poynting theorem.	2	
	Maxwell equation, magnetic charge.	2	
	Boundary condition in two different conducting media,Newton's third law in electrodynamics.	4	
Unit IV	Waves in one dimension , wave equation , sinusoidal waves , reflection and transmission	4	Chalk and talk, quiz, Group discussion
	Electromagnetic waves in vacuum:The wave equation for E and B – Monochromatic Plan waves	2	
	energy and momentum in electromagnetic waves –propagation in linear media	3	
	reflection and transmission at normal incidence- reflection and transmission at oblique incidence	4	
	electromagnetic wave in conductors, Boundary conditions at the surface of discontinuity	2	
Unit V	Wave guides–TE waves in rectangular wave guides, the co-axial transmission line	4	PPT, Chalk and talk, Quiz and Interaction
	Potentialsformulation: potentials and fields, scalar	2	
	vector potentials and Gauge transformation	3	
	Coulomb Gauge and Lorentz Gauge , Lorentz force law in potentialform,retarded potentials.	4	
	lienard-wiechert potentials, electric dipole radiation	2	

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Apply mathematical operations and develop knowledge of vector fields and scalar fields	Up to K2
CLO 2	Explain boundary value problem in electrostatics and magneto statics	Up to K3
CLO 3	Acquire knowledge on the information of the various mode of propagation in Maxwell equations	Up to K4
CLO 4	Analyses the behavior of EM wave in conducting media	Up to K4
CLO 5	categorize with the basis of radiation and radiation reaction	Up to K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3		2	2	2
CLO2	3	2	3	3	
CLO3	3	2	3	2	2
CLO4	3	2	2	2	
CLO5	3		2	2	2

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K2 & K2	1	K3	2 (K3&K3)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Elective-3	21P2PME3	Instrumentation And Methods	4	5	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Objectives:

- To impart aspects of basic concepts of instrumentation to the students.
- To enhance comprehension capabilities of students through understanding of electronic transducers.
- To Study analytical techniques and to characterize the samples.

Unit	Description	Hours	K-level	CLO
I	Static performance characteristics of instruments: Introduction – Errors and uncertainties in performance parameters - Types of errors - Static Performance Parameters – Accuracy, Precision, Resolution, Threshold, Static Sensitivity – Linearity, Range – Hysteresis – Dead Band – Backlash – Drift - Impedance loading and Matching. Self study: Types of uncertainties	15	Up to K4	1
II	Dynamic characteristics of Instruments: Dynamic Response of systems - Periodic Input - Harmonic Signal - First order system to sinusoidal input – Second order system to sinusoidal input – Periodic input – Non harmonic signal – Response of instrument systems to step input and transient input – Compensation Techniques for improving dynamic response - First order system compensation – Second order system compensation. Self study: Fourier transform method	15	Up to K4	2
III	Transducer –I : Analog transducers - Electrochemical type – Potentiometric Resistive type – Inductive type – Self generating type - Non – self generating types - Capacitive type – Piezo-Electric transducers – Digital transducers: Frequency Domain - Electromagnetic Frequency Domain – Opto-Electrical Frequency Domain. Self study: Opto-electrical Transducer.	15	Up to K4	3

IV	Transducer –II : Moderate Pressure measurements - Manometers - Elastic Transducers – High Pressure measurement – Temperature measurements - Non-Electrical Methods – Bimetallic Thermometer – Liquid in Glass Thermometer – Pressure Thermometers – Electrical Methods of temperature measurement - Electrical Resistance Thermometers - Flow Measurement - primary or Quantity Meters – Positive Displacement Meters- Nutating Disc Meter – Sliding Vane Type . Self study: Lobed impeller meter.	15	Up to K4	4
V	Thermal methods : Introduction – Thermo gravimetry (TG) – Recording of results – Information from a TG curve – Factors affecting TG curves – Instrumental factors, sample characteristics – Instruments for TG – Applications of TG. Differential Thermal Analysis(DTA) - Introduction – Factors affecting the DTA curve – Instrumentation for DTA . Self study: Applications of DTA.	15	Up to K3	5

Books For Study:

- Instrumentation Measurement and Analysis – B.C. Nakra & K.K. Chaudhry TMH New Delhi, Fourth Edition, 2017.
Unit I : 2, 2.1, 2.1.1, 2.3, 2.3.1 - 2.3.11, 2.4.
Unit II : 3, 3.3, 3.3.1, 3.4.1, 3.5, 3.7, 3.7.1, 3.7.2
Unit III : 4, 4.1, 4.1.1, 4.2, 4.3, 4.4, 4.5, 4.9, 4.9.1, 4.9.2.
Unit IV : 11.1, 11.1.1, 11.1.2, 11.2, 12, 12.1, 12.3, 12.4, 12.4.1, 12.4.2, 12.4.3, 12.5, 12.5.1, 13, 13.1, 13.2, 13.2.1, 13.2.2.
- Instrumental methods of Chemical analysis, Gurdeep R.Chatwal and Sham K.Anand, Himalaya Publishing House Pvt, LTD.,Fifth revised edition 2012. 2003.
Unit V: 41.1, 41.2, 41.3 (I), 41.3(III,IV).

Books For Reference:

- Measurement System – E.D.Doebelin Mc-Graw Hill. (1990)
- Principles of Industrial Instrumentation – Patranbis .D, TMH New Delhi, 1976.
- C.S. Rangan, G.R. Sharma and V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw-Hill (1983).
- H.H. Willard, L.L. Merrit and John A. Dean, Instrumental Methods of Analysis, 6th edition, CBS Publishers & Distributors (1986).
- D.V.S. Murty, Transducers and Instrumentation, Prentice – Hall of India (P) Ltd., New Delhi (1995).

Web Resources :

1. <https://www.electronicdesign.com/technologies/communications/article/21796367/back-to-basics-impedance-matching-part-1>
2. <https://www3.nd.edu/~pdunn/www.text/ECdynsys.pdf>
3. <https://www.electrical4u.com/piezoelectric-transducer/>
4. <https://www.americanpiezo.com/piezo-theory/whats-a-transducer.html>
5. <https://www.britannica.com/technology/electrical-resistance-thermometer>
6. <https://circuitglobe.com/resistance-thermometer.html>
7. <https://www.sciencedirect.com/topics/materials-science/thermogravimetric-analysis>
8. <https://www.iitk.ac.in/cbe/pdf/resources/TGA-DSC-reading-material.pdf>
9. <https://www.hitachihightech.com/global/products/science/tech/ana/thermal/descriptions/dta.html>

Rationale for Nature of the course

Students can pursue career in Electronic industry, Instrumentation centres and Electrical and Mechanical Industry.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Students will be trained in experiments involving Transducers (Electromechanical ,Thermo-electrical, Piezo electrical).

Students will study dynamic characteristics and performance characteristics of measuring device and will determine their operational range.

Course Designers:

1. Prof. V.Meenakshi Sundaram
2. Dr. M.Revathi

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, Errors and uncertainties in performance parameters	3	Chalk and talk, Quiz and assignment
	Types of errors , Static Performance Parameters	3	
	Accuracy, Precision, Resolution, Threshold, Static Sensitivity	3	
	Linearity, Range, Hysteresis, Dead Band	3	
	Backlash ,Drift, Impedance loading and Matching.	3	
Unit II	Dynamic Response of systems	2	Chalk and talk, Quiz and assignment
	Periodic Input , Harmonic Signal , First order system to sinusoidal input	3	
	Second order system to sinusoidal input	2	
	Periodic input , Non harmonic signal	2	
	Response of instrument systems to step input and transient input	3	
	Compensation Techniques for improving dynamic response ,First order system compensation ,Second order system compensation.	3	
Unit III	Analog transducers , Electrochemical type	2	PPT, Chalk and talk, Quiz, assignment and seminar
	Potentiometric Resistive type, Inductive type	3	
	Self generating types , Non – self generating types	3	
	Capacitive type , Piezo-Electric transducers	3	
	Digital transducers, Frequency Domain	2	
	Electromagnetic Frequency Domain, Opto-Electrical Frequency Domain.	2	
Unit IV	Moderate Pressure measurements , Manometers	2	PPT, Chalk and talk, quiz, Group discussion
	Elastic Transducers, High Pressure measurement	2	
	Temperature measurements , Non-Electrical Methods , Bimetallic Thermometer	2	
	Liquid in Glass Thermometer , Pressure Thermometers	2	
	Electrical Methods of temperature measurement - Electrical Resistance Thermometers	2	
	Flow Measurement - primary or Quantity Meters	2	
	Positive Displacement Meters, Nutating Disc Meter , Sliding Vane Type	3	
Unit V	Introduction ,Thermo gravimetry (TG) ,Recording of results , Information from a TG curve	3	PPT, Chalk and talk, Quiz and Interaction
	Factors affecting TG curves , Instrumental factors, sample characteristics	3	
	Instruments for TG – Applications of TG	3	
	Differential Thermal Analysis(DTA) ,Introduction, Factors affecting the DTA curve	3	
	Instrumentation for DTA, Applications	3	

Pedagogy : Chalk and talk , materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Illustrate the static characteristics of instruments as well as integrate the statistical error analysis of output results.	Up to K4
CLO 2	Analyze the dynamic performance characteristics and formulate the governing equations of various instruments for improving dynamic response of systems.	Up to K4
CLO 3	Focus the complete knowledge of various transducers operation and correlate the applications of modern industrial transducers	Up to K4
CLO 4	Inspect different measuring techniques in transducers to measure physical quantities in the field of science and technology	Up to K4
CLO 5	Apply the principles of thermal analysis method and examine the thermal characterization of materials	Up to K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	1
CLO2	3	3	2	2	1
CLO3	3	1	3	2	1
CLO4	3	1	3	2	2
CLO5	3	1	2	1	1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K4	2	K1 & K1	1	K1	2 (K4&K4)	1 (K4)
2	CLO 2	Up to K4	2	K2 & K3	1	K1	2 (K4&K4)	1 (K4)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K1&K1)	1 (K2)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K3&K3)	1 (K3)
5	CLO 5	Up to K3	2	K3 & K4	1	K3	2 (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Elective 4	21P12PME4	Computational Physics	4	5	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives:

The objective of the course is

- To learn and practice the fundamental programming concepts and methodologies subjected to develop C++ programs.
- To tackle the problems in the physical sciences using computer and C++ as a numerical tool
- To Numerically solve systems of nonlinear equations, Eigenvalues and eigenvectors of a matrix, integrals
- To identify appropriate numerical strategies to deal the problems in physics

Course Content :

Unit	Description	Hours	K-level	CLO
I	Data types, Operators, Expressions and Control Statements: Identifiers and Keywords – Data types – C++ Simple data types – Literals – Variables – The Const Data type – C++ Operators – Type conversion – Declaration of variables – Simple C++ Programs – Features of I/O stream – keyboard and screen I/O - Manipulators Functions - Conditional Expressions – Loop statements – Nested Control Structures – Breaking Control Statements.	15	Up to K2	1
II	Functions, arrays and pointers: Defining a function – ‘Return’ statement – Types of functions – Actual and formal arguments – Local and global variables – Default arguments – Multifunction program – Recursive function – Header files – Standard functions – Array notation, declaration and initialization – Processing with array – Arrays and functions – Multidimensional arrays – Character array – Pointer operator – Address operator – Pointer expressions – Pointer arithmetic – Pointers and functions – Pointers and arrays - Pointers and strings – Arrays of pointers – Pointers to pointers.	15	Up to K4	2

III	Structures, Classes and objects : Declaration of structure – Initialization – Functions and structures – Arrays of structures- Arrays within a structure – Nested structure – Pointers and structures – Declaration of class – Member functions – Object of a class – Accessing a member of a class - Array of class objects – Pointers and classes – Nested class – Copy constructors – Default constructors – Destructors – Static data member – Static member functions – Friend functions – ‘ this’ pointer.	15	Up to K3	3
IV	Approximation of a function and Numerical Calculus Interpolation-Least-squares Approximation – Random number generators-Introduction to Lagrange polynomials –Numerical Differentiation-Numerical Integration- Trapezoidal rule – Simpson’s rules – Newton - Cotes formulas – Gaussian quadrature formula – Estimation of errors in evaluating the integrals Roots of Equation-Extremes of a function - Bond length of a molecule.	15	Up to K4	4
V	Ordinary differential equation and applications Initial-value problems- Taylor’s series method - The Euler and Picard methods - Predictor-corrector methods-The Runge - Kutta method – Chaotic dynamics of a driven pendulum–Boundary-value and eigenvalue problems-The Shooting Method-Linear equations and the Sturm - Liouville problem-The 1-D Schrödinger equation.	15	Up to K4	5

Books for study:

UNIT I, II and III: Programming with C++ - By D. Ravichandran –Tata McGraw – Hill Pub. Co. Ltd., New Delhi.

UNIT IV and V: An Introduction to Computation Physics (2ndEdn) – TAO PANG, Cambridge, 2006 (Chap.2,3(selected sections) 4,7).

Books for References:

1. Object oriented programming with C++ - E.Balagurusamy - Tata McGraw Hill Pub. Co. Ltd.
2. Let us C++ - YashwantP.Kanetkar – BPB Publications, New Delhi.
3. Numerical Methods – Conte and deBoer.

Web Resources

- 1.<https://www.programiz.com/cpp-programming>
- 2.<https://doc.lagout.org/Others/An%20Introduction%20to%20Computational%20Physics%2C%20Second%20Edition.pdf>
- 3.<https://www.uio.no/studier/emner/matnat/fys/FYS3150/h09/undervisningsmateriale/Lecture%20Notes/lectures2009.pdf>

Rationale for Nature of the course

Contemporary research in physics and related sciences almost always involves the use of computers. They are used for data collection and analysis, numerical analysis, simulations, and symbolic manipulation. Computational physics has become a third way of doing physics and complements traditional modes of theoretical and experimental physics.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Developing Programming skill in students

Applying principles of mathematical modelling of physical systems

Students would write and execute C++ Program

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designer:

1. Dr.R.Vishnu Priya

Lecture Schedule

Unit	Topics	Hours	Mode
Unit I	Identifiers and Keywords – Data types – C++ Simple data types – Literals – Variables – The Const Data type	3	Chalk and talk, Quiz and assignment
	C++ Operators – Type conversion – Declaration of variables	3	
	Simple C++ Programs – Features of I/O stream – keyboard and screen I/O	3	
	Manipulators Functions - Conditional Expressions – Loop statements	3	
	Nested Control Structures – Breaking Control Statements	3	
Unit II	Defining a function – ‘Return’ statement – Types of functions	3	PPT, Chalk and talk, and Group discussion
	Actual and formal arguments – Local and global variables – Default arguments – Multifunction program	3	
	Recursive function – Header files – Standard functions – Array notation, declaration and initialization	3	
	Multidimensional arrays – Character array – Pointer operator – Address operator – Pointer expressions – Pointer arithmetic	3	
	Pointers and functions – Pointers and arrays - Pointers and strings – Arrays of pointers – Pointers to pointers	3	
Unit III	Declaration of structure – Initialization – Functions and structures – Arrays of structures	3	PPT, Chalk and talk, Quiz and Group discussion
	Arrays within a structure – Nested structure – Pointers and structures – Declaration of class	3	
	Member functions – Object of a class – Accessing a member of a class - Array of class objects	3	
	Pointers and classes – Nested class – Copy constructors – Default constructors – Destructors	3	
	Static data member – Static member functions – Friend functions – ‘this’ pointer.	3	
Unit IV	Interpolation-Least-squares Approximation - Random number generators - Introduction to Lagrange polynomials	3	PPT, Chalk and talk, Assignment
	Numerical Differentiation-Numerical Integration-	3	
	Trapezoidal rule – Simpson’s rules	3	
	Newton - Cotes formulas – Gaussian quadrature formula	3	
	Estimation of errors in evaluating the integrals Roots of Equation-Extremes of a function - Bond length of a molecule.	3	
Unit V	Initial-value problems- Taylor’s series method - The Euler and Picard methods	3	Chalk and talk, Quiz and Interaction
	Predictor-corrector methods-The Runge - Kutta method	3	
	Chaotic dynamics of a driven pendulum–Boundary-value and eigenvalue problems	3	
	The Shooting Method-Linear equations and the Sturm - Liouville problem-The 1-D Schrödinger equation	3	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the concepts of object-oriented programming	Up toK2
CLO-2	Contrasts the difference between the various types of functions	Up toK4
CLO-3	Make use of Structures and function programming techniques to solve problems in the C++ programming language	Up toK3
CLO-4	Implement programming techniques to solve problems in the C++ programming language.	Up toK4
CLO-5	Apply the concepts and principles of the programming language to the real-world problems and solve the problems through project-based learning	Up toK4

Mapping with CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2		1
CLO-2	3	3	2		1
CLO-3	3	3	2		1
CLO-4	3	3	2		1
CLO-5	3	3	2		1

Advance application –3, Intermediate level –2 , Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		SectionB		Section C (Either/Or)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K4	2	K2 & K3	1	K2	2(K4 & K4)	1(K3)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K3 & K3)	1(K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Practical	21P2PMP3	Practical III	4	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: To expose the students to experiments in the Mathematical modeling, optics, and properties of matter.

Practical - III (Any six only/semester)

No.	Experiments (General Physics)
1	Monte Carlo Method
2	Eigen Value determination C++
3	Hyperbolic Fringes
4	Grating-Oblique incidence
5	Owen's Bridge
6	Resolving power of prism
7	Susceptibility of liquid – Quincke's method
	Any experiment related to general Physics

Books for reference:

1. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
2. Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2008, Kitab Mahal Agencies
3. S.R. GovindaRajan, T. Murugaiyan, S. SundaraRajan, Practical Physics, 2006, Rochouse & Sons
4. Relevant reference from web Sources.

Course Designer(s):

1. Dr.M. Prema Rani
2. Mr.S.Sivaramakrishnan
3. Dr.R.Vishnu Priya

Pedagogy : Demonstration and practical session.

Course Learning Outcomes (CLOs)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level	Marks
1	Understand the given problem in terms of domain knowledge in the field of physics.	Up to K2	10
2	Design appropriate Experiment /Test for the given problem.	Up to K3	10
3	Demonstrate skill in doing the experiment by choosing the appropriate technique and instruments and record data.	Up to K3	15
4	Analyze the data collected and infer the outcome and represent the analysis in meaningful form.	Up to K4	20
5	Communicate the findings in appropriate scientific terminology.	Up to K2	5

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3		1
CLO2	3	1	3		
CLO3	3	1	3	1	
CLO4	3	1	3		
CLO5	3	1	3		1

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Practical	21P2PMP4	Practical IV	4	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: To expose the students to experiments in Electronics.

Practical - IV (Any six only/semester)

No.	Experiments (Electronics)
1	Zener Characteristics & Zener Regulator
2	OP-AMP Adder, Subtractor, Differentiator & Integrator
3	Schmitt trigger
4	Counters using Flip Flops
5	Shift Register
6	Amplitude Modulation
7	FET Characteristics & FET amplifier
	Any experiment related to Electronics

Books for reference:

1. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
2. Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2008, Kitab Mahal Agencies
3. S.R. GovindaRajan, T. Murugaiyan, S. SundaraRajan, Practical Physics, 2006, Rochouse & Sons
4. Relevant reference from web Sources.

Course Designer(s):

1. Dr.M. Prema Rani
2. Mr.S.Sivaramakrishnan
3. Dr.R.Vishnu Priya

Pedagogy : Demonstration and practical session.

Course Learning Outcomes (CLOs)

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge level	Marks
1	Understand the given problem in terms of domain knowledge in the field of physics.	Up to K2	10
2	Design appropriate Experiment /Test for the given problem.	Up to K3	10
3	Demonstrate skill in doing the experiment by choosing the appropriate technique and instruments and record data.	Up to K3	15
4	Analyze the data collected and infer the outcome and represent the analysis in meaningful form.	Up to K4	20
5	Communicate the findings in appropriate scientific terminology.	Up to K2	5

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3		1
CLO2	3	1	3		
CLO3	3	1	3	1	
CLO4	3	1	3		
CLO5	3	1	3		1

Department of Chemistry

Revised Curriculum

(Choice Based Credit system with Outcome Based Education)

Academic Year 2020-2021 onwards

III and IV semesters (B.Sc. Chemistry)

DEPARTMENT OF CHEMISTRY
Vision & mission of the department

Vision

To produce disciplined and committed students through effective teaching-learning for the professional growth and research aimed at a greener environment and healthier living of humankind.

Mission

- To ensure the quality and knowledgeable chemistry graduates capable of creating new developments for the society and applicable in daily life to become entrepreneurs.
- Inspiring students to fulfil the expectations of local, national and global needs
- Motivate the students to pursue higher studies and research to cater the need of industries.

Programme Educational objectives

After completion of the programme, the students will be able

PEO1	To continuously update their domain knowledge for continuous professional development with focus on research and industry interaction
PEO2	To endorse multiple utility of chemistry to create innovations in providing solution for sustainable green environment
PEO3	To accomplish the ability for effective communication and to understand ethical responsibilities
PEO4	To acquire inter-social relationship and interpersonal skills in order to attain leadership qualities.
PEO5	To prefer suitable career and crack in competitive examinations

Programme Outcome (PO) (aligned with Graduate Attributes)- Bachelor of Science (B.Sc.,)

At the end of the programme the students will be able to

PO1	Integrate learned skills and knowledge derived from the study of science and other related disciplines, acquiring the necessary depth and breadth required for a transdisciplinary perspective.
PO2	Demonstrate proficiency in using disciplinary –appropriate methods for research, critical analysis or creative work and provide scientific solutions to the problem of the society.
PO3	Communicate conclusions, interpretations, and implications clearly, concisely, and effectively, both orally and in writing for different types of audiences.
PO4	Articulate and apply values, principles, ethics and ideals derived from an integrated understanding of their areas of study and demonstrate awareness of current societal and environmental challenges and way of mitigating them.
PO5	Use modern tools, resources and software and be abreast with the emerging trends in their disciplinary area and practice lifelong learning.

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	- Choose - Define - Find - How - Label - List - Match - Name - Omit - Recall - Relate - Select - Show - Spell - Tell - What - When - Where - Which - Who - Why	- Classify - Compare - Contrast - Demonstrate - Explain - Extend - Illustrate - Infer - Interpret - Outline - Relate - Rephrase - Show - Summarize - Translate	- Apply - Build - Choose - Construct - Develop - Experiment with - Identify - Interview - Make use of - Model - Organize - Plan - Select - Solve - Utilize	- Analyze - Assume - Categorize - Classify - Compare - Conclusion - Contrast - Discover - Dissect - Distinguish - Divide - Examine - Function - Inference - Inspect - List - Motive - Relationships - Simplify - Survey - Take part in - Test for - Theme	- Agree - Appraise - Assess - Award - Choose - Compare - Conclude - Criteria - Criticize - Decide - Deduct - Defend - Determine - Disprove - Estimate - Evaluate - Explain - Importance - Influence - Interpret - Judge - Justify - Mark - Measure - Opinion - Perceive - Prioritize - Prove - Rate - Recommend - Rule on - Select - Support - Value	- Adapt - Build - Change - Choose - Combine - Compile - Compose - Construct - Create - Delete - Design - Develop - Discuss - Elaborate - Estimate - Formulate - Happen - Imagine - Improve - Invent - Make up - Maximize - Minimize - Modify - Original - Originate - Plan - Predict - Propose - Solution - Solve - Suppose - Test - Theory

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.

Programme Learning Outcomes (PLO)

At the end of the programme, the students will be able to

PLO's	Statement	Graduate Attributes
PLO-1	Establish a fundamental or logical understanding of the academic field of Chemistry, its different learning areas and applications in basic chemistry like atomic structure, quantum mechanics, periodic properties, chemical bonding, hydrocarbons, different states of matter, radioactivity, nuclear chemistry, metallurgy, surface chemistry, catalysis, solutions, colloidal state, corrosion, food deterioration & adulterants, water analysis and treatment and its linkages with related disciplinary areas/subjects like Physics, Mathematics, Life sciences, Environmental sciences.	• Knowledge in core competency • Environment and Sustainability
PLO – 2	Tackle problems and offer creative ideas based on analysis and critical thinking in all branches of Chemistry.	• Problem Analysis • Design and Development of solutions for complex problems
PLO – 3	Problem-solving skills that are needed to solve various kinds of chemistry-related problems with well-defined solutions and tackle complicated problems that belong to the disciplinary area limits.	• Problem Analysis • Conduct investigations of complex problems
PLO – 4	Gains basic knowledge on organic synthesis, reaction mechanism, substitution, derivative formation, stereochemistry and also analytical techniques; Enable the students to understand the properties of s,p ,d and f block elements and its important compounds; to enlighten the properties and uses of inorganic complexes, organometallic compounds, co-ordination chemistry, bio-inorganic chemistry and solid state chemistry.	• Knowledge in core competency
PLO – 5	Gain knowledge in the areas of kinetics, phase rule, molecular spectroscopy, thermodynamics, photochemistry, group theory, principle and applications of cell reactions and also to identify chemical formulae and solve numerical problems.	• Knowledge in core competency • Problem Analysis
PLO – 6	Validates the multiple utility of chemistry in the regions of industrial chemistry, material chemistry, medicinal chemistry, green chemistry, nanochemistry and polymer chemistry; employ critical thinking and the scientific knowledge to design, carryout, record and analyze the results of chemical reactions; inculcate the scientific temperament in the students and outside the scientific community; Aids the students to work in pharma industry, agro-chemical industry and in various research and development (R&D) laboratories.	• Ethics • Individual and team work • Communication Project management and Finance
PLO – 7	Gain practical knowledge to compare the strength and amount of the organic and inorganic substances; Through volumetric and gravimetric methods, to determine the physical properties like boiling point, melting point and also to check the purity of the samples; to handle various instruments like potentiometer and conductivity bridge.	• Modern Tool usage • Individual and team work • Communication

EVALUATION PATTERN (THEORY PAPERS)

Internal Assessment	:	25 Marks
External Assessment	:	75 Marks
Total	:	100 Marks

Continuous Internal Assessment : 25 Marks

Components	Marks
Test (Average of two tests) Conducted for 40 marks and converted into 10 marks)	10
Assignment	5
Quiz/ Documentation/ Case study / ICT based Assignment/ Mini Projects	5
Attendance	5
Total	25

Question Paper Pattern for External Examination: 75 Marks

Section	Marks
A- Multiple Choice Questions (10 X 1 mark)	10
B- Short answer type (5 X 2 mark)	10
B- Either/Or type (5 X 5 marks)	25
C- Open Choice type (3out of 5 X 10 marks)	30
Total	75

EVALUATION (PRACTICAL)

Continuous Internal Assessment	: 40 Marks
External Assessment	: 60 Marks

Internal Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total	40

Total : 100 Marks

Internal Assessment : 40 Marks

External Assessment : 60 Marks



DEPARTMENT OF CHEMISTRY
THE MADURA COLLEGE (AUTONOMOUS), MADURAI 625011

Curriculum structure for B. Sc. Chemistry
(With Mathematics & Physics Ancillaries CMP)

Sem	Part	Course code	Title of the course	Hrs	Credits
I	I	20U1TLA1	Language I (Tamil/Hindi/Sanskrit)	6	3
	II	20U1NEN1	English I	6	3
	IV	20U1VEN1	Value Education and Professional Ethics	3	3
	III	20U1MAC1	Allied Mathematics-I	6	5
	III	20U1CMC1	General Chemistry-I	3	3
	III	20U1CMC2	General Chemistry-II	3	3
	III	20U1CMP1	Inorganic qualitative analysis - I	3	2
		Total		30	22
II	I	20U2TLA2	Language II (Tamil/Hindi/Sanskrit)	6	3
	II	20U2NEN2	English II	6	3
	IV	20U2EVS1	Environment & Gender studies	3	3
	III	20U2MAC2	Allied Mathematics-II	6	5
	III	20U2CMC3	General Chemistry-III	3	3
	III	20U2CMC4	General Chemistry-IV	3	3
	III	20U2CMP2	Inorganic qualitative analysis - II	3	2
	IV		Extension Activity	-	1
		Total		30	23
III	I	20U3TLA3	Language III (Tamil/Hindi/Sanskrit)	6	3
	II	20U3NEN3	English III	6	3
	IV	20U3CNM1	Applied Chemistry	2	2
	IV	20U3CSM1	Industrial Chemistry	2	2
	III	20U3PAC1	Properties of Matter, Thermal Physics and Optics	4	4
	III	20U4PAP2	Allied Physics Practical-I	2	1
	III	20U3CMC5	General Chemistry-V	5	5
	III	20U3CMP3	Volumetric Analysis-I	3	2
		20U3CAO1	Add on for beginners	-	2
		20U4CSS1	Chemistry and Health	-	-
		Total		30	24

IV	I	20U4TLA4	Language IV (Tamil/Hindi/Sanskrit)	6	3
	II	20U4NEN4	English IV	6	3
	IV	20U4CNM2	Chemistry in everyday life	2	2
	IV	20U4CSM2	Nano & Green Chemistry	2	2
	III	20U4PAC2	Electricity , Electronics, Atomic and Nuclear Physics	4	4
	III	20U4PAP2	Allied Physics Practical II	2	1
	III	20U4CMC6	General Chemistry-VI	5	5
	III	20U4CMP4	Volumetric Analysis-II	3	2
		20U4CAO2	Agricultural chemistry	-	2
		20U4CSS1	Chemistry and Health	-	2
		Total			30
V	IV	20U5CSB3	Skill Based Elective-III	2	2
	III	20U5CMC7	Organic Chemistry-I	5	5
	III	20U5CMC8	Inorganic Chemistry-I	5	5
	III	20U5CMC9	Physical chemistry-I	5	5
	III	20U5CME1	Major Elective -I	4	3
	III	20U5CME2	Major Elective -II	3	2
	III	20U5CMP5	Physical Chemistry Experiments-I	3	2
	III	20U5CMP6	Organic Analysis	3	2
		Total			30
VI	IV	20U6CSB4	Skill Based Elective-IV	2	2
	III	20U6CMC10	Organic Chemistry-II	5	5
	III	20U6CMC11	Inorganic Chemistry-II	5	5
	III	20U6CMC12	Physical chemistry-II	5	5
	III	20U6CME3	Major Elective -III	3	2
	III	20U6CME4	Major Elective -IV	4	3
	III	20U6CMP3	Physical Chemistry Experiments-II	3	2
	III	20U6CMP4	Organic preparations &Gravimetric Estimations	3	2
		Total			30
Total No. of Hrs & Credits				180	147



DEPARTMENT OF CHEMISTRY
THE MADURA COLLEGE (AUTONOMOUS), MADURAI 625011

Curriculum structure for B. Sc. Chemistry
(With Zoology & Physics Ancillaries CZP)

Sem	Part	Course code	Title of the course	No. of Hrs	Credits
I	I	20U1TLA1	Language I (Tamil/Hindi/Sanskrit)	6	3
	II	20U1NEN1	English I	6	3
	IV	20U1VEN1	Value Education and Professional Ethics	3	3
	III	20U1ZAC1	Fundamentals of Invertebrates & Chordates	4	4
	III	20U1ZAP1	Allied Zoology Practical-I	2	1
	III	20U1CMC1	General Chemistry-I	3	3
	III	20U1CMC2	General Chemistry-II	3	3
	III	20U1CMP1	Inorganic qualitative analysis - I	3	2
		Total		30	22
II	I	20U2TLA2	Language II (Tamil/Hindi/Sanskrit)	6	3
	II	20U2NEN2	English II	6	3
	IV	20U2EVS1	Environment & Gender studies	3	3
	III	20U2ZAC2	Applied Zoology	4	4
	III	20U2ZAP2	Allied Zoology Practical-II	2	1
	III	20U2CMC3	General Chemistry-III	3	3
	III	20U2CMC4	General Chemistry-IV	3	3
	III	20U2CMP2	Inorganic qualitative analysis - II	3	2
	IV		Extension Activity	-	1
		Total		30	23
III	I	20U3TLA2	Language III (Tamil/Hindi/Sanskrit)	6	3
	II	20U3NEN2	English III	6	3
	IV	20U3CNM1	Chemistry in Human life	2	2
	IV	20U3CSM1	Industrial Chemistry	2	2
	III	20U3PAC1	Properties of Matter, Thermal Physics and Optics	4	4
	III	20U3PAP1	Allied Physics Practical-I	2	1
	III	20U3CMC5	General Chemistry-V	5	5
	III	20U3CMP3	Volumetric Analysis-I	3	2
		20U3CAO1	Add on for beginners	-	2
		20U4CSS1	Chemistry and Health	-	-
		Total		30	24

IV	I	20U4TLA4	Language IV ((Tamil/Hindi/Sanskrit))	6	3
	II	20U4NEN4	English IV	6	3
	IV	20U4CNM2	Chemistry in everyday life	2	2
	IV	20U4CSM2	Nano & Green Chemistry	2	2
	III	20U4PAC2	Electricity , Electronics, Atomic and Nuclear Physics	4	4
	III	20U4PAP2	Allied Physics Practical-II	2	1
	III	20U4CMC6	General Chemistry-VI	5	5
	III	20U4CMP4	Volumetric Analysis-II	3	2
		20U4CAO2	Agricultural chemistry	-	2
		20U4CSS1	Chemistry and Health	-	2
		Total		30	26
V	IV	20U5CSB3	Skill Based Elective III	2	2
	III	20U5CMC7	Organic Chemistry-I	5	5
	III	20U5CMC8	Inorganic Chemistry-I	5	5
	III	20U5CMC9	Physical chemistry-I	5	5
	III	20U5CME1	Major Elective-I	4	3
	III	20U5CME2	Major Elective-II	3	2
	III	20U5CMP3	Physical Chemistry Experiments-I	3	2
	III	20U6CMP4	Organic analysis	3	2
		Total		30	26
VI	IV	20U6CSB4	Skill Based Elective IV	2	2
	III	20U6CMC10	Organic Chemistry-II	5	5
	III	20U6CMC11	Inorganic Chemistry-II	5	5
	III	20U6CMC12	Physical chemistry-II	5	5
	III	20U6CME3	Major Elective-III	3	2
	III	20U6CME4	Major Elective-IV	4	3
	III	20U6CMP3	Physical Chemistry Experiments-II	3	2
	III	20U6CMP4	Organic preparations & Gravimetric Estimations	3	2
		Total		30	26
		Total No. of Hrs& Credits		180	147

Semester wise mapping of courses with Programme learning outcomes (PLOs)

Semester-III

	Programme learning outcomes	Core General Chemistry-V	SBE Industrial Chemistry	NME Chemistry applied in various fields	Core Practical Volumetric Analysis-I	Allied theory Allied Chemistry-I
GRADUATE ATTRIBUTES	PLO-1 - Knowledge in core competency - Environment and Sustainability	1	1	3	1	3
	PLO-2 - Problem Analysis - Design and Development of solutions for complex problems	2	1	-	3	-
	PLO-3 - Problem Analysis - Conduct investigations of complex problems	3	3	-	1	1
	PLO-4 Knowledge in core competency	3	1	1	1	1
	PLO-5 - Knowledge in core competency - Problem Analysis	3	1	1	1	1
	PLO-6 - Ethics - Individual and team work - Communication - Project management and Finance	1	3	3	3	1
	PLO-7 - Modern Tool usage - Individual and team work - Communication	-	-	-	3	

Semester wise mapping of courses with Programme learning outcomes (PLOs)

Semester-IV

	Programme learning outcomes	Core General Chemistry- VI	SBE Nano & Green Chemistry	NME Chemistry in everyday life	Core Practical Volumetric Analysis-I	Allied theory Allied Chemistry- II
GRADUATE ATTRIBUTES	PLO-1 - Knowledge in core competency - Environment and Sustainability	1	1	3	1	3
	PLO-2 - Problem Analysis - Design and Development of solutions for complex problems	2	1	-	3	-
	PLO-3 - Problem Analysis - Conduct investigations of complex problems	3	3	-	1	1
	PLO-4 Knowledge in core competency	3	1	1	1	1
	PLO-5 - Knowledge in core competency - Problem Analysis	3	1	1	1	1
	PLO-6 - Ethics - Individual and team work - Communication Project management and Finance	1	3	3	3	1
	PLO-7 - Modern Tool usage - Individual and team work - Communication	-	-	-	3	-

LIST OF ELECTIVE PAPERS OFFERED IN THE DEPARTMENT OF CHEMISTRY

Major elective papers:

1. Industrial Chemistry
2. Nano & Green Chemistry
3. Biochemistry & Dyes
4. Analytical Chemistry
5. Spectroscopy and its applications
6. Pharmaceutical Chemistry
7. Solid state Chemistry
8. Materials science

Skill based elective papers:

1. Battery & Fuel cells
2. Water Analysis
3. ICT in Chemistry
4. Organic electronics
5. Clinical Bio-chemistry
6. Polymers Science

Non Major Elective papers:

1. Chemistry in day-to-day life
2. Food adulteration
3. Diet management in health & Disease

Curriculum structure for B.Sc. Mathematics & Physics II year with Ancillary Chemistry to be implemented from 2021-22

Semester	Course	Subject Code	Course title	Contact hours/week	Credits
III	Part III: Allied –I	20U3CAC1	Allied Chemistry-I	4	4
	Allied Practical	20U3CAP1	Volumetric Analysis	2	1
IV	Part III : Allied–II	20U4CAC2	Allied Chemistry-II	4	4
	Allied Practical	20U4CAP2	Semi-micro qualitative analysis	2	1
Total				12	10

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core	20U3CMC5	General Chemistry V	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- To know about aromaticity, aromatic electrophilic substitution and synthesis of some important aromatic compounds.
- To understand the nature of colloids materials
- To understand the basic of first law of thermodynamics and the law of thermochemistry
- To understand the characteristics of elements of Group III A and IV A and the chemistry of silicones
- To provide the detailed chemistry about p-block elements especially Nitrogen and Oxygen family.

Unit	Description	Hours	K-level	CLO
I	Aromatic Compounds Aromaticity - definition - Huckel's rule - consequence of aromaticity - stability, carbon- carbon bond lengths in benzene ring, resonance energy - Comparison of aromaticity of benzenoid and non benzenoid system - Aromatic electrophilic substitution - general pattern of the mechanism involving σ and π complexes, mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction - Energy profile diagrams - Activating and deactivating substituents - orientation in mono substituted benzenes - reactions of aromatic side chain - halogenation and oxidation - Methods of preparation and chemical reactions of alkyl benzenes, naphthalene.	15	K4	CLO-1
II	Colloids Colloids : Definition, Distinguishing characteristics of solutions, colloids and suspensions - Types of colloidal dispersions - Optical properties - Tyndall effect - Kinetic properties - Brownian motion - Electrical properties - Helmholtz and diffuse double layers - electro kinetic or zeta potential - electrophoresis and its applications. Coagulation - methods of coagulation - Hardy Schultz law - Hofmeister series - Protective colloids - protective action - gold number - applications - Emulsions - classification and preparation, Gels - preparation and properties thixotropy, syneresis and imbibition. Applications of colloids.	15	K3	CLO-2

III	First law of Thermodynamics and its applications System-surrounding-Intensive and extensive variables; state and path functions; isolated, closed and open systems-First law of thermodynamics- mathematical form- Heat capacity and its relation between C_p and C_v . Isothermal process: Calculations of w , q , dE and dH for the reversible expansion of ideal gases under isothermal and adiabatic conditions. Joule- Thomson effect-derivation of Joule-Thomson coefficient for ideal gases and real gases, inversion temperatures (T_i). Variation of enthalpy change of reaction with temperature (Kirchhoff's equation). –Hess's law of constant heat of summation.	15	K2	CLO-3
IV	p-block elements–Boron and Carbon family General characteristics of elements of Group III A – Extraction of Boron - Physical and chemical properties of Boron – Diagonal relationship between Boron and Aluminium; Boron and Beryllium - compounds of boron : Borax, Boric acid, Diborane and its structure, Boron nitride – Extraction of Al – Physical and Chemical properties - uses – compounds of aluminium : Al_2O_3 , $AlCl_3$. General characteristics of elements of Group IV A – Allotropic forms of carbon : Diamond and Graphite – oxides of carbon - preparation of Silicon – Physical and chemical properties of Si – Uses – Oxides of silicon – structures of silicates. Chemistry of silicones – Manufacture of glass – types of glasses.	15	K3	CLO-4
V	p-block elements–Nitrogen and Oxygen family General characteristics of elements of V A Group – Preparation of nitrogen – Physical and chemical properties of nitrogen – anomalous behavior of nitrogen with rest of the family members– uses– compounds of nitrogen: hydrazine, hydroxylamine, nitric acid – nitrogen cycle. Preparation of phosphorus – Physical and chemical properties of phosphorus – uses – compounds of phosphorous: PH_3 , PCl_3 , PCl_5 , $POCl_3$, – Nitrogen fertilizers : Urea, Ammonium nitrate – Phosphorous fertilizers: super phosphate of lime, Triple super phosphate – Oxides of nitrogen and Phosphorous – oxoacids of nitrogen and phosphorus – ozone - oxides : acidic oxides, basic oxides, neutral oxides, amphoteric oxides, peroxides, sub oxides – sulfur compounds. Anomalous behavior of oxygen.	15	K3	CLO-5

Books for study:

1. R. D. Madan, Modern Inorganic Chemistry, 3rd revised edition., S. Chand & Company Ltd., Reprint 2014.
2. Arun Bahadur and B.S. Bahl, A Text Book of Advanced Organic Chemistry, 22nd edn, S Chand & Company, 2016.
3. Puri, Sharma and Pathania, Principles of Physical Chemistry.

Books for reference:

1. K. S. Tewari and N. K. Vishnoi, A Text Book of Organic Chemistry, 4th edition, Vikas Publishing House Pvt Ltd, 2017.
2. I. L. Finar, Organic Chemistry Vol-1&2, 6th edn, Pearson Education Asia, 2004.
3. Sp. Banerjee, Advanced Inorganic Chemistry, 2nd Edition, 1st Volume, Arunabha Sen, Books and Allied (P) Ltd., Kolkata, 2017.
4. M.K. Jain and S. C. Sharma, Modern Organic Chemistry, Visal Publishing Co, 2015.
5. N. Tewari, Advanced Organic Reaction Mechanism, 3rd Edition, Books & Allied (P) Ltd, 2011.
6. J. Rajaram and J.C. Kuriacose, Chemical Thermodynamics, Pearson Education, New Delhi, 2013.

Web resources:

1. <https://www.toppr.com/guides/chemistry/the-p-block-elements/group-13-elements-boron-family/>
2. <https://www.brightstorm.com/science/chemistry/the-periodic-table/boron-family-carbon-family-nitrogen-family/>
3. <https://www.khanacademy.org/science/chemistry/states-of-matter-and-intermolecular-forces/mixtures-and-solutions/v/suspensions-colloids-and-solutions>

Rationale for nature of the course

This course will enable the students to enrich the understanding capacity in fundamental principles of Aromatic electrophilic substitution reactions, alkyl benzenes, significance of first law of thermodynamics, understand the chemistry of p-block elements, colloidal substances.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The basic study of aromaticity, aromatic electrophilic substitution helps the students to understand the aromatic nature of organic compounds. The concept of Tyndall effect, Brownian effect were explained by doing small experiments and chart work. The applications of colloids explained by doing chart work. Through the study of Thermodynamics the student gain the knowledge of thermal effects of reactions.

Pedagogy

- Chalk-Talk Class room Activities
- group Discussion
- seminar
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	Aromatic Compounds		
	Aromaticity - definition - Huckel's rule - consequence of aromaticity - stability, carbon- carbon bond lengths in benzene ring, resonance energy. – Comparison of aromaticity of benzenoid and non benzenoid system	3	BB
	Aromatic electrophilic substitution - general pattern of the mechanism involving σ and π complexes, mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction.	4	BB/PPT
	Energy profile diagrams - Activating and deactivating substituents - orientation in mono substituted benzenes.	4	BB
	Alkanes, alkenes, alkynes, (upto C-10) cycloalkanes, and aromatic compounds. reactions of aromatic side chain - halogenation and oxidation - Methods of preparation and chemical reactions of alkyl benzenes, naphthalene.	4	BB/PPT
II	Colloids		
	Colloids : Definition , Distinguishing characteristics of solutions, colloids and suspensions - Types of colloidal dispersions.	4	BB/PPT/Animated Videos
	Optical properties-Tyndall effect– Kinetic properties – Brownian motion.	3	BB/PPT/Animated Videos
	Electrical properties–Helmholtz and diffuse double layers – electro kinetic or zeta potential – electrophoresis and its applications.	4	BB/PPT
	Coagulation – methods of coagulation – Hardy Schultz law – Hofmeister series -Protective colloids – protective action – gold number – applications- Emulsions – classification, preparation, Gels – preparation and properties thixotropy, syneresis and imbibition. Applications of colloids.	4	BB/PPT/Animated Videos
III	First Law Of Thermodynamics And Its Applications		
	System-surrounding-Intensive and extensive variables; state and path functions; isolated, closed and open systems.	2	BB/PPT
	zeroth law of thermodynamics. First law of thermodynamics-mathematical form- Heat capacity and its relation between C_p and C_v . Isothermal process:	2	BB/PPT
	Calculations of w , q , dE and dH for the reversible expansion of ideal gases under isothermal and adiabatic conditions. Joule-Thomson effect.	3	BB/PPT/
	derivation of Joule- Thomson coefficient for ideal gases and real gases, inversion temperatures (T_i).	3	BB
	Transition from ionic to covalent character and vice versa – Covalent character of ionic compounds –Fajan's rules.	2	BB/PPT
	Variation of enthalpy change of reaction with temperature (Kirchoff's equation). Hess's law of constant heat of summation- Bond energy and its calculations.	3	BB/PPT/

IV	p-block elements – Boron and Carbon family		
	General characteristics of elements of Group III A – Extraction of Boron - Physical and chemical properties of Boron. – Diagonal relationship between Boron and Aluminium; Boron and Beryllium.	3	BB/PPT
	Compounds of boron : Borax, Boric acid, Diborane and its structure, Boron nitride.	3	BB/PPT
	Extraction of Al – Physical and Chemical properties - uses – compounds of aluminium: Al_2O_3 , AlCl_3 .	3	BB/PPT
	General characteristics of elements of Group IV A – Allotropic forms of carbon : Diamond and Graphite – oxides of carbon preparation of Silicon – Physical and chemical properties of Si – Uses.	4	BB/PPT
	Oxides of silicon – structures of silicates. Chemistry of silicones.	1	BB/PPT
	Manufacture of glass – types of glasses – ceramics.	1	BB/PPT
V	p-block elements – Nitrogen and Oxygen family		
	characteristics of elements of V A Group – Preparation of nitrogen – Physical and chemical properties of nitrogen - anomalous behavior of nitrogen with rest of the family members-uses.	3	BB/PPT/Animated Videos
	compounds of nitrogen : hydrazine, hydroxylamine, nitric acid – nitrogen cycle. Preparation of phosphorus – Physical and chemical properties of phosphorus – uses	4	BB/PPT
	Electronic effects - inductive effect, resonance effect - drawing of resonance structures - conditions for resonance - stability of resonance structures,	3	BB/PPT/Animated Videos
	compounds of phosphorous: PH_3 , PCl_3 , PCl_5 , POCl_3 . Nitrogen fertilizers : Urea, Ammonium nitrate – Phosphorous fertilizers: super phosphate of lime, Triple super phosphate – Oxides of nitrogen and Phosphorous – oxoacids of nitrogen and phosphorus, ozone. - oxides: acidic oxides, basic oxides, neutral oxides, amphoteric oxides, peroxides, sub oxides - sulfur compounds. Anomalous behavior of oxygen.	5	BB/PPT/Animated Videos
Total Hours		75	

BB-Block board/Chalk and Talk

PPT-Power point presentation

After successful completion of this course, the students will be able to

CLOs	CLO statement	Knowledge level
CLO-1	Analyze the knowledge of aromaticity, its orientation, reactivity towards electrophilic substitution reactions.	Up to K4
CLO-2	Apply chemistry of colloids, properties and its application on emulsion material	Up to K3
CLO-3	Describe concepts in thermodynamics, different thermodynamic quantities such as heat and work and how they are measured, related or transformed from one to the other	Up to K2
CLO-4	Organize outline the chemistry of p-block elements, specifically Boron and Carbon family its extraction, properties and importance of silicate in glass industries	Up to K3
CLO-5	Organize chemistry of p-block elements- Nitrogen , phosphorous Oxygen and sulphur family.	Up to K3

PO and CLO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	1	3	2	2	2
CLO-2	1	3	2	2	2
CLO-3	1	3	1	2	2
CLO-4	1	3	2	1	2
CLO-5	1	3	2	1	2

PLO and CLO mapping

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7
CLO-1	3	3	-	3	-	1	-
CLO-2	3	3	-	3	-	1	-
CLO-3	3	3	-	3	-	1	-
CLO-4	3	3	-	3	-	1	-
CLO-5	3	3	-	3	-	1	-

**Learning Outcome Based Education(LOBE) &Assesment
Formative Examination I & II -Blue Print
Articulation Mapping - K Levels with Course Outcomes (CLOs)**

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLOx	Up to K2/K3	2	K1& K2	2	K1,K2	2 (K2&K2)	1(K2/K3)	
2	CLOy	Up to K3/K4	2	K1& K2	1	K2	2 (K3&K3)	2 (K3, K3/ K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination -Blue Print
Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 4	2	K1 &K2	1	K2	2 (K4&K4)	1(K4)
2	CLO 2	Up to K 3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K 2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
4	CLO 4	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise marks with K-levels

K levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total Marks	10	10	50	50	120	100.00	100

Name of the course Designers

1. Dr. R. Sathya
2. Dr. P. S. Harikrishnan

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	SBE	20U3CSM1	Industrial Chemistry	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: *The objective of this course is to make the student*

- (i) *To impart the knowledge about the different kinds of fuels and principles of combustion*
- (ii) *To learn types of cracking in petroleum products and synthetic petrol*
- (iii) *To aware about non-petroleum products*
- (iv) *To gain basic knowledge of fireworks, explosive*
- (v) *To enable the students to understand various protective coating methods*

Unit	Description	Hours	K-Level	CLO
I	Fuels and Combustion Introduction, Classification of fuels, Characteristic of good fuel, Calorific fuel, Determination of Calorific value of solid fuel by Bomb Calorimeter – Determination of calorific value of gaseous fuel, boy's gas calorimeter, Theoretical calculation of calorific value, Combustion, calculation of air qualities.	6	K2	CLO-1
II	Petroleum Products Fractional distillation of crude petroleum, Cracking, Definition and classification and types of cracking; fixed bed catalytic cracking, moving bed catalytic cracking, Synthetic petrol – polymerization, Bergius method, Octane number, Knocking and Anti-knocking number, Gasoline, Reforming, Cetane number.	6	K3	CLO-2
III	Non Petroleum Products Manufacture of power alcohol from lignocellulose, natural gas, coal gas, oil gas, synthetic gas, producer gas and water gas.	6	K3	CLO-3
IV	Fireworks and Explosives Fireworks, Definition-Composition of fireworks Principle behind explosion of Fireworks and safety measure of fire works Explosives, definition, characteristics of good explosive, classification of explosive, precaution during storage of explosive, manufacture of some important explosive – Mercury fulminate, (TNT), Nitro glycerine, PETN	6	K4	CLO-4
V	Protective Coatings Introduction, Metallic coatings – Electro plating, Definition, Characteristics, Factors influencing electro plating, General Methods of Electroplating – Electro plating of copper and nickel- Organic coating, paint – Definition Requisites of Good paint, Constituents and their role in paints, formulation of paints, disadvantageous of paint film	6	K2	CLO-5

Books for Study:

1. P. Kannan, A. Ravikrishnan, Engineering Chemistry, Sri Krishna Hitech Publishing Company, 10th edition, 2013.
2. O. P. Vermani, A. K. Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi, 2000.
3. M.G. Arora, M. Singh, Industrial Chemistry, Anmol Publications, 1st edition, Reprint 2004.

Books for Reference:

1. P. C. Jain, M. Jain, Engineering Chemistry, Dhanpat Rai & Sons, Delhi. 16th edition, 2018.
2. B.K. Sharma - Industrial Chemistry – (Goel Publishing House, Meerut) 2000.
3. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi, 2000.
4. Gavhane, K. A. Chemical reaction engineering-I, NiraliPrakashan publications, 17th edition, 2016.
5. S. Chawla, Theory and practices of engineering chemistry– Dhanpat Rai & Co, 2008
6. Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi 2000.

Web Resources:

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004132159500424ranvijay_engg_Fuels.pdf
2. https://stannescet.ac.in/cms/staff/qbank/CSE/Notes/CY8151-Engineering%20Chemistry-1908708516-unit_4.pdf
3. [https://hithaldia.in/faculty/sas_faculty/Dr_Gora_Das/Class%20Notes%20\(CH-101%20&CH-201\)%20Module-5%20\(Industrial%20Chemistry\).pdf](https://hithaldia.in/faculty/sas_faculty/Dr_Gora_Das/Class%20Notes%20(CH-101%20&CH-201)%20Module-5%20(Industrial%20Chemistry).pdf)
4. <https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf>
5. <https://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html>
6. <https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf>

Rationale for Nature of the course

This course should enable the students to get exposure about industries of Petroleum and Non-Petroleum products,. Further students to know principles of combustion and gain the basic knowledge about Fireworks, Explosives and know about the various types of corrosion and their basic prevention techniques

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The Students observing the various industrial operation and capable of correlating those process with basic principle and The Techniques studied in this course .Finally They have been asked to prepare and submit the summary of Report which comprise of what they observe, understand and Analyse

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar/Assignment
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	Fuels and Combustion		
	Introduction, Classification of fuels, Characteristic of good fuel, Calorific fuel, Determination of Calorific value of solid fuel by Bomb Calorimeter .	2	BB
	Determination of calorific value of gaseous fuel, boy's gas calorimeter,	2	BB/PPT
	Theoretical calculation of calorific value, Combustion, calculation of air qualities.	2	BB
II	Petroleum Products		
	Fractional distillation of crude petroleum, Cracking, Definition and classification and types of cracking; fixed bed catalytic cracking, moving bed catalytic cracking,	3	BB/PPT/
	Synthetic petrol – polymerization, Bergius method, Octane number, Knocking and Anti-knocking number, Gasoline, Reforming, Cetan number	3	BB/ PPT
III	Non-Petroleum Products		
	Manufacture of power alcohol from lignocellulose and natural gas.	2	BB
	Manufacture of coal gas and oil gas	2	BB/PPT
	Manufacture of synthetic, gas producer gas and water gas.	2	BB
IV	Fireworks and Explosives		
	Fireworks, Definition-Composition of fireworks Principle behind explosion of Fireworks and safety measure of fireworks	2	BB/PPT
	Explosives, definition, characteristics of good explosive, classification of explosive, precaution during storage of explosive.	2	BB/PPT
	Manufacture of some important explosive – Mercury fulminate, (TNT), Nitro glycerin, PETN	2	BB/PPT
V	Protective Coatings		
	Introduction, Metallic coatings – Electro plating, Definition, Characteristics, Factors influencing electro plating	2	BB/PPT/Animated Videos
	General Methods of Electroplating – Electro plating of copper and nickel- Organic coating	2	BB/PPT/Animated Videos
	Paint – Definition Requisites of Good paint, Constituents and their role in paints, formulation of paints, disadvantage of paint film	2	BB/PPT/Animated Videos
Total Hours		30	

BB-Block board/Chalk and Talk

PPT-Power point presentation

CLOs	CLO statement	Knowledge level
CLO1	Learning classification of fuels and calorific value	Up to K2
CLO2	Know cracking of petrol and synthetic petrol preparation	Up to K3
CLO3	Study the manufacture of non-petroleum products	Up to K3
CLO4	Understand the basic principle fireworks, explosive and propellants	Up to K4
CLO5	Gain the knowledge of various coating methods	Up to K2

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	1	2	2	2	3
CLO2	1	1	1	2	3
CLO3	1	1	1	2	3
CLO4	1	1	1	2	3
CLO5	1	2	1	2	3

PSO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	3	1	2	1	2	2	1
CLO2	1	1	1	1	1	2	1
CLO3	2	1	1	1	1	2	1
CLO4	1	1	1	1	1	2	1
CLO5	2	1	2	1	1	2	1

3-Advance application;

2-Intermediate level;

1-Basic level

Learning Outcome Based Education(LOBE) & Assessment

Formative Examinations I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLOx	Up to K2/K3	2	K1& K2	2	K1,K2	2 (K2&K2)	1(K2/K3)	
2	CLOy	Up to K3/K4	2	K1& K2	1	K2	2 (K3&K3)	2 (K3, K3/ K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

Learning Outcome Based Education(LOBE) & Assessment
Summative Examination -Blue Print
Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1 & K2	1	K2	2 (K1&K1)	1(K2)
2	CLO 2	Up to K 3	2	K1 & K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K 2	2	K1 & K2	1	K2	2 (K1&K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total Marks	10	10	50	50	120	100.00	100

Name of the course Designer

1. Dr. P. Gajendran
2. Prof. S. Vidhyasankar

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core practical	20U3CMP3	Volumetric analysis-I	2	3	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: *The objective of this course is to make the student*

- To demonstrate basic laboratory technique of titration*
- To develop the intellectual and psychomotor skills of the students by imparting knowledge in quantitative analysis.*
- To examine the quantitative estimation of inorganic compounds through volumetric techniques.*

LIST OF EXPERIMENTS

A. Acidimetry&Alkalimetry:

- Estimation of Sodium carbonate
- Estimation of Sodium hydroxide

B. Permanganometry:

- Estimation of Ferrous ammonium sulphate.
- Estimation of Oxalic acid

C. Complexometry:

- Estimation of Magnesium by EDTA Method.
- Estimation of Zinc by EDTA Method.

Books for reference:

- O.P. Pandey, N. Bajpai, S. Giri, "Practical Chemistry" S. Chand and Co Ltd., ISBN: 9788121908122, 9788121908122, 2010.
- H, W. Schimpf "A text book of volumetric analysis", Biolife Publishers, ISBN: 978-1117262451, 1117262456, 2009.
- P. M. Pherson, "Practical volumetric analysis" RSC publications, ISBN: 978-1849739146, 1849739145, 2014.
- V. Venkateswaran , R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.

Web resources:

- <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
- <https://byjus.com/chemistry/volumetric-analysis/>
- <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy02/>
- <https://chemistry.tcd.ie/assets/pdf/Preliminary%20Course/Titration%20Demonstration.pdf>

Rationale for Nature of the course

Volumetric analysis is a widely-used quantitative analytical method. As the name implies, this method involves the measurement of volume of a solution of known concentration which is used to determine the concentration of the analyte.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The knowledge of volumetric analysis develops the students approach towards accurate measurement of concentration, molecular mass and stoichiometry of a chemical equation which involves titration techniques.

Course outcomes: After complete successful of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To get domain knowledge in estimation of inorganic compounds	Up to K2
CLO2	To design the basic laboratory techniques of volumetric analysis	Up to K3
CLO3	To develop the skills for doing any titrations and recording data	Up to K3
CLO4	To make scientific claims that is supported by their data and other observations	Up to K4
CLO5	To communicate the finding	Up to K2

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	2	1	-
CLO2	3	2	2	1	2
CLO3	3	2	2	1	2
CLO4	3	2	2	1	2
CLO5	3	-	2	1	2

PSO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	-	2	-	-	3	3	3
CLO2	-	2	2	-	3	3	3
CLO3	-	2	2	-	3	3	3
CLO4	-	2	-	-	3	3	3
CLO5	-	2	-	-	3	3	3

3-Advance application;

2-Intermediate level;

1-Basic level

Evaluation

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

Components for CIA	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total	40

Summative Assessment:

	CLO statement	Knowledge level	Marks
CLO 1	To get domain knowledge in estimation of inorganic compounds	Up to K2	10
CLO 2	To design the basic laboratory techniques of volumetric analysis	Up to K3	10
CLO 3	To develop the skills for doing any titrations and recording data	Up to K3	15
CLO 4	To make scientific claims that is supported by their data and other observations	Up to K4	20
CLO 5	To communicate the finding	Up to K2	5
Total Marks			60

Name of the Course Designers

1. Dr. S.V. Karthikeyan
2. Dr. M. Karpagavalli

DEPARTMENT OF CHEMISTRY				CLASS: II UG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	NME	20U3CNM1	Applied Chemistry	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- To learn environmental management and planning
- To study about the hardness of water and their removal
- To know role of fertilizer in plant growth
- To learn how to make soap, detergents and insecticides
- To understand fuels and classification

Unit	Description	Hours	K-Level	CLO
I	ENVIRONMENTAL POLLUTION Definition – Causes, effect and control measures of air pollution (Greenhouse effect, Global warming, acid rain) - water pollution – Causes, effect and control measure.	6	K2	CLO-1
II	WASTE TREATMENT/MANAGEMENT Classification – Solid waste disposal, Solid waste management – Waste water treatment (domestic process – aerobic process – industrial process – Electrolysis process)	6	K2	CLO-2
III	AGRICULTURE Definition: Nutrition for plants - role of various elements in plant growth- natural and chemical fertilizer- preparation and uses of urea, NPK, super phosphate of lime and potash	6	K2	CLO-3
IV	SOAPS, DETERGENTS & INSECTICIDES Soaps and detergents: Preparation and types –cleansing action of soap. Insecticides: Definition, classification according to their action- preparation and uses of DDT, BHC and Bordeaux mixture.	6	K2	CLO-4
V	FUELS Introduction – classification of fuels – characteristics of good fuel – calorific value of a fuel – Gaseous fuels - advantages of gaseous fuel – composition of coal gas, LPG, Bio gas and gobar gas.	6	K2	CLO-5

Books for Study:

1. Environmental Chemistry seventh edition A.K. De, New age international publishers, 2007.
2. Industrial Chemistry, B.K. Sharma, GOEL Publishing House, Meerut, 1997.

Books For reference:

1. Engineering Chemistry 15th Edition, Jain, Jain - Dhanpath Rai publishing company (PVL), New Delhi.
2. Fundamental concepts of Applied Chemistry, J. Ghosh, S. Chand Limited, Nagpur, 2006.
3. Advanced Organic Chemistry, Bhal, B.S. and Arun Bahl, 2004, S. Chand and Co. Ltd, New Delhi.

Web Resources:

1. <https://en.wikipedia.org/wiki/Pollution>
2. https://www.geo.lu.lv/fileadmin/user_upload/lu_portal/projekti/gzzf/zinas/8.LECTURE-Environmental_pollution.pdf
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107081/lec11.pdf
4. http://eacharya.inflibnet.ac.in/data-server/eacharya-documents/55daa452e41301c73a2cb5ac_INFIEP_208/798/ET/lec%20-%205.pdf
5. <https://www.svce.ac.in/departments/chemistry/CITM/CY%206251/Engg.%20Chem.%20%20%20%20II%20word/Unit%20V%20-%20Fuels%20&%20Combustion.pdf>

Rationale for Nature of the course

This course offers students a theoretical understanding of experiential learning programs and illustrative how experiential learning programs are used in day today life environmental pollution, waste water treatment process different types of fertilizers used for plant growth, preparation and various types of soaps, detergents and insecticides, introduction, classification and characterization of fuels.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The basic study of diary chemistry helps the students to understand create awareness causes and control of water and air pollution. They should know about the importance of waste treatment and water purification. The students can easily understanding need of fertilizers for the growth of plants. And also, they should learning cleaning action of soap and detergent and action of insecticides. Finally the students can able to study the calorific value of fuels and composition of gases fuels

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar/Assignment
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	ENVIRONMENTAL POLLUTION		
	Definition – Causes, effect and control measures of air pollution.	2	Chalk and talk, Group discussion/ Animated Videos
	Greenhouse effect, Global warming, acid rain	2	
	Water pollution – Causes, effect and control measure.	2	
II	WASTE TREATMENT/MANAGEMENT		
	Waste classification – Solid waste disposal, Solid waste management	2	PPT, Chalk and talk, Group discussion/ Animated Videos/BB
	Waste water treatment –domestic process	2	
	Waste water treatment –aerobic process–industrial process–Electrolysis process	2	
III	AGRICULTURE		
	Definition: Nutrition for plants - role of various elements in plant growth	2	PPT, Chalk and talk, Group discussion/ Animated Videos/BB
	Natural and chemical fertilizer	2	
	Preparation and uses of fertilizer -urea, NPK, super phosphate of lime, potash	2	
IV	SOAP, DETERGENTS&INSECTICIDES		
	Preparation of soap– Type of soap	1	PPT, Chalk and talk, Group discussion/ Animated Videos/BB
	Detergents – classification of detergents (cationic anionic) - cleansing action of soap.	2	
	Definition, classification according to their action preparation and uses of DDT	2	
	Preparation and uses of BHC, Bordeaux mixture	1	
V	FUELS		
	Introduction – classification of fuels – characteristics of coal fuel	2	PPT, Chalk and talk, Group discussion/ Animated Videos/BB
	Calorific value of a fuel - Gaseous fuels - advantages of gaseous fuel	2	
	Composition of coal gas, LPG, Bio-gas and gobar gas.	2	
Total Hours		30	

BB-Block board/Chalk and Talk, PPT-Power point presentation

Course Learning outcome: After successful completion of this course, the student will be able

On the successful completion of the course, students will be able to

CLOs	CLO Statement	Knowledge level
CLO1	Create awareness causes and control of water and air pollution	Up to K2
CLO2	Know the importance of waste treatment and water purification	Up to K2
CLO3	Understanding need of fertilizers for the growth of plants	Up to K2
CLO4	Understand the cleaning action of soap and detergent and action of insecticides	Up to K2
CLO5	Know the calorific value of fuels and composition of gases fuels	Up to K2

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	3	1	3
CLO2	3	3	3	-	-
CLO3	3	-	3	1	3
CLO4	3	-	3	-	-
CLO5	3	-	3	-	1

3-Strongcorrelation

2-Mediumcorrelation

1-WeakCorrelation

PLO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	3	3	1	-	-	3	-
CLO2	1	2	1	-	-	3	-
CLO3	1	2	1	-	-	3	-
CLO4	1	2	1	-	-	3	-
CLO5	1	2	1	-	-	3	-

3-Advance application;

2-Intermediate level;

1-Basic level

Learning Outcome Based Education (LOBE) & Assessment

Formative Examination - I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K 2	2	K1, K1	2 (K2 &K2)	1(K1)
2	CLO y	Up to K 2	3	K1, K1,K1	2 (K2 &K2)	2(K1, K1)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

Learning Outcome Based Education (LOBE) & Assessment

Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (open Choice)
			Short answers		(Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K 2	1	K1	2	(K2&K2)	1(K1)
2	CLO 2	Up to K 2	1	K1	2	(K2&K2)	1(K1)
3	CLO 3	Up to K 2	1	K1	2	(K2&K2)	1(K1)
4	CLO 4	Up to K 2	1	K1	2	(K2&K2)	1(K1)
5	CLO 5	Up to K 2	1	K1	2	(K2&K2)	1(K1)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

Distribution of Section-wise marks with K-levels

K Levels	Section A (No Choice)	Section B (Either / or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10		50	60	46	46
K2	-	70		70	54	54
Total marks	10	70	50	130	100	100

Name of the course Designer

- Dr. R. Ramachandran

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Part-III-Core	20U4CMC6	General Chemistry -VI	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives: The objective of this course is to make the student

- To study the preparation and chemical reactions of alkyl and aryl halides with mechanism and to apply the knowledge in the synthesis of the compounds DDT and BHC
- To explain the preparation and properties of alcohols, Phenols Ethers and epoxides with mechanisms and to apply the knowledge in the synthesis of alcohol derivatives.
- To provide the detailed chemistry about halogen family and noble gases.
- To discuss the second law of thermodynamics, the concept of entropy, concept of Gibbs Free energy and their applications.
- To illustrate kinetics and its theories of chemical reactions

Unit	Description	Hours	K-Level	CLO
I	Haloalkanes and Haloarenes Classification of alkyl halides - methods of formation from alcohols, alkanes, alkenes – allylic/ benzylic bromination and chlorination – Hunsdiecker reaction, Finkelstein reaction and Swart's reaction - nucleophilic substitution reactions - mechanisms of nucleophilic substitution reactions - S_N2 and S_N1 reactions with energy profile diagrams- dehydrohalogenation with mechanism - Saytzeff's rule - reaction with metals - Wurtz reaction and formation of Grignard reagent-Preparation and properties of: Weston & Freon. Methods of formation of aryl halides-nucleophilic substitution reactions of aryl halides-addition-elimination and the elimination-addition mechanisms - electrophilic substitution -Ullmann reaction – Wurtz-Fittig reaction -Relative reactivities of alkyl, allyl, vinyl and aryl halides - Synthesis and uses of DDT and BHC.	15	K3	CLO-1
II	Alcohols, Phenols, Ethers and Epoxides Preparation of alcohols through reduction, hydroboration, hydration, oxymercuration and Grignard reaction. -Reactions of alcohol - with metals, esterification with mechanism, oxidation, dehydration, conversion to alkyl halides. Estimation of number of hydroxyl groups - Preparation of phenols - acidity of phenol vs alcohols - relative acid strength of substituted phenols - reactions of phenols - esterification, oxidation, Kolbe's, Reimer-Tiemann, Gattermann, Williamson ether synthesis, Claisen rearrangement, Schotten-Baumann reaction, Houben-Hoesch reaction-electrophilic substitution reactions. Ethers –	15	K3	CLO-2

	preparation properties and reactions - epoxide –preparation and ring opening reactions-Synthesis of aspirin, 3 and 4-nitro phenol, t-butylmethyl ether and 1-methyl-1-cyclohexanol.			
III	Halogen family and Noble gases General characteristics of halogen with reference of electro negativity, electron affinity, oxidation states, and oxidizing power – peculiarities of fluorine - Basic properties of iodine- Inter halogen compounds: Introduction – general methods of preparation, properties and structure of inter halogen compounds. Polyhalides - Pseudo halogen. Difference between halogens and pseudo halogens. -Zero group elements: Noble gases: Group discussion of zero group elements – preparation, properties, uses and structures of XeF_2 , XeF_4 and XeF_6 , XeO_3 , XeO_4 and XeO_2F_2	15	K2	CLO-3
IV	Thermodynamics – II Second law of thermodynamics – Need for second law – statements of Second law - Carnot theorem, Carnot cycle – Efficiency of heat engine. Concept of entropy – State function – entropy change in isothermal expansion of ideal gas - Entropy change in reversible and irreversible process – Entropy change accompanying by change of phase – calculation of entropy change of an ideal gas with changes in pressure, volume and temperature – Physical significance of entropy. Gibbs free energy – Work function – Variation of free energy change with temperature and pressure – Maxwell's relationship – Criteria for spontaneity – Gibbs Helmholtz equation - Partial molar properties – Clausius Clapeyron equation and its applications Third law of thermodynamics – Nernst heat theorem – statement of third law – Zeroth law of thermodynamics - Determination of absolute entropies of solids, liquids and gases.	15	K3	CLO-4
V	Chemical kinetics Definition of order and molecularity – rate of reaction - derivation of rate constant of a first, second order reaction - second order reaction (i) When reactants are taken at same initial concentration (ii) When reactants are taken at different initial concentration – derivation of half-life period. Effect of temperature on reaction rate – Arrhenius equation – concept of activation energy. Collision theory – derivation of rate constant of a bimolecular reaction – Lindemann theory of unimolecular reaction. Absolute reaction rate theory – derivation of rate constant of a bimolecular reaction – Significance of free energy of activation and entropy of activation.	15	K4	CLO-5

Books for study:

1. R. T. Morrison, R. N. Boyd and S.K. Bhattacharjee, Organic chemistry, 7th edn, Pearson Education Asia, 2010
2. Bhal, B.S. and Arun Bahl, Advanced Organic Chemistry, S. Chand and Co. Ltd., New Delhi, 2014

3. Rajaram, R. and Kuriacose, J.C., "Thermodynamics", Third Edition, S. Chand and Co., New Delhi, 1999. b. Laidler, K.J. "Chemical Kinetics" Sixth Edition, Pearson Education, New Delhi, 2011.

Books for reference:

1. I. L. Finar, Organic Chemistry Vol-1, 6thedn, Pearson Education Asia, 2004
2. Rajaram, R. and Kuriacose, J.C., "Kinetics and Mechanism of Chemical Transformation", First Edition, Macmillan India Ltd., New Delhi, 2006.
3. Glasstone. S, "Thermodynamics for Chemists", First Edition (Reprint), van Nostrand & Co., New York, 2005.
4. N. Kundu and S.K. Jain, Physical Chemistry, S. Chand & Company Ltd. 2000
5. R. D. Madan, Modern Inorganic Chemistry, 3rdedn, S. Chand & Company Ltd., Reprint 2014.

Web resources

1. <https://www.toppr.com/guides/chemistry/haloalkanes-and-haloarenes/introduction-classification/>
2. <https://www.britannica.com/science/chemical-kinetics>
3. <https://www.livescience.com/50776-thermodynamics.html>
4. <https://www.s-cool.co.uk/gcse/chemistry/the-periodic-table/revise-it/the-noble-gases-and-halogens>
5. <https://www.slideshare.net/Arrehome/halogens-and-noble-gases>
6. [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry__The_Central_Science_\(Brown_et_al.\)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_\(Summary\)](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry__The_Central_Science_(Brown_et_al.)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_(Summary))

Rationale for Nature of the course

This course will enable the students to enriching the understanding fundamental principles of organic reactions in alcohols, phenols, Halo alkanes and alkenes, understand the chemistry of p-block elements, to know the chemistry of halogens and inert gases, significance of laws of thermodynamics, kinetics of complex reactions and theories of unimolecular gaseous reactions.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The basic study of organic reaction mechanism helps the students to understand the construction of chemical reactions. The ability to draw such analogies frequently makes it possible to predict the course of untried reactions. Thermodynamics study explains, in particular, how thermal energy is transferred into and from other sources of energy and how it affects matter. Through the study of chemical kinetics, it can reasonably guide the students to know how to control the reaction conditions and improve the main reaction rate, in order to increase the production of chemical products.

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar /Assignment/Quiz through ICT- Mode

Lesson Plan

Unit	Topics	Hours	Mode
I	UNIT – I: Haloalkanes and Haloarenes		
	Classification of alkyl halides - methods of formation from alcohols, alkanes, alkenes – allylic/ benzylic bromination and chlorination – Hunsdiecker reaction, Finkelstein reaction and Swart's reaction.	3	PPT, Chalk and talk, Group discussion
	Nucleophilic substitution reactions - mechanisms of nucleophilic substitution reactions- S _N 2 and S _N 1 reactions with energy profile diagrams	3	
	Dehydrohalogenation with mechanism - Saytzeff's rule - reaction with metals -Wurtz reaction and formation of Grignard reagent-Preparation and properties of: westron&freon.	3	
	Methodsofformationofaryhalides-nucleophilic substitution reactions of arylhalides-addition-elimination and the elimination-addition mechanisms	3	
	Electrophilic substitution -Ullmann reaction – Wurtz-Fittig reaction - Relative reactivities of alkyl, allyl, vinyl and aryl halides - Synthesis and uses of DDT and BHC	3	
UNIT- II: Alcohols, Phenols, Ethers and Epoxides			
II	Preparation of alcohols through reduction, hydroboration, hydration, oxymercuration and Grignard reaction. -Reactions of alcohol - with metals, esterification with mechanism,	3	PPT, Chalk and talk, Group discussion and Assignment
	Oxidation, dehydration, conversion to alkyl halides. Estimation of number of hydroxyl groups - -electrophilic substitution reactions.	3	
	Preparation of phenols - acidity of phenol vs alcohols - relative acid strength of substituted phenols	3	
	Rreactions of phenols - esterification, oxidation, Kolbe's, Reimer-Tiemann, Gattermann, Williamson ether synthesis, Claisen rearrangement, Schotten-Baumann reaction, Houben-Hoesch reaction	3	
	Ethers – preparations, properties and reactions - epoxide –preparation and ring opening reactions-Synthesis of aspirin, 3 and 4-nitro phenol, t-butylmethyl ether and 1-methyl-1-cyclohexanol.	3	
UNIT – III : Halogen family and Noble gases:			
III	General characteristics of halogen with reference of electro negativity, electron affinity, oxidation states and oxidizing power – peculiarities of fluorine -Basic properties of iodine	5	PPT, Chalk and talk, Group discussion
	Inter halogen compounds: Introduction – general methods of preparation, properties and structure of inter halogen compounds.	4	
	Polyhalides - Pseudo halogen. Difference between halogens and pseudo halogens.	2	
	Zero group elements: Noble gases: Group discussion of zero group elements – preparation, properties, uses and structures of XeF ₂ , XeF ₄ and XeF ₆ , XeO ₃ , XeO ₄ and XeO ₂ F ₂	4	

UNIT – IV: Thermodynamics – II			
IV	Second law of thermodynamics – Need for second law – statements of Second law - Carnot theorem, Carnot cycle – Efficiency of heat engine. Concept of entropy – State function – entropy change in isothermal expansion of ideal gas	4	PPT, Chalk and talk, Group discussion
	Entropy change in reversible and irreversible process – Entropy change accompanying by change of phase – calculation of entropy change of an ideal gas with changes in pressure, volume and temperature	3	
	Physical significance of entropy. Gibbs free energy – Work function – Variation of free energy change with temperature and pressure – Maxwell's relationship – Criteria for spontaneity	3	
	Partial molar properties –Clausius Clapeyron equation and its applications	2	
	Third law of thermodynamics – Nernst heat theorem – statement of third law – Zeroth law of Thermodynamics- Determination of absolute entropies of solids, liquids and gases.	3	
UNIT – V - Chemical kinetics			
V	Definition of order and molecularity – rate of reaction - derivation of rate constant of a first, second order reaction - second order reaction.	4	PPT, Chalk and talk, Group discussion
	(i) When reactants are taken at same initial concentration (ii) When reactants are taken at different initial concentration – derivation of half-life period	4	
	Effect of temperature on reaction rate – Arrhenius equation – concept of activation energy. Collision theory – derivation of rate constant of a bimolecular reaction	4	
	– Lindemann theory of unimolecular reaction. Theory of Absolute reaction rate theory– derivation of rate constant of a bimolecular reaction – Significance of free energy of activation and entropy of activation.	3	
Total Hours		75	

Course Learning outcome:

After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To collect various reactions with mechanism involved in both the preparations and properties of alkyl and aryl halides	Up to K3
CLO2	To identify the reactions of Alcohols, Phenols Ethers and Epoxides with mechanisms and applied in the synthesis of industrial and medicinal important compounds	Up to K3
CLO3	To describe a clear knowledge about halogen family, noble gases and its uses	Up to K2
CLO4	To utilize the laws of thermodynamics, the concept of entropy, concept of Gibbs Free energy and their applications.	Up to K3
CLO5	To illustrate kinetics and its theories of chemical reactions and solve the problems related to kinetics	Up to K4

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	-	-	-
CLO2	3	2	-	-	-
CLO3	3	2	-	-	-
CLO4	3	2	-	-	-
CLO5	3	2	-	-	-

PLO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	1	-	-	3	-	-	-
CLO2	1	-	-	3	-	-	-
CLO3	1	-	-	3	-	-	-
CLO4	1	-	-	-	3	-	-
CLO5	1	-	-	-	3	-	-

3-Advance application;

2-Intermediate level;

1-Basic level

Learning Outcome Based Education(LOBE) & Assessment

Formative Examinations I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLOx	Up to K2/K3	2	K1& K2	2	K1,K2	2 (K2&K2)	1(K2/K3)	
2	CLOy	Up to K3/K4	2	K1& K2	1	K2	2 (K3&K3)	2 (K3, K3/ K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education(LOBE) & Assessment
Summative Examination -Blue Print
Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 3	2	K1 & K2	1	K1	2 (K2&K2)	1(K3)
2	CLO 2	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K 2	2	K1 & K2	1	K2	2 (K1&K1)	1(K2)
4	CLO 4	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total Marks	10	10	50	50	120	100.00	100

Name of the course Designers

1. Dr. J. Shanmugapriya
2. Dr. P. S. Harikrishnan

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	SBE	20U4CSM2	Nano & Green Chemistry	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:The objective of this course is to make the student

- (i) To introduce the students about nanomaterials and its properties
- (ii) To gain the knowledge of preparative methods of nanomaterials
- (iii) To expose the students about the carbon nanotube preparation, properties and its applications
- (iv) To help the students to understand basic principle of green chemistry and atom economy
- (v) To enable the students to study various green chemistry reactions

Unit	Description	Hours	K-Level	CLO
I	Introduction to Nanomaterials Nano material: Introduction – definition- types -0D, 1D, 2D, and 3D Nanomaterial and examples. Properties: Size effect, Optical, electrical and magnetic properties.	6	K2	CLO-1
II	Preparation of Nanomaterials Preparation of simple nanomaterials (nanometal, Metal oxide, semiconductor) – Chemical reduction method –Electrochemical methods – Sol-gel method and inert gas condensation.	6	K3	CLO-2
III	Carbon nanotubes Carbon nano structures: Preparation, properties and application of Single-walled carbon nanotube and Multi-walled carbon nanotubes	6	K3	CLO-3
IV	Basic concept in Green Chemistry Green Chemistry - Definition, need and twelve basic principles of green chemistry – Atom economy with an example – green chemistry & eco efficiency – Green synthesis - Aqueous phase reactions, reactions in ionic liquids.	6	K4	CLO-4
V	Green synthesis Solid supported synthesis, Solvent free reactions (solid phase reactions), - Green catalysts - Phase transfer catalysts (PTC) and Biocatalysts. Microwave and Ultrasound assisted green synthesis-green chemical synthesis of Paracetamol.	6	K3	CLO-5

Books for Study

1. Nanoscience and Nanotechnology: Fundamentals of Frontiers - Shubra Singh M.S. Ramachandra Rao, 2013.
2. Sanghi, R., Srivastava, M. M. "Green Chemistry" Narosa Publishing House, 2012.
3. An introduction to green chemistry V. Kumar, Vishal Publishing Co.2020

Books For references:

1. Textbook of Nanoscience and Nanotechnology - BS Murthy P Shankar, Baldev Raj, BB Rath, and James Murday - Orient Black swan Private Limited - New Delhi, 2013.
2. An Introduction to Nanomaterials and Nanoscience A. Das – CBS

Web Resources:

1. https://en.wikipedia.org/wiki/Carbon_nanotube
2. [https://www.google.com/search?q=nanomaterials+preparation+methods&sxsrf=ACYBGnQjItfDydTXtPbsVUznP6Y1ktYw:1576222370982&tbm=isch&source=iu&ictx=1&fir=8SvCwKnfu7cggM%253A%252Cvsv-t8SrrKIpeM%252C_&vet=1&usg=AI4_-kQHRgp4DR-7Podk-
ipgwqbMuRFhg&sa=X&ved=2ahUKEwiMqYn0jbLmAhuUJyDgGHQgECZgQ9QEwAXoEACQAw#imgsrc=8SvCwKnfu7cggM](https://www.google.com/search?q=nanomaterials+preparation+methods&sxsrf=ACYBGnQjItfDydTXtPbsVUznP6Y1ktYw:1576222370982&tbm=isch&source=iu&ictx=1&fir=8SvCwKnfu7cggM%253A%252Cvsv-t8SrrKIpeM%252C_&vet=1&usg=AI4_-kQHRgp4DR-7Podk-
ipgwqbMuRFhg&sa=X&ved=2ahUKEwiMqYn0jbLmAhuUJyDgGHQgECZgQ9QEwAXoEACQAw#imgsrc=8SvCwKnfu7cggM)
3. <https://www.degruyter.com/view/j/ntrev.2018.7.issue-1/ntrev-2017-0160/ntrev-2017-0160.xml?lang=en>
4. <https://www.intechopen.com/books/green-chemistry/introductory-chapter-principles-of-green-chemistry>
5. <http://advancinggreenchemistry.org/green-chem-101/what-is-gc/>

Rationale for Nature of the course

This course will enable the students to enriching the understanding fundamental principles of nano and green chemistry. Students will learn preparation, properties and applications of nanomaterial and carbon nanotubes. Ensure the student to learn green chemical reaction and synthesis.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Fundamental concept of green and nano chemistry will be focused. The preparation, properties and applications of new nanomaterials and carbon nanotubes will be developed. Basic ideas of green chemistry and green chemical reaction involving environmental hazard free reaction carried out.

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar/Assignment
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	Introduction to Nanomaterials		
	Introduction – definition- types -0D, 1D, 2D, and 3D Nanomaterial and examples.	3	BB /PPT
	Properties: Size effect – Colour – Magnetic properties	3	
II	Preparation of Nanomaterials		
	Preparation of simple nanomaterials (nanometal, Metal oxide, semiconductor) – Chemical reduction method	2	BB/ PPT/Animated Videos
	Electrochemical methods	1	
	Sol-gel method and inert gas condensation.	3	
III	Carbon nanotubes		
	Preparation, properties and application of Single-walled carbon nanotube	3	BB BB/PPT
	Preparation, properties and application of Multi-walled carbon nanotube	3	
IV	Basic concept in Green Chemistry		
	Green Chemistry - Definition, need and basic principles of green chemistry	2	BB/PPT
	Atom economy with an example – green chemistry	2	
	Eco efficiency – environmental protection laws.	2	
V	Green synthesis		
	Green synthesis - Aqueous phase reactions, reactions in ionic liquids, Solid supported synthesis, Solvent free reactions (solid phase reactions),	2	BB/PPT/Animated Videos
	Green catalysts - Phase transfer catalysts (PTC) and Biocatalysts.	2	
	Microwave and Ultrasound assisted green synthesis- green chemical synthesis of Paracetamol.	2	
Total Hours		30	

BB-Block board/Chalk and Talk

PPT-Power point presentation

Course outcome:

After complete successful of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO1	To outline the concept of nanomaterials, types and its properties	Up to K2
CLO2	Know the various synthetic methods of nanomaterials	Up to K3
CLO3	Plan the preparation, properties and applications of carbon nanotube	Up to K3
CLO4	Inspect the basic principle of green chemistry and atom economy	Up to K4
CLO5	To apply ionic liquids, green catalysis and phase transfer catalysis in green synthesis	Up to K3

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	-	1	1
CLO2	3	2	1	2	1
CLO3	3	2	2	1	1
CLO4	3	2	-	-	1
CLO5	3	2	-	1	-

PLO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	1	2	-	3	-	3	-
CLO2	1	2	-	3	-	3	-
CLO3	1	2	-	3	-	3	-
CLO4	1	2	-	3	-	3	-
CLO5	1	2	-	3	-	3	-

3-Advance application;

2-Intermediate level;

1-Basic level

Learning Outcome Based Education(LOBE) & Assessment

Formative Examinations I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLOx	Up to K2/K3	2	K1& K2	2	K1,K2	2 (K2&K2)	1(K2/K3)	
2	CLOy	Up to K3/K4	2	K1& K2	1	K2	2 (K3&K3)	2 (K3, K3/ K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

Learning Outcome Based Education(LOBE) & Assessment
Summative Examination -Blue Print
Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1 & K2	1	K1	2 (K2&K2)	1(K2)
2	CLO 2	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K 3	2	K1 & K2	1	K2	2 (K1&K1)	1(K2)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total Marks	10	10	50	50	120	100.00	100

Name of the course Designer

- Dr. P. Gajendran

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Core practical	20U4CMP4	Volumetric analysis-II	2	3	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- To intensify basic laboratory technique of titration and estimation
- To develop the intellectual and psychomotor skills of the students by imparting knowledge in quantitative analysis.
- To examine the quantitative estimation of inorganic and organic compounds through volumetric techniques.

LIST OF EXPERIMENTS

A. Dichrometry:

- Estimation of Ferrous iron using internal indicator method
- Estimation of Ferrous iron using external indicator method

B. Iodimetry:

- Estimation of $K_2Cr_2O_7$
- Estimation of Copper.
- Estimation of As_2O_3 (demonstration only)

C. Organic Estimations:

- Estimation of Aniline
- Estimation of phenol.

Books for reference:

- O.P. Pandey, N. Bajpai, S. Giri, "Practical Chemistry" S. Chand and Co Ltd., ISBN: 9788121908122, 9788121908122, 2010.
- H. W. Schimpf "A text book of volumetric analysis", Biolife Publishers, ISBN: 978-1117262451, 1117262456, 2009.
- Peter Mc Pherson, "Practical volumetric analysis" RSC publications, ISBN: 978-1849739146, 1849739145, 2014.
- V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.

Web resources:

- <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
- <https://byjus.com/chemistry/volumetric-analysis/>
- <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy02/>
- <https://chemistry.tcd.ie/assets/pdf/Preliminary%20Course/Titration%20Demonstration.pdf>

Rationale for Nature of the course

Volumetric analysis is a widely-used quantitative analytical method. As the name implies, this method involves the measurement of volume of a solution of known concentration which is used to determine the concentration of the analyte.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The knowledge of volumetric analysis develops the students approach towards accurate measurement of concentration, molecular mass and stoichiometry of a chemical equation which involves titration techniques.

Course outcomes:

After complete successful of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To get domain knowledge in estimation of inorganic compounds	Up to K2
CLO2	To design the basic laboratory techniques of volumetric analysis	Up to K3
CLO3	To develop the skills for doing any titrations and recording data	Up to K3
CLO4	To make scientific claims that is supported by their data and other observations	Up to K4
CLO5	To communicate the finding	Up to K2

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	-	-	-
CLO2	3	2	-	-	2
CLO3	3	2	-	-	2
CLO4	3	2	-	-	2
CLO5	3	-	-	-	2

PLO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	-	2		-	3	3	3
CLO2	-	2	2	-	3	3	3
CLO3	-	2	2	-	3	3	3
CLO4	-	2		-	3	3	3
CLO5	-	2		-	3	3	3

3-Advance application;

2-Intermediate level;

1-Basic level

Evaluation:

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

CIA Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total	40

Summative Assessment:

	CLO statement	Knowledge level	Marks
CLO 1	To get domain knowledge in estimation of inorganic compounds	Up to K2	10
CLO 2	To design the basic laboratory techniques of volumetric analysis	Up to K3	10
CLO 3	To develop the skills for doing any titrations and recording data	Up to K3	15
CLO 4	To make scientific claims that is supported by their data and other observations	Up to K4	20
CLO 5	To communicate the finding	Up to K2	5
Total Marks			60

Name of the Course Designers

1. Dr. S.V. Karthikeyan
2. Dr. M. Karpagavalli

DEPARTMENT OF CHEMISTRY				CLASS: II UG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	NME	20U4CNM2	Chemistry in Everyday life	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- (i) To create awareness about the various chemical industries
- (ii) To know elementary concepts of chemistry about dairy and textile industries
- (iii) To give exposure about basic process of leather industry
- (iv) To learn about food spoilage. Processing and their nutritional importance
- (v) To gain knowledge of few popular Medicinal plants and their medicinal uses

Unit	Description	Hours	K-Level	CLO
I	Unit – I: Dairy Chemistry Milk- lipids-terminology only General composition of milk - factors affecting the gross composition of milk, physio-Chemical change taking place during -boiling pasteurization- sterilization and homogenization.	6	K2	CLO-1
II	Unit – II: Textile Chemistry General classification of fibers-, production (outline procedure only), properties and uses of the following natural fibers - natural cellulose fibers - (cotton and jute) natural protein fiber - (wool and silk) - synthetic fibers (Rayon and nylon)	6	K2	CLO-2
III	Unit – III: Leather Chemistry Leather Definition Curing, preservation and tanning of hides and skins, process of dehairing and dyeing. Treatment oftannery effluents. homogenization	6	K2	CLO-3
IV	Unit – IV: Food Chemistry Food spoilage, courses of food spoilage, types of Food spoilage, food preservation, and processing by heating- sterilization and pasteurization. Adulteration in foods – milk, tea, coffee and turmeric.	6	K2	CLO-4
V	Unit-V: Medicinal chemistry Various sources of drugs, pharmacologically active constituents in plants - Indian medicinal important of plants – tulsi, neem, keezhanelli – Classification of drugs based on biological and chemical uses - Examples: Paracetamol, Dettol and aspirin (structure and preparation not needed)	6	K2	CLO-5

Books for Study:

1. Text Book of Applied Chemistry- K.Kapur. New Delhi: H.TataPublications,1994
2. Industrial Chemistry by O P Vermani new age international (p)limited
3. B.K. Sharma - Industrial Chemistry – (Goel Publishing House,Meerut)

Books For reference:

1. Principles of Dairy Chemistry-Robert Jenness & S.Patarn.. John Wiley & Sons Inc (1 December 1959);
2. Textile Chemistry –Vol .IIR. H.Peters, Elsevier, Avesterdam.
3. S. Lakshmi Pharmaceutical Chemistry, S.Chand& Sons, New Delhi,2004
4. P. Parimoo, — A Text Book of Medicinal Chemistry, CBS publishers,New Delhi, 2006
5. Seema Yadav: —Food Chemistry, Anmol publishing (P) Ltd ,New Delhi
6. Sivasankar – Food Processing and Preservation PHI.(Eastern Economy Editions).

Web Resources:

1. <http://www.agrimoon.com/wp-content/uploads/CHEMISTRY-OF-MILK.pdf>
2. <http://library.umac.mo/ebooks/b28050332.pdf>
3. <http://www.agrimoon.com/wp-content/uploads/Food-Chemistry.pdf>
4. <https://nzic.org.nz/app/uploads/2017/10/5C.pdf>
5. https://www.academia.edu/36903466/An_Introduction_to_Medicinal_Chemistry_Fifth_Edition-_Graham_L._Patrick

Rationale for Nature of the course

This course will enable the students to get exposure on industries of dairy and textile products. Further the course will enable the students to know the principles of combustion and gain the basic knowledge about food chemistry, medicinal plants. It helps to know the various techniques involved in processing the food, medicine, leather and textile products.

Activities having direct bearing on Knowledge and Skill / Skill oriented / Employability Oriented/ Entrepreneurship Oriented

- Practical classes on pasteurization
- Field visit to nearby textile and milk industry.
- Hands on training will be given to identify adulteration

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar/Assignment
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
Unit – I: Dairy industry			
1	Milk lipids-terminology and definitions only General composition of milk	2	BB
2	Factors affecting the gross composition of milk,	2	BB/PPT
3	Physio-Chemical change taking place during - boiling pasteurization- sterilization and homogenization.	2	BB
Unit – II: Textile Chemistry			
1	General classification of fibers-, production (outline procedure only	2	BB/PPT
2	properties and uses of the following natural fibers (a) natural cellulose fibers (cotton and jute)	2	BB/ PPT
3	(b) natural protein fiber(wool and silk).and	1	BB /PPT
4	(c)synthetic fibers (Rayon and nylon)	1	BB/PPT
Unit – III: Leather industry			
1	Leather: Definition Curing, preservation and tanning of hides and skins,	3	BB
2	Process of dehairing and dyeing. Treatment of tannery effluents.	3	BB/PPT
Unit – IV: Food Industry			
1	Food spoilage, courses of food spoilage, types of Food spoilage,	2	BB/PPT
2	Food preservation, preservation and processing by heating- sterilization, pasteurization.	2	BB/PPT
3	Sources , requirement deficiency diseases of A, D, E, K , B and C	2	BB/PPT
Unit-V: Medicinal chemistry			
1	Various sources of drugs, pharmacologically active constituents in plants	2	BB/PPT/Animated Videos
2	Indian medicinal plants – tulsi, neem, keezhanelli – their importance	2	BB/PPT/Animated Videos
3	Classification of drugs based on biological and chemical uses - Examples: Paracetamol, Dettol and aspirin (structure and preparation not needed)	2	BB/PPT/Animated Videos
Total Hours		30	

BB-Block board/Chalk and Talk

PPT-Power point presentation

Course learning outcome: After complete successful of this course, the student will be able to

CLOs	CLO Statement	Knowledge level
CLO1	Understand basic concepts of milk	Up to K2
CLO2	Know the general properties of fibers and their uses	Up to K2
CLO3	Study the preparation and processing of leather	Up to K2
CLO4	Understanding of food spoilage , food preservation and vitamins	Up to K2
CLO5	Gain the knowledge of medicinal plants and drug interaction	Up to K2

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	2	1	1	1	2
CLO2	2	1	1	1	2
CLO3	2	1	1	2	2
CLO4	2	1	1	1	2
CLO5	2	1	1	2	2

3- Strong correlation; 2-Medium correlation; 1-Weak Correlation

PLO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	1	2	-	2	-	3	-
CLO2	1	2	-	2	-	3	-
CLO3	1	2	-	2	-	3	-
CLO4	1	2	-	2	-	3	-
CLO5	1	2	-	2	-	3	-

3-Advance application; 2-Intermediate level; 1-Basic level

Learning Outcome Based Education (LOBE) & Assessment

Formative Examination - I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K 2	2	K1, K1	2 (K2 &K2)	1(K1)
2	CLO y	Up to K 2	3	K1, K1,K1	2 (K2 &K2)	2(K1, K1)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (open Choice)
			Short answers		(Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K 2	1	K1	2	(K2&K2)	1(K1)
2	CLO 2	Up to K 2	1	K1	2	(K2&K2)	1(K1)
3	CLO 3	Up to K 2	1	K1	2	(K2&K2)	1(K1)
4	CLO 4	Up to K 2	1	K1	2	(K2&K2)	1(K1)
5	CLO 5	Up to K 2	1	K1	2	(K2&K2)	1(K1)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

Distribution of Section-wise marks with K-levels

K Levels	Section A (No Choice)	Section B (Either / or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10		50	60	46	46
K2	-	70		70	54	54
Total marks	10	70	50	130	100	100

Name of the course Designer

- Prof .S. Selvakumar

DEPARTMENT OF CHEMISTRY				CLASS: II B. Sc. Mathematics & II B. Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Part-III Allied	20U3CAC1	Allied Chemistry – I	4	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives: *The objectives of this course are to make the student*

- To explain the various atomic models and rules for writing electronic configuration*
- To discuss the types of chemical bonds, classification of organic compounds and organic reactions*
- To classify organic compound based on its functional groups*
- To predict the adsorption process and its applications*
- To examine the types of catalysis and its applications*

Unit	Course Contents	Hours	K-Level	CLO
I	Introduction to structure of atom- Fundamental particles - proton, neutron and electron - Rutherford and Niels Bohr's model of an atom and their defects - Sommerfeld's modification of atomic structure, quantum numbers – Orbitals: shapes of <i>s</i> , <i>p</i> and <i>d</i> orbitals. - Pauli's exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle - Heisenberg's uncertainty principle.	12	K2	CLO-1
II	Types of chemical Bonds – electrovalent (ionic), covalent, coordinate covalent, metallic and Hydrogen bonding. Characteristics of electrovalent and covalent compounds. Valence Bond Theory - Types of overlapping (<i>s-s</i> , <i>s-p</i> and <i>p-p</i> overlapping), Sigma and pi bonds, Hybridization- <i>sp</i> , <i>sp</i> ² and <i>sp</i> ³ hybridization in acetylene, ethylene & methane only.	12	K4	CLO-2
III	Importance of organic compounds in daily life – Classification of organic compounds. Functional groups – definition – Various functional groups - General formula and examples for the following: Alcohols, Alkyl Halide, Carbonyl compounds (aldehyde and ketone), Carboxylic acids and Amines. Types of organic reactions – Substitution, Addition and Elimination reactions (examples only, not mechanism)	12	K3	CLO-3
IV	Definition of adsorption, occlusion, absorption, adsorbent, and adsorbate – Types of adsorption: Physisorption and chemisorption – differences between Physisorption and Chemisorption – various	12	K3	CLO-4

	applications of adsorptions – Factors influencing adsorption process- nature of gases, nature of adsorbent, influence of temperature and pressure.			
V	Definition, Characteristics of catalysts - Types of catalyst (Homogeneous catalysis and heterogeneous catalysis) – Acid and base catalysis – Enzyme catalysis with example only: positive catalysis, negative catalysis and auto catalysis – catalytic promoters – catalytic poison-. Intermediate compound formation theory-adsorption isotherm.	12	K3	CLO-5

Books for study:

1. Puri, B.R., Sharma, L.R. and Pathania, M.S., 2004 (41stEdn.), Principles of Physical Chemistry, S.N. Chand and Co., New Delhi.
2. Bhal, B.S. and Arun Bahl, 2004, Advanced Organic Chemistry, S. Chand and Co. Ltd., New Delhi.
3. Sathya Prakash, Tuli, Basu & Madan, 1999, Advanced Inorganic Chemistry. Vol. II, 17th Revised Edition, S. Chand and Co. Ltd., Ram Nagar., New Delhi.

Books for reference:

1. Morrison, R.T., and Boyd, R.N., 1999, Organic Chemistry, Prentice-Hall of India, Pvt. Ltd., New Delhi.
2. Sharma, B.K., 1989, Polymer Chemistry, Goel Publishing House, Meerut.
3. Mukhopadhyay, R. and Datta, S., Engineering Chemistry, New Age international PVT, Publishers, New Delhi, 2007
4. Sharma, B. K., Industrial chemistry, Goel Publishing House, 1994

Web Resources:

1. <https://byjus.com/jee/atomic-structure/>
2. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Atomic_Theory/Atomic_Structure](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Atomic_Theory/Atomic_Structure)
3. <https://www.khanacademy.org/science/chemistry/chemical-bonds/types-chemical-bonds/v/ionic-bonds-and-coulombs-law?modal=1>,
4. <https://ocw.mit.edu/courses/chemistry/5-12-organic-chemistry-i-spring-2005/syllabus/>
5. <https://byjus.com/jee/surface-chemistry/>, <http://www.ncert.nic.in/ncerts/l/lech105.pdf>
6. <https://byjus.com/chemistry/catalysis/>

Rationale for Nature of the course

The basic knowledge and concept of atom models and shape of orbitals in molecules. The concept of valence bond theory, Hybridization will help the student to understand the structure of molecules. To understand the reaction mechanism and its pathway to ensure the knowledge of organic reactions. To comprehend the concept of surface chemistry, application and catalysis involved in various reactions.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

To comprehend the basic ideas of atom models and particle present in it. To enable the basic knowledge of organic reactions and its pathway. To know the shape, size, bond angle and geometry of the molecules based on hybridisation concept. To enable the study of adsorption and its isotherms and applicable catalyst in various chemical reactions.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving

Lesson plan:

Unit	Descriptions	Staff Name	Hours	Lecture Mode
I	ATOMIC STRUCTURE			
	Introduction to structure of atom- Fundamental particles - proton, neutron and electron	-	1	PPT, Chalk and talk, Quiz and Group discussion
	Rutherford and Niels Bohr’s model of an atom and their defects	-	2	
	Sommerfeld’s modification of atomic structure, quantum numbers	-	1	
	Orbitals: shapes of s, p and d orbitals. .	-	4	
	Pauli’s exclusion principle - Hund’s rule of maximum multiplicity - Aufbau principle - Heisenberg’s uncertainty principle		4	
II	CHEMICAL BONDING			
	Types of chemical Bonds – electrovalent(ionic), covalent	-	1	PPT, Chalk and talk, Quiz and Group discussion
	co-ordinate covalent, metallic and Hydrogen bonding	-	2	
	Characteristics of electrovalent and covalent compounds	-	1	
	Valence Bond Theory - Types of overlapping (s-s, s-p and p-p overlapping), Sigma and pi bonds	-	3	
	Sigma and pi bonds	-	2	
	Hybridization- <i>sp</i> , <i>sp</i> ² and <i>sp</i> ³ hybridization in, acetylene, ethylene & methane only.	-	3	
III	INTRODUCTION TO ORGANIC CHEMISTRY			
	Importance of organic compounds in daily life – Classification of organic compounds	-	1	PPT, Chalk and talk, Quiz and Group discussion
	Functional groups – definition – various functional groups	-	2	
	General formula and examples for the following: Alcohols, Alkyl Halide, Carbonyl compounds (aldehyde and ketone)	-	4	
	Carboxylic acids and Amines. Types of organic reactions – Substitution	-	3	
	Addition and Elimination reactions (examples only, not mechanism)		2	

IV	SURFACE CHEMISTRY			
	Definition of adsorption, occlusion, absorption	-	2	PPT, Chalk and talk, Quiz and Group discussion
	adsorbent, and adsorbate – Types of adsorption	-	2	
	Physisorption and chemisorption – differences between Physisorption and Chemisorption	-	4	
	various applications of adsorptions – factors influencing adsorption process- nature of gases, nature of adsorbent, influence of temperature and pressure.	-	4	
V	CATALYSIS			
	Definition, Characteristics of catalysts - Types of catalyst	-	1	PPT, Chalk and talk, Quiz and Group discussion
	(Homogeneous catalysis and heterogeneous catalysis) – Acid and base catalysis	-	4	
	Enzyme catalysis with example only: positive catalysis, negative catalysis	-	3	
	auto catalysis – catalytic promoters	-	2	
	catalytic poison-. Intermediate compound formation theory- adsorption isotherm.	-	2	
Total Hours			60	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	CLO Statement	Knowledge level
CLO1	To discuss atomic models, and occupancy of electrons on various quantum levels.	Up to K2
CLO2	To illustrate the overlapping of orbitals and hybridization of simple molecules	Up to K4
CLO3	To find the importance of organic compounds in daily life and to describe the types of organic reactions	Up to K3
CLO4	To inspect the types of adsorption and factors affecting the process	Up to K3
CLO5	To identify the characteristics of catalyst and to explicate the types of catalysis	Up to K3

POs and COs Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	2	1	1
CLO2	3	2	1		1
CLO3	3	2	2	1	
CLO4	3	2	1	2	1
CLO5	3	2	1	1	2

PLOs and CLOs Mapping (Department of Mathematics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
CLO1	1	-	-	-	-	-	-	-
CLO2	1	-	-	-	-	-	-	-
CLO3	1	-	-	-	-	-	-	-
CLO4	1	-	-	-	-	-	-	-
CLO5	1	-	-	-	-	-	-	-

3-Advance application;

2-Intermediate level;

1-Basic level

PLO and CLO Mapping (Department of Physics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	3						
CLO2	3						
CLO3	3						
CLO4	3						
CLO5	3						

3-Advance application;

2-Intermediate level;

1-Basic level

Learning Outcome Based Education (LOBE) & Assessment

Formative Examinations I & II – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO x	Up to K 2/K3	2	K1& K2	2	K1,K2	2 (K2&K2)	1(K2/K3)
2	CLO y	K3/K 4	2	K1& K2	1	K2	2 (K3&K3)	2(K3, K3/K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each section			4		6		10	20

K1-Rememberingandrecallingfactswithspecificanswers

K2-Basicunderstandingoffactsandstatingmainideaswithgeneralanswers

K3-Applicationoriented-SolvingProblems

K4-Examining,analysing,presentationandmakeinferenceswith evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1 & K2	1	K2	2 (K1&K1)	1(K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
3	CLO 3	Up to K 3	2	K1 & K2	1	K1	2 (K2&K2)	1(K3)
4	CLO 4	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1-Rememberingandrecallingfactswithspecificanswers

K2-Basicunderstandingoffactsandstatingmainideaswithgeneralanswers

K3-Applicationoriented-SolvingProblems

K4-Examining,analysing,presentationandmakeinferenceswith evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

Name of the Course Designer

- Dr. P. Prasanna

DEPARTMENT OF CHEMISTRY				CLASS: II B. Sc. Mathematics & II B. Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Part-III Allied	20U4CAC2	Allied Chemistry – II	4	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives: *The objectives of this course are to make the student*

- To understand the modern concepts of acids and bases*
- To study the classification and properties of saccharides*
- To recognize about the basic ideas of amino acid and proteins*
- To learn the different types of fertilizers used for plant growth*
- To know about polymers, corrosion and its prevention*

Unit	Description	Hours	K-Level	CLO
I	ACIDS AND BASES Modern concepts of acids and bases – Arrhenius concept, Bronsted-Lowry concept- Lewis concept – relative strength of acids- relative strength bases –concept of pH - buffer solutions – definition - theory of buffer action and applications – Henderson’s Equation - strength of solutions – normality- molarity – molality .	12	K4	CLO1
II	CARBOHYDRATES Monosaccharides: Definition – classification of carbohydrate – monosaccharides – properties and uses of glucose and fructose – configuration of glucose – mutarotation Disaccharides: Sucrose – manufacture – properties and uses – distinction between sucrose, glucose and fructose. Polysaccharides: Starch – Structure, properties and uses.	12	K3	CLO2
III	AMINO ACIDS AND VITAMINS Amino acids – Definition, general methods of preparation, properties and uses of Glycine. Proteins – Definition, classification, general properties – colour reactions (Xanthoproteic test, Ninhydrin test and Millon’s test) and relationship of amino acid with proteins. Vitamins: Definition, classification, sources, function, deficiency of fat soluble vitamins A & D and water soluble vitamins B1 and C (structure and synthesis not expected).	12	K3	CLO3

IV	INDUSTRIAL CHEMISTRY (i) POLYMERS AND CORROSION Introduction: Definition of monomer and polymers – classification of polymers based on micro structures (chemical). General methods of preparation, properties and uses of the following polymers: Thermoplastics- polyethylene and thermosetting plastic - phenol-formaldehyde resins (Bakelite). Definition of corrosion – types of corrosion – factors affecting corrosion process- nature of metal (position in galvanic series, purity of the metal, nature of surface film, volatility of corrosion product)- nature of environment (temperature, humidity, impurity, pH) – corrosion control - cathodic protection – sacrificial anodic protection.	12	K3	CLO4
V	FERTILIZERS Plant Nutrient – Macro and micro nutrients - role of various elements in plant growth-classification – natural fertilizer and chemical fertilizer – nitrogenous, phosphatic and potash fertilizers – functions of the following: Nitrogenous fertilizers: ammonium sulphate, urea. Phosphatic fertilizers: super phosphate of lime, triple super phosphate of lime. Potash fertilizers: potassium sulphate, potassium nitrate.	12	K2	CLO5

Books for study:

1. Puri, B.R., Sharma, L.R. and Pathania, M.S., 2004 (41stEdn.), Principles of Physical Chemistry, S.N. Chand and Co., New Delhi.
2. Bhal, B.S.andArunBahl, 2004, Advanced Organic Chemistry, S. Chand and Co. Ltd., New Delhi.
3. N. Krishnamurthy, P. Vallinayagam, D. Madhavan, Engineering Chemistry, 2009, 2nd Edition, PHI Learning New Delhi.

Books for reference:

1. Morrison, R.T., and Boyd, R.N., 1999, Organic Chemistry, Prentice-Hall of India, Pvt. Ltd., New Delhi.
2. Sharma, B.K., 1989, Polymer Chemistry, Goel Publishing House, Meerut.
3. Mukhopathyay. R and Datta. S, Engineering Chemistry, New Age international PVL, Publishers, New Delhi.
4. Puri. B.R., Sharma. L.R., 1989, Principles of Inorganic Chemistry, S. N. Chand and Co., Jalandar.
5. Sharma, B. K., Industrial chemistry, Goel Publishing House, 1994

Web resources:

1. <https://byjus.com/chemistry/acids-and-bases/#:~:text=contains%20lactic%20acid.-,What%20are%20Acids%20and%20Bases%3F,identified%20by%20their%20sour%20taste.>
2. <https://byjus.com/biology/carbohydrates/>
3. <https://byjus.com/biology/amino-acids/>
4. <https://kidshealth.org/en/teens/vitamins-minerals.html>)
5. <https://byjus.com/jee/polymers/>

6. <https://byjus.com/jee/corrosion/>)
7. <https://byjus.com/biology/fertilizers/>)

Rationale for Nature of the course

This course should enable the students to understand the modern concepts of acids & bases and their comparative strength, study the classification preparation and properties of saccharides to structural arrangement of atoms, recognize about the basic concepts of amino acid and proteins, learn the different types of fertilizers used for plant growth, and know the applicability of polymers in our day today life, corrosion and its prevention methods.

Activities having direct bearing on Skill development

The basic study of acids and bases helps the students to understand the strengths and pH of solutions. The ability to predict the nature and compare the strength of acid and bases. To know about the classification of reducing and non-reducing sugars. Through the study and the analysis of amino acid and proteins student able to testing of protein samples and comprehend the properties of amino acids. To familiarise usage, utility and classification of polymers in our day today life. Student able to know the types of corrosion and its inhibitors. To know the plant nutrients and applicability of fertilizers in agriculture.

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar /Assignment/Quiz through ICT- Mode

Lecture Schedule

Unit	Topics	Hours	Mode
I	ACIDS AND BASES		
	Modern concepts of acids and bases – Arrhenius concept, Bronsted-Lowery	2	PPT, Chalk and talk, Quiz and Group discussion
	Lewis concept – Relative strength of acids- Relative strength bases	3	
	Concept of pH – pOH -pH scale	2	
	Buffer solutions – definition - theory of buffer action and applications – Henderson’s Equation	3	
	Strength of solutions – normality- molarity – molality	2	
II	CARBOHYDRATES		
	Monosaccharides : Definition – classification of carbohydrate –	2	PPT, Chalk and talk, Quiz and Group discussion
	Monosaccharides – properties and uses of glucose and fructose – configuration of glucose – Mutarotation	3	
	Disaccharides: Sucrose – manufacture – properties and uses – distinction between sucrose, glucose and fructose	3	
	Polysaccharides: Starch: Structure, properties and uses	4	
III	AMINO ACIDS AND VITAMINS		
	Amino acids – Definition, general methods of preparation, properties and	3	PPT, Chalk and talk, Quiz and Group discussion
	Proteins – Definition, Classification, general properties – colour reactions (Xanthoproteic test, Ninhydrin test and Millon’s test) and relationship of amino acid with proteins.	3	
	Vitamins: Definition, classification, sources, function and deficiency of fat soluble vitamins A & D	3	
	Definition, classification, sources, function and deficiency of water soluble vitamins B1 and C	3	
IV	INDUSTRIAL CHEMISTRY		
	Introduction: Definition of monomer and polymers - classification of polymers based on micro structures (Chemical).	2	PPT, Chalk and talk, Quiz and Group discussion
	General methods of preparation, properties and uses of the following polymers: thermoplastic polyethylene and thermosetting phenol-formaldehyde resins (Bakelite).	3	
	Definition – Types of corrosion – Factors affecting corrosion process- nature of metal (position in galvanic series, purity of the metal, nature of surface film, volatility of corrosion product)	3	
	nature of environment (temperature, humidity, impurity, pH)	2	
	Corrosion control - cathodic protection – sacrificial anodic protection	2	
V	FERTILIZERS		
	Plant Nutrient – Macro and micro nutrients - role of various elements in	3	PPT, Chalk and talk, Quiz, and Assignment
	Classification: natural fertilizer and chemical fertilizer – Nitrogenous, Phosphatic and Potash fertilizers -	2	
	Functions of the following: Nitrogenous fertilizers: ammonium Sulphate,	2	
	Phosphatic fertilizers: super phosphate of lime, triple super phosphate of	2	
	Potashfertilizers: potassium Sulphate, potassium nitrate.	3	
Total Hours		60	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLOs	Course learning Outcomes	Knowledge level
CLO-1	To analyse the relative strength acids and bases and buffer action	UptoK4
CLO-2	To indicate structure of carbohydrates and figure out the configuration of glucose	UptoK3
CLO-3	To classify proteins, vitamins and to explain the sources, functions and deficiency of vitamins A, D, & B, C and illustrate the preparation, properties and uses of glycine	UptoK3
CLO-4	To illustrate types of the polymers and to indicate types of the corrosion and its control measures	UptoK3
CLO-5	To understand the role of various elements in plant growth and to classify the fertilizers	UptoK2

POs and CLOs Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	1	-	-
CLO2	3	2	1	-	-
CLO3	3	2	1	-	-
CLO4	3	2	1	-	-
CLO5	3	2	1	-	-

PLOs and CLOs Mapping (Department of Mathematics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
CLO1	1	2	3	2	-	-	-	-
CLO2	1	-	3	-	-	-	-	-
CLO3	1	-	3	-	-	-	-	-
CLO4	1	-	3	-	-	-	-	-
CLO5	1	-	3	-	-	-	-	-

3-Advance application;

2-Intermediate level;

1-Basic level

PLOs and CLOs Mapping (Department of Physics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	1	1	2	1	-	-	-
CLO2	1	-	-	-	-	-	-
CLO3	1	-	-	-	-	-	-
CLO4	1	-	-	-	-	1	1
CLO5	1	-	-	-	-	1	1

3-Advance application;

2-Intermediate level;

1-Basic level

Learning Outcome Based Education (LOBE) & Assessment

Formative Examinations I & II – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K-Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO _x	Up to K2/K3	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
2	CLO _y	Up to K3/K4	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education(LOBE) & Assessment
Summative Examination -Blue Print
Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
2	CLO 2	Up to K 3	2	K1 & K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K 3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
4	CLO 4	Up to K 3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
5	CLO 5	Up to K 2	2	K1 & K2	1	K2	2 (K1&K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A and B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	9	10	--	19	15.83	42%
K2	11	10	10	31	25.83	
K3	-	20	30	50	41.67	42%
K4	-	10	10	20	16.67	16%
Total marks	20	50	50	120	100.00	100%

Name of the Course Designer

- Dr. M. Boominathan

DEPARTMENT OF CHEMISTRY				CLASS: II B. Sc. Mathematics & II B. Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Allied Chemistry practical	20U3CAP1	Volumetric analysis	1	2	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: *The objective of this course is to make the student*

- (i) *To demonstrate basic laboratory technique of volumetric analysis*
- (ii) *To develop the intellectual and psychomotor skills of the students by imparting knowledge in volumetric analysis*
- (iii) *To examine the quantitative estimation of acids, bases and inorganic compounds through volumetric techniques.*

LIST OF EXPERIMENTS

1. Estimation of HCl by using standard Oxalic acid and link HCl (*Acidimetry*)
2. Estimation of NaOH by using standard Sodium carbonate and link HCl (*Alkalimetry*)
3. Estimation of Oxalic acid by using standard Ferrous ammonium sulphate (FAS) and link KMnO₄ (*Permanganometry*)
4. Estimation of FAS by using standard Ferrous ammonium sulphate and link KMnO₄ (*Permanganometry*)
5. Estimation of glycine using standard Oxalic acid and link NaOH.
6. Estimation of copper by iodometric method using standard dichromate and link thio solution (Demonstration only)

Books for references :

1. Dr. Chirag R. Fultariya & Dr. Jalpa P. Harsor, "Volumetric analysis: Concepts and Experiments", 1st edition, ISBN No. 9781365799303.
2. Vogel's text book of macro and semi-micro qualitative inorganic analysis, 5th edition.
3. O. P. Pandey, D. N. Bajpai, S. Giri, Practical Chemistry, ISBN: 9788121908122, Revised edition, S Chand & Co Ltd.
4. V. Venkateswaran , R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.

Web resources:

1. <https://byjus.com/chemistry/volumetric-analysis/>
2. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>

Pedagogy : Providing demonstration of given experiment

Rationale for Nature of the course

Volumetric analysis is a widely-used quantitative analytical method. As the name implies, this method involves the measurement of volume of a solution of known concentration which is used to determine the concentration of the analyte.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The knowledge of Volumetric analysis develops the students approach towards accurate measurement of concentration, molecular mass, purity percentage, formula of compounds and percentage composition of an element and stoichiometry of a chemical equation.

Course outcomes:

After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To get domain knowledge in estimation of inorganic compounds	Up to K2
CLO2	To design the basic laboratory techniques of volumetric analysis	Up to K3
CLO3	To develop the skills for doing any titrations and recording data	Up to K3
CLO4	To make scientific claims that is supported by their data and other observations	Up to K4
CLO5	To communicate the finding	Up to K2

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	-	-	-
CLO2	3	2	-	-	-
CLO3	3	2	-	-	-
CLO4	3	2	-	-	-
CLO5	3	2	2	2	-

PLO and CLO Mapping (Department of Mathematics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
CLO1	1	1		1	1	-	-	-
CLO2	1	-		-	-	-	-	-
CLO3	1	-	1	-	-	1	-	-
CLO4	1	-		-	-		-	-
CLO5	1	-	1	-	-	1	-	-

3-Advance application;

2-Intermediate level;

1-Basic level

PLO and CLO Mapping (Department of Physics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	1	-	1	1	-	1	-
CLO2	1	-	-	-	-	-	-
CLO3	1	1	1	2	-	1	-
CLO4	1	-	-	-	-	-	-
CLO5	1	1	1	2	-	1	-

3-Advance application;

2-Intermediate level;

1-Basic level

Evaluation:

Continuous Internal Assessment : 40 Marks

External Assessment : 60 Marks

Total : 100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total Marks	40

Summative Assessment:

	CLO statement	Knowledge level	Marks
CLO 1	To get domain knowledge in estimation of inorganic compounds	Up to K2	10
CLO 2	To design the basic laboratory techniques of volumetric analysis	Up to K3	10
CLO 3	To develop the skills for doing any titrations and recording data	Up to K3	15
CLO 4	To make scientific claims that is supported by their data and other observations	Up to K4	20
CLO 5	To communicate the finding	Up to K2	5
Total Marks			60

Name of the Course Designers

1. Dr. J. Shanmugapriya
2. Dr. S. V. Karthikeyan

DEPARTMENT OF CHEMISTRY				CLASS: II B. Sc. Mathematics & II B. Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Allied practical	20U4CAP2	Semi-micro qualitative analysis	1	2	40	60	100

Nature of Course			
Knowledge and skill			Employability oriented
Skill oriented	✓		Entrepreneurship oriented

Course Objectives: The objective of this course is to make the student

- To demonstrate basic laboratory techniques of qualitative analysis
- To develop the intellectual and psychomotor skills of the students by imparting knowledge in qualitative analysis of inorganic compounds
- To examine the qualitative analysis of inorganic compounds.

SEMI-MICRO QUALITATIVE ANALYSIS

- Semi-micro qualitative analysis of simple inorganic salts containing one cation and interfering, non-interfering anionic radicals.

Books for references:

- Vogel's text book of macro and semi-micro qualitative inorganic analysis, 5th edition.
- O. P. Pandey, D. N. Bajpai, S. Giri, Practical Chemistry, ISBN: 9788121908122, Revised edition, S Chand & Co Ltd.
- V.V. Ramanujam, Inorganic Semimicro qualitative analysis, National Publishing company, Madras, 1974
- V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.

Web resources:

- <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
- <https://byjus.com/chemistry/volumetric-analysis/>

Pedagogy : Providing demonstration of given experiment

Rationale for Nature of the course

Semi-micro qualitative analysis is used for qualitative analysis of both cations and anions present in the given inorganic mixture.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Students will develop skill to analyse the given unknown material even in micro level composition.

Course outcomes: After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To demonstrate the basic laboratory techniques of qualitative analysis.	Up to K2
CLO2	To demonstrate mastery of basic semi-micro qualitative analysis of simple salts containing one anion and one cation.	Up to K2
CLO3	To identify the interfering acid radical, eliminate interfering anion and to perform a systematic analysis	Up to K3
CLO4	To systematically analyse the general group cations.	Up to K3
CLO5	To infer analytical data and make scientific claims that is supported by their results and other observations.	Up to K4

PO and CLO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO1	3	2	-	-	-
CLO2	3	2	-	-	-
CLO3	3	2	-	-	-
CLO4	3	2	-	-	-
CLO5	3	2	2	2	1

PLO and CLO Mapping (Department of Mathematics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PSO 8
CLO1	1	1		1	1	-	-	-
CLO2	1	-	-	-	-	-	-	-
CLO3	1	-	1	-	-	1	-	-
CLO4	1	-		-	-	-	-	-
CLO5	1	-	1	-	-	1	-	-

3-Advance application;

2-Intermediate level;

1-Basic level

PSO and CLO Mapping (Department of Physics)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	1	-	1	1	-	1	-
CLO2	1	-	-	-	-	-	-
CLO3	1	1	1	2	-	1	-
CLO4	1	-	-	-	-	-	-
CLO5	1	1	1	2	-	1	-

3-Advance application;

2-Intermediate level;

1-Basic level

Evaluation:

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total Marks	40

Summative Assessment:

	CLO statement	Knowledge level	Marks
CLO 1	To demonstrate the basic laboratory techniques of qualitative analysis.	Up to K2	10
CLO 2	To demonstrate mastery of basic semi-micro qualitative analysis of simple salts containing one anion and one cation.	Up to K2	10
CLO 3	To identify the interfering acid radical, eliminate interfering anion and to perform a systematic analysis	Up to K3	15
CLO 4	To systematically analyse the general group cations.	Up to K3	20
CLO 5	To infer analytical data and make scientific claims that is supported by their data and other observations.	Up to K4	5
Total Marks			60

Name of the Course Designers

1. Dr. J. Shanmugapriya
2. Dr. S. V. Karthikeyan

FOR ADD ON COURSES:

Evaluation:

Continuous Internal Assessment	:	50 Marks
External Assessment	:	50 Marks
Total	:	100 Marks

- ✓ Evaluation by internal examiner

CIA Components

Component	Evaluation type	Marks
I	Periodic assignment (3)	20
II	Paper presentation/Group discussion	15
III	Quiz/viva-voce	15

For Final Semester Examinations:

- ✓ Total end semester examination marks : 50
- ✓ Duration : 2 hours
- ✓ Exam pattern:

Part	Type	No. of questions	Marks per question	No. of questions to be answered	Total Marks
A	Objective	10	1	10	10
B	Descriptive	7	10	4	40
Total Marks					50

- ✓ Minimum pass marks : 40 (Both CIA & end semester exams put together)
- ✓ There is no pass minimum separately for internal and external components.

FOR SELF-STUDY COURSES:

- ✓ Duration of the course : 1 year
- ✓ Evaluation by internal examiner
- ✓ Minimum pass marks : 40 (Both CIA & end semester exams put together)
- ✓ There is no pass minimum separately for internal and external components.

Assessment type		Marks
Internal examination	Part – A – Objective type Answer ALL questions - (10 x 1 = 10 Marks)	10
	Part – B – Descriptive type, Open choice Answer ANY THREE questions (3/5 x 5 = 15 Marks)	15
Assignment (2)		25
Project / Case study		25
Seminar/model		25
Total Marks		100

DEPARTMENT OF CHEMISTRY				CLASS: II B. Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Add on course	20U4CAO1	Add on for beginners	2	2	50	50	100

UNIT I - Chemistry of cosmetics and perfumes

(6 hours)

A General study including preparation and uses of the following:

Hair dye, hair spray, shampoo, Suntan lotions, Face Powder, Lipsticks, Talcum Powder, Nail enamel, Creams (Cold, Vanishing and Shaving Creams), Antiperspirants and artificial flavours. Essential oils and their importance in Cosmetic industries with reference to Eugenol, Geraniol, Sandalwood oil, jasmone, 2-phenylethyl alcohol, Eucalyptus, Civetone, Muscone.

UNIT II - Pesticide Chemistry

(6 hours)

General Introduction to pesticides (Natural and Synthetic), benefits and advance effects, Changing Concept of pesticides, Structural activity relationship, Synthesis and technical manufacture and use of representative pesticides in the following classes: Organo chlorides (DDT, Gammexene); Organo phosphate (Malation, Parathion); Carbamate (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (alachlor and Butachlor)

UNIT III – Fermentation

(6 hours)

Aerobic and anaerobic fermentation, Production of (i) Ethyl alcohol and Citric acid (ii) Antibiotics Penicillin, Cephalosporin, Chloromycetin and Streptomycin (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin C. Preparation of Aspirin and Magnesium bisilicate (Antacid)

UNIT IV - Business Skills for chemists

(6 hours)

Key business concepts: Business plans, Market need, Market used, Project management and routes to market. Chemistry in Industry: Current Challenges and Opportunities for the Chemistry & using Industries, Role of Chemistry in India and global economics. Making money: Financial aspects of business with case studies. Intellectual property: Concept of intellectual property, patents.

UNIT V - Biochemistry of disease

(6 hours)

A diagnostic approach by blood/urine analysis.

Blood: Composition and function of blood and preservation of sample, Anaemia, Regulation, estimation and interpretation for blood sugar, urea creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples formation of urine. Composition and estimation of constituents of normal and pathological urine.

References:

1. Patrick.G. (2017), Introduction to Medicinal Chemistry, Oxford University Press.
2. Singh.H; Kapoor S.K (1996), Medicinal and Pharmaceutical Chemistry, VallabhPrakashan.
3. Foye,W.O.Lemke, T.L: William, D.A(1995), Principles of Medicinal Chemistry, B.I.WaverlyPvt.Ltd.
4. Devlin, T.M. (2010), Textbook of Biochemistry with Clinical Correlation, Wiley.
5. Berg, J.M.; Tymoczko, J.L.; Stryer, L(2002), Biochemistry, W.H.Freeman.
6. Pandey, N.; Dharmi, K.(2014), Intellectual Property Rights, PHI Learning Pvt.
7. Ganguli, P. (2001), Intellectual Property Rights: Unleashing the knowledge, McGraw Hill.
8. Barel, A.O.; Paye, M.; Maibach, H.I.(2014). Handbook of Cosmetic Science and Technology, CRC Press.
9. Gupta, P.K; Gupta, S.K.(2011), Pharmaceuticals and Cosmetics, PragatiPrakashan.
10. Kumar,R.(2018).Chemistry of Cosmetics, Prestige Publisher.

Name of the Course Designer

- Dr. M. Karpagavalli

DEPARTMENT OF CHEMISTRY				CLASS: II. B. Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Add on course	20U4CAO2	Agricultural chemistry	2	2	50	50	100

Objectives:

The objective of the course is to know the importance of agricultural chemistry and an exposure to analyze and find a suitable method to cultivate and to promote agricultural methods.

Unit I - Chemistry of soil

(6 Hours)

Composition of soil - Organic and Inorganic constituents. - Chemical aspects of soil -acid, alkali and saline soil. Nitrogen fixation in soils - biological nitrogen fixation.

Unit II - Plant Nutrients and Fertilizers

(6Hours)

Plant nutrients - Sources and roles of macro and micro nutrients in plant growth –Nutritional deficiency in plants - symptoms, corrective measures - Fertilizers - classification of NPK fertilizers - natural and synthetic.

Unit III – Pesticides

(6 Hours)

Definition – Classification – organic and inorganic pesticides and its mechanism of action – Safe handling of pesticides, Fungicides - definition – classification – mechanism of action – sulfur, copper and mercury compounds.

Unit IV – Herbicides

(6 Hours)

Definition – classification – mechanism of action – Arsenic and boron compounds – urea compounds, nitro compounds and chloro compounds.

Unit V - Plant Growth Regulators

(6 Hours)

Definition - Classification - Structure and functions of – Absciscic acid - Auxins - Cytokinins - Ethylene - Gibberellins.

References:

1. Tisdale, S. L., Nelson, W. L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990
2. Hesse, P. R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971.
3. Buchel, K. H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
4. Sree Ramula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi, 1979.

Name of the Course Designers

1. Dr. M. Hasmath Farzana
2. Dr. J. Shanmugapriya

DEPARTMENT OF CHEMISTRY				CLASS: II B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III & IV	Self-Study	20U4CSS1	Chemistry and Health	2		50	50	100

Course Objectives

This is a self-study course on understanding chemistry in health. This is an attempt to make the students aware of fundamental chemistry of health maintenance with food and medicines, deviation from healthy living, correcting such deviation with medicinal practices and products.

UNIT –I: Food and Health

(6 hrs)

Food materials: sources, types – calorific value-Macro and micronutrients – non- dietary foods - balanced diet-imbalance and its consequences.

UNIT-II: Health and Chemicals

(6 hrs)

Food and allergy -natural and manmade food materials - food pollution – food contamination-organic food materials- Effect of food materials on body ailments.

UNIT-III: Health and Biomolecules

(6 hrs)

Health maintenance - Height weight-body mass index-obesity – Role of enzymes , hormones in health - Nutritional additives-vitamins-micro nutrients - various disorders associated with deficiencies of metal and non metal elements. Sources for various nutrients - fibre content - vitamins etc.

UNIT- IV: Diagnostic tools

(6 hrs)

Traditional methods of diagnosis – Pulse – blood – Microscopy, Endoscopy, Auto-analyser, Differential cell counter, X-ray, ECG, EEG,scanning : ultrasound, echo, CT, MRI,

UNIT –V: Drug Chemistry

(6 hrs)

Requirements of an ideal drug - Need for conversion of drug into medicine – Additives and their role – Various forms of administration of drugs: solid, liquid, semisolid, aerosols, powders, tablet, capsules, injectables, syrups, suspensions, ointments, creams.

References:

1. David Krupadanam.G. L. , Vijayaprasad. D, VaraprasadRao. K, Reddy. K. L. N, Sudhakar. C, Drugs University press (India) Ltd., Orient Longman, First edn.2001.
2. Ramnaiksood, Medical laboratory technology-Methods and interpretation, 3rd edn, Jaypee Brothers medical publishers, 1995.
3. JayashreeGhosh, Applied Chemistry, 1stEdn, S. Chand & company pvt. Ltd, 2016.

Name of the Course designers

1. Dr. M. Malarvizhi
2. Dr. J. Shanmugapriya

DEPARTMENT OF CHEMISTRY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact week	CIA	Ext	Total
	Certificate	21CCC03	Certificate Course in Bio-informatics	2	30	50	50	100

Objectives:

The Objective of the course is to

- i) Give Awareness about inter disciplinary science course
- ii) Support any Computation studies of a biological experimental work within the scope of course

Salient Features:

- Hands On training by experts during practical Hours
- Giving exposure about Various Data Base
- Basic Programming ability of programming language quoted in syllabus
- Course will be conducted after college regular working hours
- Giving Brief exposure about basic aspects of chemistry and Biology and Various free software

Unit I Introduction to Bioinformatics

Introduction – History – Scope and application of the bioinformatics.

Unit II Introduction to Various Biological Data Base

Major Bioinformatics data base – NCBI, Nucleotide database – Genbank, EMBL and protein database (including primary, secondary database) – PROSITE, PRINTS, Protein structural database – PDB, SCOP and CATH.

Unit III Chemistry behind bioinformatics

Types of interaction (including Covalent and Non-Covalent interaction) Basic introduction to Biomolecules such as Amino Acids, , Protein, DNA and RNA.

Unit IV Deep insight about structure of protein molecules

Primary, Secondary, Tertiary, Quaternary structures of protein molecules, DNA, RNA.

Unit V Protein Structure Prediction

Basic introduction to various types of modelling threading, evaluation of the predicted structure, Ramachandran Plot, molecular visualisation tools, Rasmol and Swiss PDB viewer introduction to docking and demonstration.

Awareness about Perl, Python and basic commands in Linux operating system.

Books for study:

1. S.C.Rastogi et al., 2006. Bioinformatics concepts, skills and applications, 2nd Edition, CBS.
2. C.Subramanian, 2015. A text book of Bioinformatics. 1st edition, Dominant Publishers.
3. B.G.Curran et al., 2010. Bioinformatics. 1st edition, CBS Publishers and Distributors, PVT.

Books for reference:

1. Z. Ghoshand, B. Mallick. 2008. Bioinformatics: Principles and Applications. Oxford University Press, New Delhi.
2. Lesk, A.M. 2002. Introduction to Bioinformatics. Oxford University Press, London.
3. N.J.Chikale and V.S.Gomase. 2007. Bioinformatics. 1st edition. Himalaya Publishing house Ltd.
4. Vittal R. Srinivas, 2005. Bioinformatics a modern approach. Prentice Hall of India PVT. Ltd.
5. Lehninger Principles of Biochemistry: 6th edition

CIA MARK DISTRIBUTION		EXTERNAL MARK DISTRIBUTION	
Seminar	15	TEST	20
Test	10	PROJECT	30
Quiz	5		
TEST	20		
Total	50	Total	50

DEPARTMENT OF CHEMISTRY			Certificate Course				
Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
Certificate Course		Certificate course in analysis of adulterant and preparation of household product	2	30	50	50	100

Objectives:

The Objective of the course is to

- To learn the principle of food chemistry
- To detect the adulterant milk products
- The awareness of contaminant food
- The gaining awareness of household products
- To learn the manufacturing process of household products

Unit-I –ADULTRATION

Adulterations: definition, classification, adulterants, types of adulterants- intentional, incidental, Filth – deleterious- economical – objectionable- microbial adulterant- injurious adulterants/contaminants in foods and their health effects, prevention of food adulterants.

Unit-II- Detection of Adulterant in Milk and Milk Product, oil & fats, sugar & confectionaries

Detection of water in milk- detergent milk and milk product- detection of starch in khoya, chenna, paneer- detection of mashed potatoes, sweet potatoes, and other starches in ghee and butter. Detection of other oils in coconut oil based on solidification. Detection of sugar solution honey (using water, burning)- Detection of chalk powder in sugar, pithi sugar-jaggery.

Unit-III- Detection of Adulterant in food grain, spice and contaminant

Detection of extraneous matters- dust, pebble, stone, straw, weed seed, damaged grain, insect, rodent hair, and excreta. Detection of dhatura- bran-khesri dhal- added colour- iron filling in atta, maida, suji- turmeric in rice- rhodamine B in ragi- filth resin, soap stone in asafoetida- papaya seed in pepper- dye in chilli – cassia bark in cinnamon- charcoal in cumin- argemone in mustard.

Unit-IV-Preparation of following household products

Preparation of white phenol, soap oil, cleaning powder, shampoo

Unit-V- Preparation of following household products

Preparation of the candle, ink, sattu neelam and washing powder

Books for study:

- A.K. Jain, Environmental Engineering, 2018, Krishna Publishing
- S.H.H. Shinawy, A.M.E. Mohamed, Detection of adulteration in milk and some dairy products, 2018, DOI:10.21608/avmj.2018.166615.
- H.D. Belitz, W. Grosch, P. Schieberle, Food Chemistry, 4th Revised and extended edition, Springer, 2009, ISBN: 978-3-540-69934-7.

Books for study:

- R.J. Krisztal, Nursing home litigation; Pretrial practice and trials, Second Edition, ISBN-13: 978-1930056480.
- P.J. Carter, Workbook to accompany Lippincott's Text book for nursing assistance, 7th edition.

I UG Ratifications

Course Code	Course Title	Nature of course	Rationale	Activities having direct bearing on nature of course
20U1CMC1	General Chemistry-I	Skill Oriented	Students will be dealing with fundamental concepts of organic chemistry, Nomenclature, Classification of organic reactions, Electronic effect involving in Organic compounds, Chemical bonding and Acid base chemistry.	This course will help the students to understand ambiguity concerning which chemical compound the name refers to: each chemical name should refer to a single substance. Learning of classification of the nature of functional groups draws impacts on the reactions of compounds and at some level their physical properties. Study of acid and base chemistry will make the students to learn about importance of its role in everything from digestion of the foods we eat to the function of the medicine we take and even the cleaning products we use. The theoretical chemical bonding knowledge, helps students in design new materials with desirable properties for specific uses.
20U1CMC2	General Chemistry-II	Skill Oriented	This course should enable the students to comprehend the basic concepts of atomic structure, quantum chemistry and periodic properties.	This course enables the students to understand reactivity and behaviour of chemicals. Study of Quantum theory helps them to know the basic principles of day to day components including lasers, CDs, DVDs, solar cells, fibre-optics. The theoretical chemical bonding knowledge helps students in design new materials with desirable properties for specific uses.
20U2CMC3	General Chemistry-III	Knowledge and Skill	This course will empower the students to grasp the basic concepts of organic chemistry, the preparation and properties of aliphatic as well as alicyclic compounds; to understand the reaction mechanism involved in aliphatic compounds; to know the kinetic theory of gases and various gas laws.	The elementary knowledge, and concepts of aliphatic and alicyclic reactions will help the students to synthesize various molecules. Postulates of kinetic theory of gases help the students to explain the behaviour of gases and to solve the problems regarding molecular velocities.

20U2CMC4	General Chemistry-IV	Knowledge and Skill	This course will enable the students to explain the basic knowledge on the physical properties of liquids; to know the chemistry of s - block elements and its complexes; to design the theory behind the volumetric analysis; able to summarize the basic metallurgical processes.	Based on the knowledge on the properties of liquids, students will be able to discuss the factors affecting surface tension and viscosity and classify types of liquid crystals; able to find the applications of Be and Mg by knowing the chemistry of s-block elements; can apply the theory behind the volumetric analysis, which gives the information about the concentration, and primary & secondary standards and to solve problems based on titrimetric analysis; gain knowledge on various refining methods.
20U1CMP1	Inorganic Qualitative Analysis-I	Skill oriented	Semi Micro quantitative analysis is used for qualitative analysis of both cation and anion present in the given inorganic salt.	Students will develop skill to analyse the given unknown inorganic salt even in micro level composition.
20U2CMP2	Inorganic Qualitative Analysis-I	Skill oriented	Semi Micro quantitative analysis is used for qualitative analysis of both cations and anions present in the given inorganic mixture salts.	Students will develop skill to analyse the unknown mixture of inorganic salts even in micro level composition.
20U1CAC1	Allied Chemistry-II	Knowledge & Skill	The basic knowledge and concept of atom models and shape of orbitals in molecules. The concept of valence bond theory, Hybridization will help the student to understand the structure of molecules. To understand the reaction mechanism and its pathway to ensure the knowledge of organic reactions. To comprehend the concept of surface chemistry, application and catalysis involved in various reactions.	To comprehend the basic ideas of atom models and particle present in it. To enable the basic knowledge of organic reactions and its pathway. To know the shape, size, bond angle and geometry of the molecules based on hybridisation concept. To enable the study of adsorption and its isotherms and applicable catalyst in various chemical reactions.

20U2CAC2	Allied Chemistry-II	Knowledge & Skill	This course should enable the students to understand the modern concepts of acids & bases and their comparative strength, study the classification preparation and properties of saccharides to structural arrangement of atoms, recognize about the basic concepts of amino acid and proteins, learn the different types of fertilizers used for plant growth, and know the applicability of polymers in our day today life, corrosion and its prevention methods.	The basic study of acids and bases helps the students to understand the strengths and pH of solutions. The ability to predict the nature and compare the strength of acid and bases. To know about the classification of reducing and non-reducing sugars. Through the study and the analysis of amino acid and proteins student able to testing of protein samples and comprehend the properties of amino acids. To familiarise usage, utility and classification of polymers in our day today life. Student able to know the types of corrosion and its inhibitors. To know the plant nutrients and applicability of fertilizers in agriculture.
20U1CAP1	Volumetric Analysis	Skill oriented	Volumetric analysis is a widely-used quantitative analytical method. As the name implies, this method involves the measurement of volume of a solution of known concentration which is used to determine the concentration of the analyte.	The knowledge of volumetric analysis develops the students approach towards accurate measurement of concentration, molecular mass, purity percentage, formula of compounds and percentage composition of an element and stoichiometry of a chemical equation.
20U2CAP1	Semi-micro qualitative analysis	Skill oriented	Semi Micro quantitative analysis is used for qualitative analysis of both cations and anions present in the given inorganic mixture.	Students will develop skill to analyse the given unknown material even in micro level composition.

DEPARTMENT OF CHEMISTRY

VISION & MISSION OF THE DEPARTMENT

Vision

To produce disciplined and committed students through effective teaching-learning for the professional growth and research aimed at a greener environment and healthier living of humankind.

Mission

- To ensure the quality and knowledgeable chemistry graduates capable of creating new developments for the society and applicable in daily life to become entrepreneurs.
- Inspiring students to fulfill the expectations of local, national and global needs
- Motivate the students to pursue higher studies and research to cater the need of industries.

Program Educational Objectives

After completion of the programme, the students will be able to

PEO 1	Have noteworthy prospects in various service domains at national and international level, and can work as scientist, analyst, quality controller, academics and research organizations.
PEO 2	Do various synthesis, separation, analysis, computational, design and development of new products.
PEO 3	Take leadership quality to handle all kind of situations in diversities by providing interdisciplinary and multidisciplinary learning environment.
PEO 4	Endorse multiple efficacies of chemistry to generate innovations in providing solution for sustainable green environment and to adopt new skills and techniques to overcome the problem related with new technologies.
PEO 5	Formulate, explore and examine scientifically real-life problems along with ethical attitude which works in multidisciplinary team.

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	- Choose - Define - Find - How - Label - List - Match - Name - On it - Recall - Relate - Select - Show - Spell - Tell - What - When - Where - Which - Who - Why	- Classify - Compare - Contrast - Demonstrate - Explain - Extend - Illustrate - Infer - Interpret - Outline - Relate - Rephrase - Show - Summarize - Translate	- Apply - Build - Choose - Construct - Develop - Experiment with - Identify - Interview - Make use of - Model - Organize - Plan - Select - Solve - Utilize	- Analyze - Assume - Categorize - Classify - Compare - Conclusion - Contrast - Discover - Dissect - Distinguish - Divide - Examine - Function - Inference - Inspect - List - Motive - Relationships - Simplify - Survey - Take part in - Test for - Theme	- Agree - Appraise - Assess - Award - Choose - Compare - Conclude - Criteria - Criticize - Decide - Deduct - Defend - Determine - Disprove - Estimate - Evaluate - Explain - Importance - Influence - Interpret - Judge - Justify - Mark - Measure - Opinion - Perceive - Prioritize - Prove - Rate - Recommend - Rule on - Select - Support - Value	- Adapt - Build - Change - Choose - Combine - Compile - Compose - Construct - Create - Delete - Design - Develop - Discuss - Elaborate - Estimate - Formulate - Happen - Imagine - Improve - Invent - Make up - Maximize - Minimize - Modify - Original - Originate - Plan - Predict - Propose - Solution - Solve - Suppose - Test - Theory

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, A bridge Edition. Boston, MA: Allyn and Bacon.

Program Educational Objectives

After completion of the programme, the students will be able to

PEO 1	Have noteworthy prospects in various service domains at national and international level, and can work as scientist, analyst, quality controller, academics and research organizations.
PEO 2	Do various synthesis, separation, analysis, computational, design and development of new products.
PEO 3	Take leadership quality to handle all kind of situations in diversities by providing interdisciplinary and multidisciplinary learning environment.
PEO 4	Endorse multiple efficacies of chemistry to generate innovations in providing solution for sustainable green environment and to adopt new skills and techniques to overcome the problem related with new technologies.
PEO 5	Formulate, explore and examine scientifically real-life problems along with ethical attitude which works in multidisciplinary team.

Programme Learning Outcomes with Graduate attributes (PLO)

PLO	At the end of the programme, the students will be able to	Graduate Attributes
PLO-1	Comprehend facts, information and skills in Organic, Inorganic, Physical and other related areas of chemistry including interdisciplinary and multi-disciplinary courses.	• Knowledge in core competency
PLO-2	Develop laboratory skills in all areas of chemistry Viz., Qualitative, Quantitative Analysis of the chemical compounds and other important techniques.	• Development of Laboratory skills • Problem Analysis
PLO-3	Encourage the students to pursue higher studies up to research level in frontier area of chemical sciences and to make the students to appear in National Level Exams like GATE, CSR-UGC.	• Developing student's competency • Problem solving
PLO-4	Create synthetic and analytical ability especially synthesis and characterization of Organic and Inorganic compounds.	• Knowledge in core competency • Analytical ability
PLO-5	Use relevant ideas and skills, especially Problem solving, interpretation of spectra (UV, IR, NMR) for structural elucidation of chemical compounds to acquire knowledge in several emerging areas of chemistry,	• Skill development • Problem solving

Qualification for Admission

Pass in B. Sc. Chemistry

Duration of the Course

The students shall undergo prescribed course of study for the period of two academic years under CBCS semester pattern with outcome based education.

Medium of Instruction: English

System: Choice Based Credit System with Outcome Based Education Model

Courses of Study with Credit Distribution

Category	No. of courses	No. of credits
Major core theory	12	48
Major core practical	8	16
Major core elective	4	16
Non Major Elective	2	4
Project	1	6
Total	27	90

Nature of the Course

Courses are classified according to the following nature

- Knowledge & Skill
- Employability Oriented
- Entrepreneurship Oriented

Teaching & Evaluation Pattern

- **Outcome Based Education (OBE) & Assessment**

This curriculum is designed based on Tamilnadu State Council for Higher Education (TANSCHE) State Integrated Board of Studies & UGC

Evaluation

Formative (Continuous Internal Assessment)	: 25 marks
Summative (External)	: 75 marks
Total	:100 marks

Formative Test (CIA) : 25 Marks

Components of Formative Assessment	Marks
Internal Test (<i>Average of two tests</i>) (Conducted for 40 marks and converted into 10 marks)	10
Assignment	5
Quiz	5
Seminar	5
Total	25

Question Paper Pattern for Summative Examination

Section	Question pattern	Marks
A	Multiple choice (10 x 1 marks)	10
B	Short answer (5 x 2 marks)	10
C	Either / or type (5 x 5 marks)	25
D	Open choice type (3 out of 5 x 10 marks)	30
Total		75

In respect of external examinations passing minimum is 45% for PG Courses and in total, aggregate of 50%. The curriculum is revised to suit the changing trends by propagation of ideas ensuring professional growth through innovative method of teaching.

Question Paper Pattern for Internal Test

Section	Question pattern	Marks
A	Short answer (5 x 2 marks)	10
B	Either / or type (2 x 5 marks)	10
C	Open choice type (2 out of 3 x 10 marks)	20
Total		40

- Centralized system of two internal assessment test
- Duration of internal test will be 2 hours
- Students shall write retest on the genuine grounds if they are absent in either Test-I or Test-II with the approval of HoD and the Principal

- ✓ For the purpose of Formative assessment (CIA), the course teacher may decide the CLO for the two tests as per the following conditions.

- Any two CLOs shall be considered for the first test.
- Two CLOs (other than those already considered for the first test) shall be considered for the second test.
- The remaining CLO may be considered for assignment

The blue print for the internal test will be as follows.

Units	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

EVALUATION PATTERN FOR PRACTICAL PAPERS

Continuous Internal Assessment : 40 Marks

External Assessment : 60 Marks

Internal Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total	40

Internal Assessment : 40 Marks

External Assessment : 60 Marks

Total : 100 Marks



DEPARTMENT OF CHEMISTRY
THE MADURA COLLEGE (AUTONOMOUS), MADURAI 625011
Curriculum structure for M. Sc. Chemistry under CBCS pattern with effect from
academic year 2021-22 onwards

Sem .	Course	Course Code	Course title	Contact hours/ week	Credits
I	Core-1	21P1CMC1	Organic Chemistry-I	5	4
	Core-2	21P1CMC2	Inorganic chemistry-I	5	4
	Core-3	21P1CMC3	Physical Chemistry I	5	4
	Core-Elective-I	21P1CME1	Biomolecules and Separation Techniques	5	4
	NME-I	21P1CNM1	Applied Chemistry	2	2
	Practicals-I	21P1CMP1	Organic Qualitative Analysis	4	2
	Practicals II	21P1CMP2	Inorganic Semi micro Qualitative	4	2
Total hours & credits				30	22
II	Core-4	21P2CMC4	Organic Chemistry-II	5	4
	Core-5	21P2CMC5	Inorganic Chemistry-II	5	4
	Core-6	21P2CMC6	Physical Chemistry II	5	4
	Core-Elective-	21P2CME2	Synthetic methods, Green Chemistry &	5	4
	NME-II	21P2CNM2	Industrial Chemistry and safety	2	2
	Practicals-III	21P2CMP3	Organic Estimation	4	2
	Practicals-IV	21P2CMP4	Inorganic estimation and Complex	4	2
Total hours & credits				30	22
III	Core-7	21P3CMC7	Organic Chemistry-III	6	4
	Core-8	21P3CMC8	Inorganic chemistry-III	5	4
	Core-9	21P3CMC9	Physical Chemistry-III	5	4
	Core-Elective-	21P3CME3	Nano chemistry and Polymer	6	4
	Practicals-V	21P3CMP5	Physical Chemistry Lab-I	4	2
	Practicals-VI	21P3CMP6	Inorganic gravimetric Estimation	4	2
Total hours & credits				30	20
IV	Core-10	21P4CMC1	Organic Chemistry -IV	5	4
	Core-11	21P4CMC1	Inorganic Chemistry-IV	6	4
	Core-12	21P4CMC1	Physical Chemistry-IV	5	4
	Core-Elective-IV	21P4CME4	CSIR/NET/GATE/SET Examination Preparation (Objective Pattern only)	6	4
	Practicals-VII	21P4CMP7	Physical Chemistry Lab-II	4	2
	Practicals-VIII	21P4CMP8	Organic Preparation	4	2
	Project	21P4CMR		0	6
Total hours & credits				30	26
Total hours & credits				120	90

Semester wise mapping of courses with Programme learning outcomes (PLOs)

Semester-I

	Programme learning outcomes	Core-1 Organic Chemistry-I	Core-2 Inorganic chemistry-I	Core-3 Physical Chemistry I	Core elective-1 Biomolecules and Separation Techniques	Practical-I Organic Qualitative Analysis	Practical-II Inorganic Semi micro Qualitative Analysis
GRADUATE ATTRIBUTES	PLO-1 Knowledge base	3	3	3	3	2	2
	PLO-2 Problem solving, lab skills					3	3
	PLO-3 Problem solving, students competency	2	2	2	3	3	3
	PLO-4 Analytical ability	2	2	2	1	1	1
	PLO-5 Skill developing, problem solving	2	2	2	2	2	2

Semester wise mapping of courses with Programme learning outcomes (PLOs)

Semester-II

	Programme learning outcomes	Core-4 Organic Chemistry-II	Core-2 Inorganic chemistry-II	Core-3 Physical Chemistry II	Core elective-1 Synthetic methods, Green Chemistry & Renewable energy	Practical-I Organic Estimation	Practical-II Inorganic estimation and Preparation
GRADUATE ATTRIBUTES	PLO-1 Knowledge base	3	3	3	3	2	2
	PLO-2 Problem solving, lab skills					3	3
	PLO-3 Problem solving, students competency	2	2	2	2	1	1
	PLO-4 Analytical ability	2	2	2	2	3	3
	PLO-5 Skill developing, problem solving	2	2	2	2	2	2

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core	21P1CMC1	Organic Chemistry-I	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives: The objective of this course is to make the student

- To expand the knowledge of basic concepts in organic chemistry
- To know and prove the mechanism for given organic reaction through various techniques and to examine the intermediates involved in the given conversion
- To explore the knowledge of aromatic electrophilic substitution reactions
- To gain the knowledge of nucleophilic substitution in aliphatic and aromatic systems
- To apply knowledge in synthesizing molecules using various substitution reactions.

Unit	Description	Hours	K-Level	CLO
I	NATURE OF BONDING AND AROMATICITY <i>Nature of bonding:</i> Shapes of simple organic molecules - bond angle, bond length, bond energies, electronegativity, dipole moment in organic molecules – Electronic Effects: hyperconjugative, inductive and field effects and their influence - rules of resonance – tautomerism - steric effects – Hard and soft acids and bases. <i>Aromaticity:</i> Huckel's theory of aromaticity: three-, four-, five-, six-, seven-, and eight-membered rings – other systems with aromatic sextet - concept of homo-aromaticity and anti-aromaticity. <i>Bonding weaker than covalent:</i> Addition compounds – Electron donor-acceptor (EDA) complexes – Crown ether complexes – inclusion compounds – Cyclodextrins – Catenanes and Rotaxanes. <i>Self-study:</i> Hydrogen bonding: Inter- and intra- molecular – study of fullerenes.	15	Up to K2	CLO-1
II	REACTION MECHANISM Types of reaction and mechanism – Thermodynamic and kinetic requirements of reaction – Kinetic and thermodynamic control – Hammond postulate – Methods of determining mechanisms: Identification of products, determination of the presence of intermediate, study of catalysis, isotopic labelling, kinetic and stereochemical evidence, isotope effects.	15	Up to K4	CLO-2

	Linear Free energy Relationships: First Hammett plots - Hammett equation – physical significance of reaction and substituent constants – uses of Hammett plots - Taft equation – simple problems. Organic reactive intermediates: Generation, stability, structure and reactivity of carbocations, carbanions and free radicals. Self-study: Carbenes and nitrenes.			
III	AROMATIC ELECTROPHILIC SUBSTITUTION REACTIONS Arenium ion mechanism – σ and π complex - Mechanism of nitration, sulfonation, Friedel Crafts alkylation, acylation and diazo coupling reactions. Orientation and reactivity in mono substituted benzene ring and benzene ring with more than one substituent – <i>ortho/para</i> ratio – <i>ipso</i> substitutions – Quantitative treatment – Electrophilic substitution of other aromatic species: Naphthalene, Pyridine, Pyrrole, Indole, Quinoline. Study of following reactions: Bischler-Napieralski, Pictet-Spengler, Scholl, Vilsmeier, Gattermann, Reimer-Tiemann, Kolbe-Schmitt, Mannich, Jacobsen and Haworth reactions.	15	Up to K3	CLO-3
IV	ALIPHATIC NUCLEOPHILIC SUBSTITUTION REACTIONS Mechanism of nucleophilic substitution reaction: S_N^1 and S_N^2 mechanisms. Stereochemistry of substitution reactions: Steric orientation in S_N^1 and S_N^2 – Neighbouring group participation: NGP by σ and π bonds – Role of following groups in NGP: C=C, cyclopropyl, aromatic rings, C-C, Hydrogen - S_N^i mechanism – Factors affecting reactivity: structure of alkyl group, nature of solvent, nature of leaving group, nature of nucleophilic reagent – Phase transfer catalysts in nucleophilic substitution reactions.	15	Up to K4	CLO-4
V	AROMATIC NUCLEOPHILIC SUBSTITUTION REACTIONS S_NAr mechanism in aryl halides by Meisenheimer complex - S_N^1, $S_{RN}1$ and benzyne mechanism – Reactivity: The effect of substrate structure, leaving group and attacking nucleophile - Ambident nucleophiles and ambident substrates – Study of following name reactions and rearrangements: Chichibabin, Schiemann, Meerwein arylation, Gomberg, Bamberger, Heck, Ullmann, Suzuki coupling, Stephens-Castro coupling, Von Richter, Sommelet Hauser and Smiles.	15	Up to K4	CLO-5

Books for study:

1. Clayden, J., Greeves, N. and Warren, S. "Organic Chemistry" Second Edition, Oxford University Press, New York, 2012.
2. Smith, M. B. March, J. "March's Advanced Organic Chemistry: Reactions, mechanisms and Structure" Sixth Edition, Wiley, 2007.
3. Skyes, P., "A Guide Book to Mechanism in Organic Chemistry" Sixth Edition, John Wiley & Sons, Inc. New York, 2011.

Books for reference:

1. Smith, M. B., "Organic Synthesis" Fourth Edition, Elsevier Inc., 2016.
2. Mukherji, S.M., and Singh, S. P., "Reaction Mechanism in Organic Chemistry" Revised edition, Trinity press, 2010.
3. Norman, R. O. C. and Coxon, J. M. "Principles of Organic Synthesis" Third edition, Nelson Thrones, United Kingdom, 2003.
4. Carey, F. A. and Sundberg, R. J. "Advanced Organic Chemistry-Part A: Structure and mechanisms" Fifth edition, Springer, 2007.
5. Carey, F. A. "Organic Chemistry" Fourth edition, Mc Graw Hill, 2000. Mukherji, S.M., and Singh, S. P., "Reaction Mechanism in Organic Chemistry" Third edition, MacMillan India Ltd, 2006.

Web resources:

1. https://onlinecourses.nptel.ac.in/noc21_cy07/preview
2. https://onlinecourses.swayam2.ac.in/cec20_ma20/preview
3. <https://www.ntnu.edu/studies/mschem/organic-chemistry>
4. <https://www.youtube.com/watch?v=SAmLVOKIw28>

Rationale for Nature of the course

This course will enable the students to comprehend the basic concepts of organic chemistry, structure of organic molecules, understand the reaction mechanism & the ways to prove it, electrophilic and nucleophilic substitution reactions in both aliphatic and aromatic substrates.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The basic knowledge, concepts of reaction mechanism and study of various substitution reactions will help the students to write mechanism for a given conversion and to identify the intermediates involved. They can introduce a new functional group theoretically on the aliphatic and aromatic substrates by applying the techniques of electrophilic and nucleophilic reactions.

Pedagogy:

- Chalk-Talk Class room Activities
- Seminar
- Assignment and Quiz through ICT

Lesson plan:

Unit	Topics	Hours	Mode
I	<i>Nature of bonding</i> : Shapes of simple organic molecules - bond angle, bond length, bond energies, electronegativity, dipole moment in organic	3	PPT, Chalk and talk, Group discussion
	Electronic Effects: hyperconjugative, inductive and field effects and their influence - rules of resonance – tautomerism - steric effects	3	
	Hard and soft acids and bases.	1	
	<i>Aromaticity</i> : Huckel's theory of aromaticity: three-, four-, five-, six-, seven-, and eight-membered rings – other systems with aromatic sextet	3	
	Concept of homo-aromaticity and anti-aromaticity.	1	
	<i>Bonding weaker than covalent</i> : Addition compounds – Electron donor-acceptor (EDA) complexes	2	
	Crown ether complexes – inclusion compounds – Cyclodextrins – Catenanes and Rotaxanes.	2	
II	Types of reaction and mechanism – Thermodynamic and kinetic requirements of reaction – Kinetic and thermodynamic control –	4	PPT, Chalk and talk, Assignment
	Methods of determining mechanisms: Identification of products, determination of the presence of intermediate, study of catalysis, isotopic labelling, kinetic and stereochemical evidence, isotope effects.	3	
	Linear Free energy Relationships: First Hammett plots - Hammett equation – physical significance of reaction and substituent constants – uses of Hammett plots - Taft equation – simple problems.	4	
	Organic reactive intermediates: Generation, stability, structure and reactivity of carbocations, carbanions and free radicals.	4	
III	Arenium ion mechanism – σ and π complex	1	PPT, Chalk and talk, Assignment
	Mechanism of nitration, sulfonation, Friedel Crafts alkylation, acylation and diazo coupling reactions.	3	
	Orientation and reactivity in mono substituted benzene ring and benzene ring with more than one substituent	3	
	<i>ortho/para</i> ratio – <i>ipso</i> substitutions – Quantitative treatment	2	
	Electrophilic substitution of other aromatic species: Naphthalene, Pyridine, Pyrrole, Indole, Quinoline.	3	
	Study of following reactions: Bischler-Napieralski, Pictet-Spengler, Scholl, Vilsmeier, Gattermann, Reimer-Tiemann, Kolbe-Schmitt,	3	
IV	Mechanism of nucleophilic substitution reaction: S_N^1 and S_N^2	3	PPT, Chalk and talk, Group discussion
	Stereochemistry of substitution reactions: Steric orientation in S_N^1 and	2	
	Neighbouring group participation: NGP by σ and π bonds – Role of following groups in NGP: C=C, cyclopropyl, aromatic rings, C-C,	4	
	S_N^1 mechanism – Factors affecting reactivity: structure of alkyl group, nature of solvent, nature of leaving group, nature of nucleophilic reagent	4	
	Phase transfer catalysts in nucleophilic substitution reactions.	2	
V	S_NAr mechanism in aryl halides by Meisenheimer complex	2	PPT, Chalk and talk, Group discussion
	S_N^1 , $S_{RN}1$ and benzyne mechanism	3	
	Reactivity: The effect of substrate structure, leaving group and attacking	3	
	Ambident nucleophiles and ambident substrates	1	
	Study of following name reactions and rearrangements: Chichibabin, Schiemann, Meerwein arylation, Gomberg, Bamberger, Heck, Ullmann	3	
	Suzuki coupling, Stephens-Castro coupling, Von Richter, Sommelet Hauser and Smiles.	3	

Course learning outcome:

After successful completion of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO 1	Understand the concept of aromaticity and to know the nature of bond, electronic effects and other properties of molecules.	Up to K2
CLO 2	Recognise the type of mechanism & intermediates involved in the given organic reaction and to prove mechanism for the reaction.	Up to K4
CLO 3	Identify the ways to modify aromatic compounds <i>via</i> electrophilic substitution reactions.	Up to K3
CLO 4	Analyse chemical transformations based on aliphatic nucleophilic substitution reaction	Up to K4
CLO 5	Organize the techniques of aromatic nucleophilic substitution reactions for synthesizing/transforming molecules	Up to K4

Mapping of CLOs with PLOs

#	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5
CLO-1	2		2		
CLO-2	2		2		
CLO-3	2		2	2	
CLO-4	2		2	2	
CLO-5	2		2	2	

Advance application– 3; Intermediate level–2;

Basic level–1

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education (LOBE) & Assessment
Formative Examinations I & II – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1& K1)	1(K2)
2	CLO 2	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2 (K2& K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

Name of the course Designers

1. Dr. S. V. Karthikeyan
2. Dr. M. Karpagavalli

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core	21P1CMC2	Inorganic Chemistry - I	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives: The objective of this course is to make the student

- To understand the basic and advanced concepts in bonding and enable the students to identify the structure and bonding of simple molecules.
- To study the various types of packing in solids
- To provide knowledge of band theories and diffraction studies
- To understand knowledge of the structure and bonding in boron compounds.
- To enable students appreciate the structure of inorganic chain and cluster compounds.

Unit	Course Contents	Hours	K-Level	CLO
I	CHEMICAL BONDING Valence bond approach to bonding-Hitler-London, Pauling and Slater refinements, concept of hybridization and structure of molecules, VSEPR theory shapes of molecules. M.O. approach to covalent bonding – symmetry and overlap of atomic orbitals – symmetry of molecular orbitals – Weak Chemical forces: van der Waals forces, Hydrogen bondingsigma and pi bonding – energy levels in homo and hetero nuclear diatomic systems – bond length, bond order and bond energy, Application to small molecules such as BeCl ₂ , BCl ₃ and CCl ₄ , SF ₄ , etc, ionic character in a covalent bond - The concept of multicenter bonding. pseudo halogens: Structure and bonding in ClF ₃ , BrF ₃ , BrF ₅ , IF ₅ , IF ₇ etc . Oxides and oxyacids of halogens, bonding in noble gas compounds – XeCl ₂ , XeF ₄ , XeOF ₄ , XeF ₆ .	15	Up to K3	CLO-1
II	CHEMISTRY OF SOLID STATE I: STRUCTURE Close packing of atoms and ions HCP and BCC types of packing voids, radius ratio – derivation – its influence on structures. Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant. Representative structures of AB and AB ₂ types of compounds - rock salt, cesium chloride, wurtzite, zinc blende, rutile, fluorite, antiferite, cadmium iodide and nickel arsenide. Structure of graphite and diamond. Spinel -normal and inverse types and perovskite structures.	15	Up to K4	CLO-2

III	CHEMISTRY OF SOLID STATE II: DIFFRACTION METHODS Band theory of solids- non-stoichiometry- point defects – linear defects- effects due to dislocations-electrical properties of solids-conductor, insulator, semiconductor-intrinsic-impurity semiconductors-optical properties-lasers and phosphors-elementary study of liquid crystals. Difference between point group and space group – screw axis – glide plane - symmetry elements –relationship between molecular symmetry and crystallographic symmetry – The Concept of reciprocal lattice – X-ray diffraction by single crystal – rotating crystal – powder diffraction. Neutron diffraction: Elementary treatment – comparison with X-ray diffraction. Electron diffraction- Basic principle. Crystal Growth methods: (hydrothermal and gel methods).	15	Up to K2	CLO-3
IV	BORON COMPOUNDS AND CLUSTERS Chemistry of boron – boranes, higher boranes, borazines, boron nitrides, hydroborate ions – Preparation, properties and structure, STYX numbers, Wade's rules. Carboranes- Types such as nido-closo, arachno-preaprtion properties and Structure. Metallocarboranes-a general study. Metal clusters: Chemistry of low nuclearity metal clusters only, Structure of Re_2Cl_8 ; multiple metal-metal bonds.	15	Up to K4	CLO-4
V	INORGANIC CHAIN AND CLUSTER COMPOUNDS Types of inorganic polymers, comparison with organic polymers, silanes, higher silanes, multiple bonded systems, silicon nitrides, siloxanes. P-N compounds, cyclophosphazenes and S-N compounds – S_4N_4 , $(\text{SN})_x$. Isopoly and heteropoly acids – Structure and bonding of 6- and 12 – isopoly and heteropoly anions. Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three dimensional silicates.	15	Up to K4	CLO-5

Books for study:

1. R. D. Madan, Modern Inorganic Chemistry, 3rd edn, S. Chand & Company Ltd., Reprint 2014.
2. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic chemistry-Principles on structure and reactivity, 4th Ed, Pearson- education, 2002.
3. F. A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, Wiley Eastern, 1988.
4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry, WB Sanders Co, USA, 1977.
5. Concise Inorganic Chemistry: Fifth Edition by J.D. Lee.

Books for Reference:

1. P.L. Soni, Text book of Inorganic Chemistry, 20th edn, Sultan Chand & Sons, 2000.
2. Puri B.R., Sharma L.R., Kalia K.K principles of Inorganic chemistry. 35th edition, New edition: Shoban Lal Nagin Chand and co. 2013
3. R. B. Heslop and K. Jones, Inorganic Chemistry, Elsevier, 1976.
4. Sp. Banerjee, Advanced Inorganic Chemistry 2nd edn, Vol- and 2Arunabha Sen, Books and Allied (P) Ltd., Kolkata, 2017.
5. Sathya Prakash, Tuli, Basu & Madan, Advanced Inorganic Chemistry. Vol. II, 17th edition, 1999.

Web references

1. <https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2011/06/VSEPR-Theory.pdf>, http://www.idconline.com/technical_references/pdfs/chemical_engineering/Valence_bond_theory.pdf, https://chemistry.tcd.ie/assets/pdf/sf-chemistry/Molecular_Orbital_Theory.pdf, <https://byjus.com/jee/hybridization/>
2. <https://ncert.nic.in/ncerts/l/lech101.pdf>, <https://www.vedantu.com/revision-notes/cbse-class-12-chemistry-notes-chapter-1-the-solid-state>
3. <http://web.iitd.ac.in/~elias/links/Elias%20lectures%20boron%20chemistry%202015%20final%2011th%20sept.pdf>
4. <http://ggu.ac.in/download/IT/Dr%20S%20S%20Thakur%20and%20Dr%20G%20K%20Patra%20M%20Sc%20IV%20Sem-Inorganic%20Chemistry-S-2-AR7148.pdf>,
5. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/11.inorganic_chemistry-iii/29._metal-metal_bonds_and_their_evidences/et/9108_et_et_29.pdf
6. <https://ipsonline.in/Files/2006/JanMar/ReviewArticle2.pdf>
7. http://www.fhberlin.mpg.de/acnew/departement/pages/teaching/pages/teaching__wintersemester__2016_2017/thomas_lunkenbein__structural_chemistry_of_silicates__170127.pdf

Rationale for Nature of the course

The basic knowledge, concept of valence bond theory, VSEPR theory, Molecular orbital theory and study of bonding nature, structural elucidation and arrangement of atoms in a molecule with help of X-ray diffraction analysis in solid state chemistry, the boron compounds and cluster compounds will help the student to understand the structure, bonding and types of molecules.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

To comprehend the formation of new modules for the framing the structure of the molecule and their properties which ensure the knowledge of pathway of inorganic reactions.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Lesson plan:

Unit	Descriptions	Hours	Lecture Mode
I	CHEMICAL BONDING		
	V.B. approach to bonding-Hitler-London, Pauling and Slater refinements, Concept of hybridization and structure of molecules, VSEPR theory shapes of molecules	3	BB/PPT/ AnimatedVideos
	M.O. approach to covalent bonding – symmetry and overlap of atomic orbitals – symmetry of molecular orbitals, sigma and pi bonding, Weak Chemical forces: van der Waals forces, Hydrogen bonding.	3	BB/PPT/ AnimatedVideos
	sigma and pi bonding Energy levels in homo and hetero nuclear diatomic systems, bond length, bond order and bond energy	3	BB/PPT/ AnimatedVideos
	Application to small molecules such as BeCl ₂ , BCl ₃ and CCl ₄ , SF ₄ , etc, Ionic character in a covalent bond, The concept of multicenter bonding	2	BB/PPT/ AnimatedVideos
	Pseudo halogens, Structure and bonding in ClF ₃ , BrF ₃ , BrF ₅ , IF ₅ , IF ₇ etc.	2	BB/PPT/ AnimatedVideos
	Oxides and oxyacids of halogens, Bonding in Noble gas compounds – XeCl ₂ , XeF ₄ , XeOF ₄ , XeF ₆	2	BB/PPT/ AnimatedVideos
II	CHEMISTRY OF SOLID STATE I: STRUCTURE		
	Close packing of atoms and ions HCP types of packing voids	3	BB/PPT/ AnimatedVideos
	Close packing of atoms and ions BCC types of packing voids, ratio – derivation – its influence on structures	3	BB/PPT/ AnimatedVideos
	Lattice energy – Born-Lande equation, Kapustinski equation, Madelung constant.	3	BB/PPT/ AnimatedVideos
	Representative structures of AB and AB ₂ types of compounds - rock salt, cesium chloride, wurtzite	2	BB/PPT/ AnimatedVideos
	zinc blende, rutile, fluorite, antiferite, cadmium iodide, Nickel arsenide.	2	BB/PPT/ AnimatedVideos
	Structure of graphite and diamond, Spinels -normal and inverse types and perovskite structures	2	BB/PPT/ AnimatedVideos
III	CHEMISTRY OF SOLID STATE II: DIFFRACTION METHODS		
	Band theory of solids- non-stoichiometry- point defects, linear defects- effects due to dislocations	3	BB/PPT/ AnimatedVideos
	electrical properties of solids-conductor, insulator, semiconductor-intrinsic-impurity semiconductors	3	BB/PPT/ AnimatedVideos
	optical properties-lasers and phosphors-elementary study of liquid crystals, Difference between point group and space group	3	BB/PPT/ AnimatedVideos
	screw axis and glide plane, symmetry elements-relationship between molecular symmetry and crystallographic symmetry	2	BB/PPT/ AnimatedVideos
	The Concept of reciprocal lattice, X-ray diffraction by single crystal – rotating crystal, powder diffraction	2	BB/PPT/ AnimatedVideos
	Neutron diffraction: Elementary treatment – comparison with X-ray diffraction, Electron diffraction- Basic principle. Crystal Growth methods: From melt and solution (hydrothermal, Gel methods).	2	BB/PPT/ AnimatedVideos

IV	BORON COMPOUNDS AND CLUSTERS		
	Chemistry of boron – boranes, higher boranes, borazines, boron nitrides	3	BB/PPT/ AnimatedVideos
	hydroborate ions – Preparation, properties, hydroborate ions-structure	3	BB/PPT/ AnimatedVideos
	STYX numbers, Wade's rules, Carboranes, Carboranes types such as nido-closo- preaprtion properties and Structure	3	BB/PPT/ AnimatedVideos
	Carboranes types such as nido-closo- preaprtion properties and Structure	2	BB/PPT/ AnimatedVideos
	Carboranes types such as arachno- preaprtion properties and Structure, Metallocarboranes-a general study	2	BB/PPT/ AnimatedVideos
	Metal clusters: Chemistry of low nuclearity metal clusters only, Structure of Re_2Cl_8 ; multiple metal-metal bonds	2	BB/PPT/ AnimatedVideos
V	INORGANIC CHAIN AND CLUSTER COMPOUNDS		
	Types of inorganic polymers, Types of inorganic polymers-comparison with organic polymers	3	BB/PPT/ AnimatedVideos
	silanes, higher silanes, multiple bonded systems, silicon nitrides, siloxanes	3	BB/PPT/ AnimatedVideos
	P-N compounds, cyclophosphazenes, S-N compounds – S_4N_4 , $(\text{SN})_x$	3	BB/PPT/ AnimatedVideos
	Isopoly acids – Structure and bonding of 6- and 12- isopoly anions, heteropoly acids – Structure and bonding of 6- and 12- heteropoly anions.	2	BB/PPT/ AnimatedVideos
	Structure of silicates, applications of Paulings rule of electrovalence	2	BB/PPT/ AnimatedVideos
	isomorphous replacements in silicates -ortho, meta and pyro silicates, one dimensional, two dimensional and three dimensional silicates.	2	BB/PPT/ AnimatedVideos

BB-Blockboard/ChalkandTalk
PPT-Powerpointpresentation

Course learning outcome:

After complete successful of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To predict the structure and types of bond in inorganic molecules using VB and MO theories	Up to K3
CLO2	To illustrate the various types packing in solids	Up to K4
CLO3	To organize the knowledge on band theories of solids and diffraction studies	Up to K2
CLO4	To infer knowledge about structure and bonding in boron compounds	Up to K4
CLO5	To illustrate the structure of inorganic chain and cluster compounds	Up to K4

PLOand CLOMapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
CLO 1	1		3	1	2
CLO 2	1		3	1	2
CLO 3	1		3	1	2
CLO 4	1		3	1	2
CLO 5	1		3	1	2

3-Advance application; 2-Intermediate level; 1-Basic level

Internal Assessment : 25 Marks

External Assessment : 75 Marks

Total : 100 Marks

Components of FormativeAssessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education (LOBE) & Assessment
Formative – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K2 & K3	1	K1	2 (K2& K2)	1(K3)
2	CLO 2	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
3	CLO 3	Up to K2	2	K1 & K1	1	K1	2 (K1& K1)	1(K2)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Name of the course Designers

1. Dr. P. Prasanna
2. Dr. A. Xavier

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core	21P1CMC3	Physical Chemistry – I	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives: *The objective of this course is to make the student*

- To understand chemical kinetics and explore the reaction kinetics of fast reactions.*
- To infer knowledge on various aspects of Photochemistry, theories of reaction kinetics and mechanism involved in catalysis.*
- To gain on understanding of the Ionic activity, ionic interactions, Debye-Hückel-Bjerrum model, Debye-Hückel limiting law.*
- To study the Debye-Hückel theory of strong electrolytes.*
- To classify the Electrical double layer, electrocapillary phenomena, surfactants, and to study the applications of Fuel Cells, Corrosion and its Protection.*

Unit	Description	Hours	K-Level	CLO
I	CHEMICAL KINETICS AND CATALYSIS Absolute reaction rate theory -Thermodynamic terms-Significance of entropy Reactions in solution: factors determining reaction rates in solutions, effect of dielectric constant and ionic strength, - Bronsted – Bjerrum equation-Primary and Secondary salt effect, influence of solvent on reaction rates. Acid-base catalysis-Bronsted relations, catalytic coefficients and their determination. Enzyme catalysis and its mechanism, Michaelis-Menten equation, effect of pH and temperature on enzyme catalysis, Mechanism of enzyme inhibition kinetics of surface reactions- unimolecular reactions-Bimolecular reactions-Langmuir Hinshelwood and Elay-Rideal mechanism.	15	Up to K2	CLO-1
II	CHEMICAL DYNAMICS Potential energy surfaces-Dynamics of unimolecular reactions-Lindemann Hinshelwood, Rice-Ramsperger- Kassel(RRK) theory-Rice-Ramsperger-Kassel -Marcus (RRKM) theory. Study of fast reactions by stopped flow techniques- relaxation method, flash photolysis and the nuclear magnetic resonance method. Linear free energy relationship-Hammett equation, Taft equation-Separation of polar, resonance and steric effects.	15	Up to K3	CLO-2

III	PHOTOCHEMISTRY Jablonski diagram, Primary and Secondary Processes, quantum yield and its determination-chemical actinometer. Excimers and exciplexes-Kinetics of collisional quenching-Stern Volmer equations-Photosensitization, Chemiluminescence-Photosynthesis, solar energy conversions. Semiconductor photo catalysis, lasers. Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water, solvated electrons.	15	Up to K4	CLO-3
IV	ELECTROCHEMISTRY – I Deviation from ideal behaviour.ion-solvent and ion-ion interactions. Debye-Hückel-Bjerrum model, Ion association and triple ion formations- Expression for the mean activity coefficient. Debye-Hückel limiting law and its applications -Diverse ion effect. Van't Hoff factor and its relation to colligative properties. Debye-Hückel theory of strong electrolytes. Debye-Hückel length and potential around a central ion, its interpretation. Transport of ions in Solution: Electrolytic conduction- Debye - Hückel-Onsager treatment of strong electrolytes- ionic atmosphere- Anomalous conductance of non -aqueous electrolytes.	15	Up to K3	CLO-4
V	ELECTROCHEMISTRY- II Electrical double layer - Electrocapillary phenomena - Surfactants - Lipmann's equation, Electrokinetic phenomena- Zeta potential and its applications - Structure of electrical double layer – Helmholtz-Perrin, Guoy-Chapmann and Stern models. Butler-Volmer equation for one electron transfer reaction - equilibrium and exchange current densities- and symmetry factor - transfer coefficient. Cyclic voltammetry and Stripping voltammetry - principle – instrumentation- Corrosion and passivation of metals - Pourbaix diagram - Evans diagram –Batteries and Fuel cells-Ion selective electrodes.	15	Up to K4	CLO-5

Books for study:

1. L. R. Puri, Y. R. Sharma and R. S. Pathania, Principles of Physical Chemistry 46th Ed, 2012.
2. K. J. Laidler, Chemical Kinetics, Harper and Row, New York, 1987.
3. Rohatgi-Mukherjee, K.K., "Fundamentals of Photochemistry", Second Edition, Wiley Eastern Ltd, New York, 2011.

Books for reference

1. R. G. Frost and Pearson, Kinetics and Mechanism, Wiley New York, 1961.
2. Philip H. Rieger, Electrochemistry ,2nd Edition, 2010.
3. A. W. Anderson, Physical Chemistry of Surfaces, Wiley - Interscience, Newyork, 1990.
4. Paula, Peter Atkins and Julio de, Elements of Physical chemistry, 5th Ed, Oxford U. P, 2012.
5. G. L. Agarwal, Basic Chemical Kinetics, Tata McGraw Hill, 1990.
6. N. J. Turro, Modern molecular photochemistry, Benjamin/Cummings, Menlo Park, California, 1978.

Web resources

1. [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_The_Central_Science_\(Brown_et_al.\)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_\(Summary\)](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_The_Central_Science_(Brown_et_al.)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_(Summary))
2. <https://pubs.acs.org/doi/pdf/10.1021/cr60035a002>
3. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Spectroscopy/Electronic_Spectroscopy/Fluorescence_and_Phosphorescence](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Electronic_Spectroscopy/Fluorescence_and_Phosphorescence)
4. [https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_\(Analytical_Chemistry\)/Electrochemistry](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry)

Rationale for Nature of the course

This course will enable the students to comprehend the concepts of photochemistry, theories of kinetics, understand the basic concepts and applications of electrochemistry.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The basic knowledge, concepts of kinetics and electrochemistry will help the students to solve the problems related to kinetics and electrochemistry. The study of photochemistry and electrochemistry enable the students to do project related to solar cells.

Pedagogy

- Chalk-Talk class room activities
- Seminar
- Assignment and Quiz through ICT

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	CHEMICAL KINETICS AND CATALYSIS		
	Absolute reaction rate theory -Thermodynamic terms-Significance of entropy Reactions in solution:	3	Chalk and talk/PPT/ Group discussion
	factors determining reaction rates in solutions, effect of dielectric constant and ionic strength,	2	
	Bronsted –Bjerrum equation-Primary and Secondary salt effect, influence of solvent on reaction rates. Acid -base catalysis-Bronsted relations, catalytic coefficients and their determination	5	
	Enzyme catalysis and its mechanism, Michaelis-Menten equation, effect of pH and temperature on enzyme catalysis, Mechanism of enzyme inhibition kinetics of surface reactions	3	
	unimolecular reactions-Bimolecular reactions-Langmuir Hinshelwood and Elay-Rideal mechanism.	2	
II	CHEMICAL DYNAMICS		
	Potential energy surfaces-Dynamics of unimolecular reactions	3	Chalk and talk/PPT/ Group discussion
	Lindemann Hinshelwood, Rice-Ramsperger- Kassel (RRK) theory. Rice-Ramsperger-Kassel -Marsus (RRKM) theory	3	
	Study of fast reactions by stopped flow techniques- relaxation method, flash photolysis and the nuclear magnetic resonance method.	4	
	Linear free energy relationship-Hammett equation, Taft equation	3	
	Separation of polar, resonance and steric effects.	2	
III	PHOTOCHEMISTRY		
	Jablonski diagram, Primary and Secondary Processes, quantum yield and its determination	3	Chalk and talk/PPT/ Animated videos/ Assignment
	chemicalactinometer. Excimers and exciplexes-Kinetics of collisional quenching-Stern Volmer equations	3	
	Photosensitization, Chemiluminescence-Photosynthesis, solar energy conversions	3	
	Semiconductor photo catalysis, lasers. Radiation Chemistry-linear energy transfer, G-value	3	
	Dosimeters, radiolysis of water, solvated electrons	3	
IV	ELECTROCHEMISTRY i		
	Deviation from ideal behaviour. ion-solvent and ion-ion interactions. Debye-Hückel-Bjerrum model, Ion association and triple ion	4	Chalk and talk/PPT/ Group discussion
	Debye-Hückel limiting law and its applications -Diverse ion effect. Van't Hoff factor and its relation to colligative properties	4	
	Debye-Hückel theory of strong electrolytes.Debye-Hückel length and potential around a central ion, its interpretation	4	
	Transport of ions in Solution: Electrolytic conduction- Debye -Hückel-Onsager treatment of strong electrolytes- ionic atmosphere-	3	

V	ELECTROCHEMISTRY II		
	Electrical double layer - Electrocapillary phenomena - Surfactants - Lipmann's equation,	3	Chalk and talk/PPT/ Assignment
	Electrokinetic phenomena- Zeta potential and its applications - Structure of electrical double layer – Helmholtz-Perrin, Guoy-Chapmann and Stern models.	4	
	Butler-Volmer equation for one electron transfer reaction - equilibrium and exchange current densities- and symmetry factor - transfer coefficient.	4	
	Cyclic voltammetry and Stripping voltammetry - principle – instrumentation- Corrosion and passivation of metals - Pourbaix diagram - Evans diagram – Batteries and Fuel cells-Ion selective electrodes.	4	

Course Learning outcome:

After successful completion of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO-1	Summarize the theories of kinetics, and mechanism of enzyme catalysis.	Up to K2
CLO-2	Develop equations based on the theories and mechanisms of kinetics.	Up to K3
CLO-3	Illustrate the various aspects of photochemistry, radiation chemistry and its applications	Up to K4
CLO-4	Make use of concepts of ionic interactions, theory of electrolytes, double layer models, Debye-Hückel limiting law.	Up to K3
CLO-5	Analyze the problem in the concept of electrical double layers, design of Batteries, Fuel cells and ion selective electrodes	Up to K4

Mapping of CLOs with PLOs

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	3	1	3	3	2
CLO2	3	1	2	3	2
CLO3	3	1	1	3	2
CLO4	3	1	2	3	2
CLO5	3	1	3	3	2

Advance application-3;

Intermediate level-2;

Basic level-1

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education (LOBE) & Assessment

Formative Examination I & II – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	K 3	2	K2 & K3	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K 4	2	K3 & K4	1	K2	2 (K4&K4)	1(K4)
4	CLO 4	Up to K 3	2	K2 & K3	1	K2	2 (K3&K3)	1(K3)
5	CLO 5	Up to K 4	2	K3 & K4	1	K3	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

Name of the course Designers

1. Dr. M. Malarvizhi

2. Dr. R. Ramachandran

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Elective-I	21P1CME1	Biomolecules and Separation Techniques	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- To have a knowledge about protein metallobiomolecules and the role of metal ions in biological process.
- To learn about chemical toxicology and uses of inorganic compounds as therapeutic agents.
- To discuss about polymeric bio-organic molecules such as carbohydrates, proteins and nucleic acids.
- To describe about the structure, stereochemistry and synthesis of antibiotics and vitamins.
- To learn about various types of separation techniques for organic and biomolecules.

Unit	Description	Hours	K-Level	CLO
I	METALLOPROTEINS Iron containing proteins: Metalloporphyrins-Haemoglobin and myoglobin-Structures and work functions- synthetic oxygen carriers- Electron carrier proteins -Cytochrome- structure and work function. Magnesium containing proteins: Chlorophyll-structure-photosynthetic sequence. Copper containing proteins: Classification-blue copper proteins-structure of blue copper electron transferases-copper protein as oxidases-cytochrome oxidase-mechanistic studies of cytochrome oxidase	15	Up to K2	CLO -1
II	METALLOENZYMES Metalloenzymes: Carboxy peptidase A-structure and function ;Carbonic anhydrase- inhibition and poisoning – Corrin ring system – Vitamin B12 (cyanocobalamin) and B12 coenzymes- In vivo and In vitro nitrogen fixation. Essentials of trace elements and chemical toxicology: Trace elements in biological system. Metal ion toxicity- classes of toxic metal compounds – detoxification. Metals in medicine: Anti-arthritis drugs- Au and Cu in rheumatoid arthritis – Pt, and metallocenes in anti-cancer drugs. Transport and storage of metals: Mechanism-Fe and Cu storage and transport –sodium and potassium ions pumping.	15	Up to K3	CLO -2

III	PROTEINS,NUCLEICACIDSAND CARBOHYDRATES Proteins: Aminoacids and Protein structure, Analysis of N-terminal and C-terminals in a polypeptide. Sanger method, Edman degradation and Enzymatic analysis. Primary, secondary and tertiary structure of proteins. Nucleic acids and Carbohydrates: Chemistry of nucleic acids, nucleosides and nucleotides–Structure RNA and DNA and their biologicalimportance.Pyranoseandfuranoseformsofaldohexoseanddketohexose–methods used for the determination of ringsize-conformationofaldohexopyranose–structureand synthesis of lactose and sucrose. Briefstudyofstarch andcellulose.	15	Up to K4	CLO -3
IV	ANTIBIOTICS AND VITAMINS Antibiotics and vitamins: A detailed study of structure, stereochemistry and synthesis of penicillin, cephalosporin. Chemistry and physiological action of ascorbic acid, thiamin, riboflavin and pyridoxine–Elementary aspect of vitamins A, E, K and B ₁₂ .	15	Up to K3	CLO -4
V	SEPARATION TECHNIQUES Basic aspects of thin-layer chromatography (TLC),column chromatography and flash vacuum column chromatography. Principles, theory, instrumentation and applications of Ion-exchange column Chromatography, Gel-permeation Chromatography, Gas chromatography and High Performance Liquid chromatography(HPLC)-Interpretation of chromatogram and separation of components from the mixture.	15	Up to K4	CLO -5

Books for study:

1. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, Panima Publishing Corporation, 1997.
2. David L. Nelson and Michael M. Cox, Leninger Principles of Biochemistry, WH Freeman, 2017.
3. D. A. Skoog and D. M. West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, 4th Ed, 1982.

Books for reference:

1. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Eastern, 5th Ed, 1998.
2. John McMurray, Organic Chemistry, International Edition, 8th Ed, 2017.
3. I. L. Finar, Organic Chemistry Vol 2, Stereochemistry and the Chemistry of Natural Product, Dorling Kindersley India (P) Ltd, 2009.
4. B. S. Furniss, A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, Vogel's text book of Practical Organic Chemistry, Pearsons Education (Singapore) PTE Ltd, 3rd reprint, 2005.
5. Douglas A. Skoog, F. James Holler and Stanley R. Crouch, Principles of Instrumental Analysis, CENAGE Learning, 7th Ed, 2018.
6. Douglas A. Skoog, Donald M. West, F. James and Stanley R. Crouch, Fundamentals of Analytical Chemistry, 8th Ed, 2004.

Web resources

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4002152/>
2. https://chem.libretexts.org/Courses/University_of_Arkansas_Little_Rock/CHEM_4320%2F%2F5320%3A_Biochemistry_1/04%3A_Overview_of_Hemoglobin_and_Myoglobin/4.2%3A_Oxygen__Transport_by__the_Proteins__Myoglobin_and__Hemoglobin
3. <https://www.open.edu/openlearn/science-maths-technology/biology/nutrition-vitamins-and-minerals/content-section-1>.
4. <https://nptel.ac.in/courses/104/105/102105034/> (28 Videos)
5. <https://www.vanderbilt.edu/AnS/physics/brau/H182/Fleming%20reading/ANTIBIOTICS%20LECTURE%20FOR%20WEB.pdf>
6. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-4_02-Water%20soluble%20Vitamins%204.pdf

Rationale for Nature of the course

This course represents an attractive means of combining state-of-the-art transition metal catalysis with the benefits of natural enzymes, importance of biological macromolecules in the constituents of organisms and separation techniques for the purification of natural products.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The basic concept of biomolecules helps the students for development of their skills in designing of Bio mimicry products and development of new designed Medicine (understanding biomolecules enables modulation of biology, as well as mimicking).

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Lesson Plan

Unit	Topics	Hours	Mode
I	UNIT-I METALLO PROTEINS		
	Iron containing proteins: Metalloporphyrins-Haemoglobin and myoglobin – Structures and work functions	3	BB/PPT/ Animated Videos
	Synthetic oxygen carriers – Cytochrome – structure and work function.	3	
	Magnesium containing proteins Chlorophyll – structure – photosynthetic sequence.	3	
	Copper containing proteins: Classification –blue copper proteins – structure of blue copper electron transferases –	3	
	Copper protein as oxidases – Cytochrome c oxidase – mechanistic studies of cytochrome c oxidase	3	
	UNIT-II METALLOENZYMES		
II	Metalloenzymes: Carboxy peptidase A – structure and function ; Carbonic anhydrase – inhibition and poisoning – Corrin ring system	2	BB/PPT/ Animated Videos
	Vitamin B12 (cyanocobalamin) and B12 coenzymes – In vivo and in vitro nitrogen fixation.	3	
	Essential soft trace elements and chemical toxicology: Trace elements in biological system. Metal ion toxicity – classes of toxic metal compounds – detoxification.	2	
	Metals in medicine: Anti-arthritis drugs – Au and Cu in rheumatoid arthritis – Pt, and metallocenes in anti-cancer drugs	3	
	Transport and storage of metals: Mechanism – Fe and Cu storage and transport	3	
	Sodium and potassium ions pumping	2	
	UNIT-III: PROTEINS, NUCLEIC ACIDS AND CARBOHYDRATES		
III	Proteins: Amino acid and Protein structure, Analysis of N-terminal and C-terminals in a polypeptide	2	BB/PPT/ Animated Videos/ Assignment
	Sanger method, Edman degradation and Enzymatic analysis. Primary, secondary and tertiary structure of proteins.	3	
	Nucleic acids and Carbohydrates: Chemistry of nucleic acids, nucleosides and nucleotides	2	
	Structure of RNA and DNA and their biological importance.	3	
	Pyranose and furanose forms of aldohexose and ketohexose – methods used for the determination of ring size	2	
	Conformation of aldohexopyranose – structure and synthesis of lactose and sucrose. A brief study of starch and cellulose.	3	
	UNIT-IV: ANTIBIOTICS AND VITAMINS		
IV	A detailed study of structure, stereochemistry and synthesis of penicillin, cephalosporin.	5	BB/PPT/ Animated Videos
	Chemistry and physiological action of ascorbic acid, thiamin, riboflavin and pyridoxine	4	
	Elementary aspect of vitamin A, E	3	
	Elementary aspect of vitamin K and B12	3	

	UNIT V: SEPARATION TECHNIQUES		
V	Basic aspects of thin-layer chromatography (TLC), column chromatography and flash vacuum column chromatography.	4	BB/PPT/ Animated Videos
	Principles, theory, instrumentation and application of Ion-exchange column Chromatography	3	
	Principles, theory, instrumentation and application of, Gel-permeation Chromatography, Gas chromatography and High Performance Liquid chromatography (HPLC)	4	
	Interpretation of chromatogram and separation of components from the mixture.	4	
	Total	75	

Course learning outcome:

After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge Level
CLO1	To understand the Structures and work functions of Metalloproteins and apply the knowledge of work function on synthetic oxygen carries	Up to K2
CLO2	To illustrate the various functions of metalloenzymes and apply the knowledge on detoxification	Up to K3
CLO3	To focus on the components and approach to determine the structure of amino acids, proteins, nucleic acids and carbohydrate.	Up to K4
CLO4	To identify the method of synthesis and physiological action of antibiotics and vitamins.	Up to K3
CLO5	To inspect the suitable techniques for the separation of organic as well as bio molecules.	Up to K4

Mapping of CLOs with PLOs

#	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5
CLO-1	2	2	3	1	1
CLO-2	2	2	3	1	1
CLO-3	2	2	3	1	1
CLO-4	2	2	3		1
CLO-5	2	2	3	1	1

Advance application– 3; Intermediate level–2;

Basic level–1

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education (LOBE) & Assessment Formative Examinations I & II – Blue Print Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K 3	2	K2& K3	1	K2	2 (K3&K3)	1(K3)
3	CLO 3	Up to K 4	2	K3& K4	1	K2	2 (K4&K4)	1(K4)
4	CLO 4	K 3	2	K2& K3	1	K1	2 (K2&K2)	1(K3)
5	CLO 5	Up to K 4	2	K3& K4	1	K3	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1-Rememberingandrecallingfactswithspecificanswers

K2-Basicunderstandingoffactsandstatingmainideaswithgeneralanswers

K3-Applicationoriented-SolvingProblems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

Name of the course Designers

1. Dr. J. Shanmugapriya
2. Dr.M.Boominathan

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major practical	21P1CMP1	Organic qualitative analysis	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: The objective of this course is to imparting training in qualitative analysis of organic compounds along with separation of organic mixtures.

EXPERIMENT

Analysis of Organic mixtures: Two compound Systems (Maximum of Five Mixtures). It involves the following steps.

- Separation of organic mixtures
- Elemental analysis
- Functional group(s) identification
- preparation of derivatives
- Physical properties determination (melting point and boiling point)

Books for reference:

1. B. S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's textbook of Practical Organic Chemistry, Pearson, 5th edition, 1989.
2. N.S. Gnanpragasam and G. Ramamurthy, Organic Chemistry Lab Manual, S. Viswanathan Pvt. Ltd.

Web resources:

1. https://www.researchgate.net/profile/SushilMathapati/publication/332029217_Qualitative_analysis_of_organic_mixture_Binary_and_Ternary_chart_for_MSc_organic_students/links/5c9b920292851cf0ae9c629e/Qualitative-analysis-of-organic-mixture-Binary-and-Ternary-chart-for-MSc-organic-students.pdf?origin=publication_detail
2. <http://do.chem.uni.wroc.pl/system/files/Preparatory%20classes.pdf>

Pedagogy : Providing demonstration of given experiment

Rationale for Nature of the course

This laboratory course helps the students to understand the qualitative analysis of mixtures, the functions of various reagents and reaction mechanisms.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Through this course, students will learn basic laboratory technique for analysis. It develops the intellectual and psychomotor skills of students by imparting knowledge in qualitative analysis of organic compounds. By this, students can recall the importance of synthetic organic chemistry and the applications in chemical industries.

Course outcomes: After complete successful of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To inspect the method for separating the binary organic mixture	Up to K4
CLO2	To apply the basic organic theoretical concepts for analyzing the unknown compound	Up to K3
CLO3	To analyze the elements and functional group present in the individual components	Up to K4
CLO4	To select an appropriate derivative and acquire skills to prepare it	Up to K3
CLO5	To interpret the physical properties of the derivative	Up to K2

Mapping of CLOs with PLOs

#	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5
CLO-1	1	3	1	3	1
CLO-2	1	3	1	3	1
CLO-3	1	3	1	3	1
CLO-4	1	3	1	3	1
CLO-5	1	3	1	3	1

Advance application– 3; Intermediate level–2;

Basic level–1

Evaluation:

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total Marks	40

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO 1	To inspect the method for separating the binary organic mixture	Up to K4	10
CLO 2	To apply the basic organic theoretical concepts for analyzing the unknown compound	Up to K3	10
CLO 3	To analyze the elements and functional group present in the individual components	Up to K4	15
CLO 4	To select an appropriate derivative and acquire skills to prepare it	Up to K3	20
CLO 5	To interpret the physical properties of the derivative	Up to K2	5
Total Marks			60

Name of the course Designer

Dr. J. Shanmugapriya

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Practical	21P1CMP2	Inorganic Semi Micro Qualitative Analysis	2	4	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: *The objective of this course is to make the student*

- To encourage more hands-on training to post graduate students by adding more individualized practical exercises*
- To demonstrate basic laboratory technique of Inorganic qualitative analysis*
- To develop the intellectual and psychomotor skills of the students by imparting knowledge in qualitative analysis of Inorganic compounds*

Inorganic Qualitative Analysis

- Qualitative analysis of a mixture containing four cations of which two will be a less familiar.
- Semi micro methods using the conventional scheme with hydrogen sulphide will be adopted.
- FAMILIAR CATIONS TO BE STUDIED: Pb, Cu, Cd, Bi, Fe, Al, Ni, Co, Mn, Zn, Ba, Sr, Ca, Mg.
- LESS FAMILIAR CATIONS TO BE STUDIED: W, Se, Te, Mo, CE, Ti, V, U, Re, Th, Li

Books for reference:

1. Vogel Text Book of Qualitative Chemical Analysis, 5th edn. ELBS/Longman England, 1989
2. V. V. Ramanujam. Inorganic Semi micro qualitative analysis, National publishing company, Madras, 1974

Web resources:

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
2. <http://www.rbmcollege.ac.in/sites/default/files/files/reading%20material/inorganic-qualitative-analysis.pdf>
3. <https://pubs.acs.org/doi/abs/10.1021/ed033p417.2>
4. <https://www.nature.com/articles/147559b0>

Pedagogy: Demonstration and practical session.

Rationale for Nature of the course

The basic knowledge and concept of reactions and mechanisms in qualitative analysis. Systematic analysis of cations in each group and their similar properties can be observed.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

To understand the qualitative general group analysis to predict in which each group of cations are present in it. Characteristics test for each cation can be studied in which students are identified and inferred the familiar and less familiar cations and check the purity of a sample.

Course outcomes: After complete successful of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	Demonstrate the basic laboratory techniques of qualitative analysis of Inorganic salts containing four cations.	Up to K2
CLO2	To design the basic laboratory techniques of salt analysis	Up to K3
CLO3	Develop the skills for doing systematically analyse the general group cations and their individual separation of cations.	Up to K3
CLO4	Interpret the analytical data.	Up to K4
CLO5	To communicate the finding	Up to K2

PLO and CLO Mapping

CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	1	3		1	2
CLO2	1	3	2	1	2
CLO3	1	3	2	1	2
CLO4	1	3	2	1	2
CLO5	1	3	2	1	2

3-Advance application;

2-Intermediate level;

1-Basic level

Evaluation

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

Formative Assessment:

Components for CIA	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total	40

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO-1	Demonstrate the basic laboratory techniques of qualitative analysis of Inorganic salts containing four cations.	Up to K2	10
CLO-2	To design the basic laboratory techniques of salt analysis	Up to K3	10
CLO-3	Develop the skills for doing systematically analyse the general group cations and their individual separation of cations.	Up to K3	15
CLO-4	Interpret the analytical data.	Up to K4	20
CLO-5	To communicate the finding	Up to K2	5
	Total Marks		60

Name of the Course Designer

- Dr. P. Prasanna

DEPARTMENT OF CHEMISTRY				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Non-Major Elective	21P1CNM1	Applied Chemistry	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: *The objective of this course is to make the student*

- (i) *To study about the usage of safety matches and its preparation, calculation of oxidation numbers.*
- (ii) *To know about corrosion, rusting of iron, and manufacturing of paints.*
- (iii) *To study the preparation and importance of Antipyretics, Analgesics and Antiseptics.*
- (iv) *To study about different types of polymers like PVC, Nylon and polyethylene.*
- (v) *To know about the hardness of water disadvantages and removal of hardness using various methods.*

Unit	Description	Hours	K-level	CLO
I	Small Scale Units Preparation and importance of safety matches – Agarbattis - Naphthalene balls - Shoe polish – Chalk piece – tooth paste – phenoyl – ink- camphor tablets.	6	Up to K2	CLO-1
II	Corrosion Corrosion – definition – Types of corrosion- rusting of iron – preventive methods: Cathodic and Anodic protection-corrosion inhibitors-Electro plating method – Paints – varnishes.	6	Up to K2	CLO-2
III	Pharmaceutical Chemistry Classification of drugs - Application of the following drugs: Antipyretics: Salicin, Phenacetin, Aspirin, Tylenol. Analgesics: Novalgin, Chloroform, Diethyl ether. Antiseptics: Chloramine-T, Dettol, Thymol, Boric acid, Potassium permanganate. (structure and synthesis not necessary) Chemotherapy: definition – classification of chemotherapeutic agents (names and uses only).	6	Up to K2	CLO-3
IV	Polymers Monomer – polymer – definition – classification – differences between thermoplastics and thermosetting polymers – Polymerization: definition, types and examples – examples for addition, condensation and co-ordination polymers – Properties and uses of following: Polyethylene, Polyvinyl chloride (PVC), Polytetrafluoroethylene (PTFE), and Nylon-66	6	Up to K2	CLO-4
V	Water Treatment Water: Source of water – characteristics of water – Hardness of water – Types – Temporary hardness – permanent hardness – disadvantages of hard water – Removal of hardness – Reverse osmosis – zeolite process.	6	Up to K2	CLO-5

Books for study:

1. Ghosh, J. Fundamental concepts of Applied Chemistry, 1st Edition, S. Chand Limited, Nagpur, 2006.
2. Jain, P. C., Jain, M. Engineering chemistry, 15th edition., 1998, Dhanpat Rai Publishing Company.
3. Kapur, K. Text Book of Applied Chemistry, 1st edition, New Delhi, H.Tata publications, 1994.

Books for Reference:

1. Sharma, B. K., Industrial chemistry, 11th Edition Goel Puplicsihing House, 1994.
2. Charrabarthi B.N., Industrial Chemistry, 1st Edition, Oxford and IBH Publishing co. Pvt. Ltd. 1981.
3. A, L. Gupta, Polymer Chemistry, PragatiPrakshan Publications, Meerut, Revised edition, 2010.
4. Jayashree Gosh, A textbook of Pharmaceutical Chemistry, S. Chand Publications, 1st edition, 2017

Web resources

1. <https://www.entrepreneurindia.co/book-details/294/surfactants-disinfectants-cleaners-toiletries-personal-care-products-manufacturing-and-formulations>
2. <https://www.twi-global.com/technical-knowledge/faqs/what-is-corrosion>
3. <https://accessmedicine.mhmedical.com/content.aspx?sectionid=102161048&bookid=1613>
4. <https://www.sciencenewsforstudents.org/article/explainer-what-are-polymers>
5. <https://www.hunterwater.com.au>

Rationale for Nature of the course

This course will enable the students to enrich the understanding of preparation of various compounds like Agarbattis, Naphthalene balls, Shoe polish etc., fundamental principles of corrosion and mechanism of rust formation, Antipyretics and analgesics, Antiseptics, polymers and its types. Students know about the hardness of water and how the hardness will be removed.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The basic study of preparation of various compounds like Agarbattis, Naphthalene balls, Shoe polish etc., the concepts of corrosion and its mechanism were explained by doing chart work. The Removal of hardness, Reverse osmosis, zeolite process was explained by industrial visit.

Pedagogy

- Chalk-Talk Class room Activities
- group Discussion
- seminar
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	Small Scale Units		
	Introduction and manufacturing of Safety matches – Agarbattis.	2	BB/PPT
	Manufacturing of Naphthalene balls - Shoe polish – Chalk piece.	2	BB/PPT/
	Preparation and importance of tooth paste – phenoyl – ink- camphor tablets.	2	BB/PPT
II	Corrosion		
	Corrosion – definition - Types of corrosion- rusting of iron.	2	BB/PPT
	Preventive methods: Cathodic and Anodic protection-corrosion inhibitors.	2	BB/PPT
	Electro plating method – Paints – varnishes.	2	BB/PPT
III	Pharmaceutical Chemistry		
	Classification of drugs- Application of the following drugs: Antipyretics: Salicin, Phenacetin, Aspirin, Tylenol.	2	BB/PPT
	Analgesics: Novalgin, Chloroform, Diethyl ether. Antiseptics: Chloramine-T, Dettol, Thymol.	2	BB
	Boric acid, Potassium permanganate.(structure and synthesis not necessary) Chemotherapy:definition – classification ofchemotherapeutic agents(names and uses only).	2	BB/PPT
IV	Polymers		
	Monomer – polymer – definition – classification – differences between thermoplastics and thermosetting polymers	2	BB/PPT
	Polymerization: definition, types and examples – examples for addition, condensation and co-ordination polymers	2	BB/PPT
	Properties and uses of following: Polyethylene, Polyvinyl chloride (PVC), Polytetrafluoroethylene (PTFE), and Nylon-66	2	BB
V	Water Treatment		
	Water: Source of water – characteristics of water – Hardness of water	2	BB/PPT
	Types – Temporary hardness – permanent hardness – disadvantages of hard water	2	BB/PPT
	Removal of hardness – Reverse osmosis – zeolite process	2	BB/PPT
	Total Hours	30	

Course outcome: After complete successful of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO1	Elaborate the preparation and importance of household products.	Up to K2
CLO2	Explain the corrosion and its preventive methods.	Up to K2
CLO3	Outline the importance of Antipyretics, Analgesics and Antiseptics.	Up to K2
CLO4	Illustrate the different types of polymers and polymerisation.	Up to K2
CLO5	Know about the hardness of water and its types, various removable methods.	Up to K2

PLO and CLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	1	1	1	2	2
CLO2	1	2	1	3	2
CLO3	2	3	2	3	2
CLO4	1	2	1	1	1
CLO5	1	3	1	1	2

3-Advance application;

2-Intermediate level;

1-Basic level

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K2
Quiz	5	K2
Seminar	5	K2
Total	25	

Learning Outcome Based Education (LOBE) & Assessment

Formative Examination-I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K 2	2	K1, K1	2 (K2 &K2)	1(K1)
2	CLO y	Up to K 2	3	K1, K1,K1	2 (K2 &K2)	2(K1, K1)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

**Learning Outcome Based Education (LOBE) & Assessment Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)**

Units	CLOs	K- Level	Section A		Section B		Section C (open Choice)
			Short answers		(Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K 2	1	K1	1	2 (K2&K2)	K1
2	CLO 2	Up to K 2	1	K1	1	2 (K2&K2)	K1
3	CLO 3	Up to K 2	1	K1	1	2 (K2&K2)	K1
4	CLO 4	Up to K 2	1	K1	1	2 (K2&K2)	K1
5	CLO 5	Up to K 2	1	K1	1	2 (K2&K2)	K1
No. of Questions to be asked			5		5		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers.

Distribution of Section-wise marks with K-levels

K Levels	Section A (No Choice)	Section B (Either / or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10		50	60	46	46
K2	-	70		70	54	54
Total marks	10	70	50	130	100	100

Name of the course Designer

- Dr. R. Sathya

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core	21P2CMC4	Organic Chemistry-II	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- To illustrate mechanism involving in addition reactions across Carbon-Carbon multiple bonds and its synthetic utility.
- To study mechanisms in addition of Carbon-Heteroatom multiple bonds and Elimination reactions
- To identify the stereochemical aspects of organic molecules
- To apply various types of oxidation and reduction reagents along with their mechanism and synthetic utility.
- To analyse reaction mechanisms involved in rearrangements and name reactions

Unit	Description	Hours	K-Level	CLO
I	ADDITION TO CARBON-CARBON MULTIPLE BONDS Mechanism of Carbon-Carbon Addition reactions: Electrophilic, Nucleophilic and Free radical addition to C-C double bond and triple bond-cyclic mechanism- orientation and reactivity. Addition to cyclopropane ring-Addition to conjugated system-Addition of carbenes-Michael addition and Robinson annulation. Hydroxylation of olefinic double bonds (OsO ₄ , KMnO ₄); Woodward and Prevost oxidation. Epoxidation using peracids including Sharpless epoxidation, Ozonolysis. Hydrogenation (homogenous and heterogeneous)- Transfer hydrogenation-Hydroboration-Hydration of carbon-carbon double and triple bonds.	15	Up to K4	CLO-1
II	ADDITION TO CARBON-HETERO ATOM MULTIPLE BONDS AND ELIMINATION REACTIONS Addition to Carbon-Hetero atom multiple bonds Nucleophilic addition to –C=O bond. A study of Darzen'sglycidic ester, Stobbe and Knoevenagel condensation reactions; Wittig, Wittig-Horner olefination reactions; Julia olefination & Peterson alkene synthesis. Elimination reactions: E ₁ , E ₂ , E ₁ cb and E _i -elimination. Conformation of mechanism; solvent, substrate, leaving group effects-Saytzeff'sVs Hoffman elimination; Stereochemistry of E ₂ eliminations, Elimination in cyclohexane ring system; Mechanism of pyrolytic eliminations. Examples: Chugaev reactions and Cope elimination, Hoffmann degradation and pyrolysis of esters.	15	Up to K2	CLO-2

III	STEREOCHEMISTRY Optical isomerism -Optical activity, Chirality, Symmetry elements, Asymmetric and Dissymmetric chiral molecules. specification by Cahn-Ingold-Prelog notations-Calculation of number of optical isomers. Description of various types of optically active compounds including allenes, cumulenes, spiranes, biphenyls, <i>trans</i> -cyclooctene.-R&S nomenclature of simple compounds, racemic modification & classification of racemic modifications, quasi racemates. Compounds containing two asymmetric centers: Nomenclature-D & L, R & S, R* & S*, <i>Erythro</i> and <i>threo</i> isomers Interpretation of homotopic, enantiotopic and diastereotopic atoms, groups and faces. Pro-chiral carbon. Concept of <i>Re</i> - and <i>Si</i> - faces. Stereospecific and Stereoselective reactions. Asymmetric Synthesis-Cram's rule, Prelog's rule and Felkin-Anh Model-Stereochemistry of compounds containing nitrogen Geometrical isomerism -E and Z notation –Determination of configuration of geometrical isomers by simple techniques like hydroxylation, hydroboration and methods based on physical properties	15	Up to K3	CLO-3
IV	OXIDATION AND REDUCTION REACTIONS Oxidation: Introduction, Different oxidative processes Oxidation with Cr (including PCC, PDC, Jones) and Mn (including MnO ₂ and BaMnO ₄) reagents; Oxidation with LTA, DDQ and SeO ₂ ; Oxidation using DMSO either with DCC or Ac ₂ O or Oxaloyl chloride; Oxidation using HIO ₄ and Dess-Martin Periodinane (DMP) reagent-ruthenium tetroxide-Thallium (III) Nitrate Reduction: Introduction. Different reductive processes:Reduction with NaBH ₄ , NaCNBH ₃ , Zn(BH ₄) ₂ LiAlH ₄ , Li(^t BuO) ₃ AlH, DIBAL-H, Red-Al, Et ₃ SiH and Bu ₃ SnH; Reduction using selectrides; Birch reduction.Lawesson reagent – TiCl ₄ / Zn-Cu (Mac Murray's reagent) – TiCl ₄ /Mg-Hg-Wilkinson's catalyst, Lindlar catalyst-BH ₃ /THF, 9-BBN, Baker's yeast	15	Up to K3	CLO-4
V	MOLECULAR REARRANGEMENTS & NAME REACTIONS General mechanism – nature of migration, migratory aptitude, memory effects -A study of mechanism of the following rearrangements: <i>Carbon-carbon migration: Carbon-nitrogen migration :Carbon-oxygen migration</i> Beckmann, Curtius, Hofmann, Schmidt, Lossen, Wolff, Pinacol, Wagner Meerwin, Demjanov, Dienone-Phenol, Favorski, Benzidine, Claisen, Cope, Sommelet Hauser, Pummerer and Von-Richter rearrangements. A study of the following name reactions: Dieckmann cyclization, Hofmann-Löffler Freytag reaction, Mitsunobu reaction, Shapiro reaction, Eschenmoser-Tanabe and Ramburg-Backlund reactions.	15	Up to K4	CLO-5

Books for study:

1. F. Carey and R. J. Sundberg, Advanced Organic Chemistry-Part A and B, Springer Science & Business Media, 5 th Ed, 2007.
2. M. B. Smith and Jerry March, Advanced Organic Chemistry, John Wiley & Sons, 5th Ed, 2001
3. Nasipuri, D. "Stereochemistry of organic compounds" Second Edition, New Age International Pvt. Ltd., 2005.

Books for reference:

1. E.S. Gould Henry, Mechanism and structure in organic chemistry, Holtco INC 1963.
2. Graham Solomons, Organic chemistry, John Wiley and Sons INC 5th Edn 1992.
3. R.K. Mackie and D.M. Smith, Guide Book to organic synthesis, ELBS, 1982.
4. H.O. House, Modern synthetic reactions, Cambridge university press 3rd Edn, 1972.
5. W. Caruthers, Some modern methods of organic synthesis, Cambridge University.
6. Eliel, E.L., Wilen, S. H. "Stereochemistry of Carbon Compounds", First Edition, Wiley, 2008.

Web resources

1. <https://onlinelibrary.wiley.com/doi/10.1002/9780470084960.ch15>
2. [https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3ARadical_Reactions_of_Carbohydrates_\(Binkley\)/II%3ARadical_Reactions_of_Carbohydrates/18%3ACompounds_with_Carbon%E2%80%93Carbon_Multiple_Bonds_I%3AAddition_Reactions](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3ARadical_Reactions_of_Carbohydrates_(Binkley)/II%3ARadical_Reactions_of_Carbohydrates/18%3ACompounds_with_Carbon%E2%80%93Carbon_Multiple_Bonds_I%3AAddition_Reactions)
3. <https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118093559.ch2>
4. <https://schoolbag.info/chemistry/organic/108.html>

Rationale for Nature of the course

This course will enable the students to understand the basic concepts about how the organic reactions are carried out and also to make the students to learn the mechanisms of different organic reactions including various stereo chemical and mechanistic aspects.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

This basic study of organic reactions, rearrangements stereochemistry concepts make the students to evaluate the organic reactions, based on the influence of the substituents on substrate molecules and nature of solvent and the parametric conditions. Students will also design new organic reactions in order to achieve the required product.

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Quiz through ICT- Mode
- Animated video for chemical reactions

Lesson Plan

Unit	Descriptions	Hours	Mode
I	ADDITION TO CARBON-CARBON MULTIPLE BONDS		
	Mechanism of Carbon-Carbon Addition reactions: Electrophilic, Nucleophilic and Free radical addition to C-C double bond and Triple bond-cyclic mechanism- orientation and reactivity. Addition to cyclopropane ring	5	PPT, Chalk and talk, Group discussion
	Addition of carbenes-Michael addition and Robinson annulation. Hydroxylation of olefinic double bonds (OsO ₄ , KMnO ₄); Woodward and Prevost oxidation. Epoxidation using peracids including Sharpless epoxidation, Ozonolysis.	5	
	Hydrogenation (homogenous and heterogeneous)- Transfer hydrogenation-Hydroboration-Hydration of carbon-carbon double and triple bonds.	5	
II	ADDITION TO CARBON-HETERO ATOM MULTIPLE BONDS AND ELIMINATION REACTIONS		
	Addition to carbon-hetero atom multiple bonds -Nucleophilic addition to C=O bond. A study of Darzen's glycidic ester, Stobbe and Knoevenagel condensation reactions; Wittig, Wittig-Horner olefination reactions	3	PPT, Chalk and talk, Group discussion
	Julia olefination & Peterson alkene synthesis. Asymmetric reduction of carbonyl functions (Corey's procedure)	2	
	Elimination reactions: E ₁ , E ₂ , E ₁ cb and E _i -elimination. Conformation of mechanism; solvent, substrate, leaving group effects-Saytzeff's Vs Hoffman elimination	5	
	Stereochemistry of E ₂ eliminations, Elimination in cyclohexane ring system; Mechanism of pyrolytic eliminations. Examples: Chugaev reactions and Cope elimination, Hoffmann degradation and pyrolysis of esters.	5	
III	STEREOCHEMISTRY		
	Optical isomerism -Optical activity, Chirality, Symmetry elements, Asymmetric and Dissymmetric chiral molecules. Specification by Cahn-Ingold-Prelog notations-Calculation of number of optical isomers. Description of various types of optically active compounds including allenes, cumulenes, spiranes, biphenyls, <i>trans</i> -cyclooctene.	4	PPT, Chalk and talk, Group discussion
	R&S nomenclature of simple compounds, racemic modification & classification of racemic modifications, quasi racemates. Compounds containing two asymmetric centers: Nomenclature-D & L, R & S, R* & S*, <i>Erythro</i> and <i>threo</i> isomers and their inter conversion	4	
	Interpretation of homotopic, enantiotopic and diastereotopic atoms, groups and faces. Pro-chiral carbon. Concept of <i>Re</i> - and <i>Si</i> - faces. Stereospecific and Stereoselective reactions. Asymmetric Synthesis- Cram's rule, Prelog's rule and Felkin-Anh model- Stereochemistry of compounds containing nitrogen	5	

	Geometrical isomerism -E and Z notation –Determination of configuration of geometrical isomers by simple techniques like hydroxylation, hydroboration and methods based on physical properties	2	
IV	OXIDATION AND REDUCTION REACTIONS		
	<i>Oxidation:</i> Introduction, Different oxidative processes Oxidation with Cr (including PCC, PDC, Jones) and Mn (including MnO ₂ and BaMnO ₄) reagents;	4	PPT, Chalk and talk, Group discussion
	Oxidation with LTA, DDQ and SeO ₂ ; Oxidation using DMSO either with DCC or Ac ₂ O or Oxaloyl chloride; Oxidation using HIO ₄ and Dess-Martin Periodinane (DMP) reagent-Ruthenium tetroxide-Thallium (III) Nitrate	3	
	<i>Reduction:</i> Introduction. Different reductive processes :Reduction with NaBH ₄ , NaCNBH ₃ , Zn(BH ₄) ₂ LiAlH ₄ , Li(^t BuO) ₃ AlH, DIBAL-H, Red-Al, Et ₃ SiH and Bu ₃ SnH; Reduction using selectrides; Birch reduction.	4	
	SnCl ₂ , Lawesson reagent – TiCl ₄ / Zn-Cu (Mac Murrays reagent) – TiCl ₄ /Mg-Hg-Wilkinson's catalyst, Lindlar catalyst-BH ₃ /THF, 9-BBN, Baker's yeast	4	
V	MOLECULAR REARRANGEMENTS & NAME REACTIONS		
	General mechanism – nature of migration, migratory aptitude, memory effects -A study of mechanism of the following rearrangements: <i>Carbon-carbon migration: Carbon-nitrogen migration :Carbon-oxygen migration</i> Beckmann, Curtius, Hofmann, Schmidt, Lossen, Wolff, Pinacol	5	PPT, Chalk and talk, Group discussion
	Wagner Meerwin, Demjanov, Dienone-Phenol, Favorski, Benzidine, Claisen, Cope, Sommet Hauser, Pummerer and Von-Richter rearrangements.	5	
	A study of the following name reactions: Dieckmann cyclization, Hofmann-Löffler Freytag reaction, Mitsunobu reaction, Shapiro reaction, Eschenmoser-Tanabe and Ramburg-Backlund reactions.	5	
Total Hours		75	

BB-Blockboard/ChalkandTalk PPT-Powerpointpresentation

Course Learning outcome: After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	Correlate mechanisms of addition reactions and examine the synthetic routes for organic transformations in carbon-carbon multiple bonds	Up to K4
CLO2	Organise and analyse mechanisms involved in addition across carbon-heteroatom bonds and elimination reactions	Up to K2
CLO3	Inspect the molecule on the basis of chirality and other stereochemical aspects.	Up to K3
CLO4	Interpret usages of the various oxidizing and reducing reagents to synthesize organic compounds.	Up to K3
CLO5	Conclude the potential applications of various rearrangements and name reactions in the synthesis of organic compounds and giving mechanism pertaining to them.	Up to K4

Mapping of CLOs with PLOs

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
CLO1	3	2	3	2	1
CLO2	3	2	3	2	1
CLO3	3	2	3	2	1
CLO4	3	2	3	2	1
CLO5	3	2	3	2	1

3-Advance application;

2-Intermediate level;

1-Basic level

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education (LOBE) & Assessment

Formative Examinations I & II – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 4	2	K3 & K4	1	K3	2 (K4&K4)	1(K4)
2	CLO 2	Up to K 2	2	K1 & K1	1	K1	2 (K1&K1)	1(K2)
3	CLO 3	Up to K 3	2	K2 & K3	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K 3	2	K2 & K3	1	K1	2 (K2&K2)	1(K3)
5	CLO 5	Up to K 4	2	K3 & K4	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1-Rememberingandrecallingfactswithspecificanswers

K2-Basicunderstandingoffactsandstatingmainideaswithgeneralanswers

K3-Applicationoriented-SolvingProblems

K4-Examining,analyzing,presentationandmakeinferenceswith evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	21.7	30
K4	2	20	20	42	43.3	35
Total marks	20	50	50	120	100	100

Name of the course Designers

1. Dr. J. Shanmugapriya
2. Dr. P.S.Harikrishnan

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core	21P2CMC5	Inorganic Chemistry - II	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- (i) To learn about thermodynamic and stereochemical aspects of complex formation
- (ii) To learn about Various theories of complexes and their magnetic properties
- (iii) To learn about term symbols and energy level diagram of weak and strong field ligands, charge transfer spectra and spectral properties of lanthanides and actinides.
- (iv) To learn about various mechanisms of substitution and electron transfer reactions.

Unit	Description	Hours	K-Level	CLO
I	STABILITY OF COMPLEXES Stability of complexes- Factors affecting the stability of complexes, Thermodynamic and kinetic stability aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Bjerrum's method (Potentiometric method), Spectrophotometric method, Polarographic method and Continuous variation method (Job's method)	15	Up to K2	CLO-1
II	METAL-LIGAND BONDING Crystal field theory – Splitting of d orbitals under various geometries - factors affecting splitting, CFSE, evidences for CFSE (Structural and thermodynamic effects), spectrochemical series, Jorgensen relation, site preferences, Jahn Teller distortion – Dynamic and Static J.T. effect, Jahn Teller effect and chelation, Application of CFT – Magnetic properties, spectral properties and Kinetic properties, Limitations of CFT, Evidences for M-L overlap. MOT – MO theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes. Nephelauxetic effect, Magnetic properties of complexes. Comparison of CFT and MOT of bonding in octahedral complexes.	15	Up to K4	CLO-2

III	ELECTRONIC SPECTRA OF COMPLEXES Spectroscopic term symbols for d^n ions – derivation of term symbols and ground state term symbol, Hund's rule, Selection rules – breakdown of selection rules, spin orbit coupling, band intensities, weak and strong field limits – correlation diagram, Energy level diagrams. Orgel diagram for weak field O and T_d complexes – Splitting of energy levels due to Jahn-Teller distortion. Modified Orgel diagram – Limitations of Orgel diagram and Tanabe-Sugano (T-S) diagrams – Evaluation of Dq and B values for d^2 – d^8 complexes, charge transfer spectra. Comparison between d-d bands and CT bands – Numerical problems, Lanthanides and Actinides-Spectral properties.	15	Up to K3	CLO-3
IV	INORGANIC REACTION MECHANISM-I Stereochemical aspects- Stereoisomerism in inorganic complexes- Isomerism arising out of ligand distribution and ligand conformation, Chirality and nomenclature of chiral complexes; Application of ORD and CD in the identification of complexes. Macrocyclic ligands- Porphyrins, Corrins, Schiff's bases, crown ethers, etc. Electron transfer reactions– Inner sphere (ISET) and outer sphere (OSET) electron transfer reactions. Role of bridging ligand with ISET reaction – tunneling transfer – multiple bridging in the activated complex in the ISET process. Complimentary and non complimentary ET reactions. Cross reactions and Marcus Hush theory.	15	Up to K4	CLO-4
V	INORGANIC REACTION MECHANISM-II Reaction mechanism of coordination compounds – Types of ligand substitution reactions – mechanism; Dissociative mechanism (D), Associative mechanism (A) interchange mechanism (I), Labile and Inert complexes. Substitution Reaction in octahedral complexes – general mechanism, general rate law for D, A and I - distinction between D, A, I pathways, replacement of coordinated water, mechanism of acid hydrolysis, base hydrolysis – DCB mechanism – direct and indirect evidences in favour of the mechanism. Anation Reactions. Substitution in square planar complexes – General mechanism, Trans effect, influences of entering and leaving groups. Application of trans effect – synthesis and isomers of $Pt(II)$ complexes – theories of trans effect and cis-trans isomerisation reaction. Application of substitution reactions in the synthesis of Platinum and Cobalt complexes.	15	Up to K4	CLO-5

Books for study:

1. F. Basolo and R. G. Pearson, Mechanism of Inorganic reactions, Wiley Eastern, 1967.
2. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic chemistry-Principles on structure and reactivity, 4th Ed, Pearson- education, 2002.
3. K. F. Purcell and J. C. Kotz, Inorganic Chemistry, WB Sanders Co, USA, 1977.

Books for reference:

1. D. F. Shriver, P. W. Atkins and C. H. Longford, Inorganic Chemistry, ELBS, 2nd Ed, 1994.
2. R. B. Heslop and K. Jones, Inorganic Chemistry, Elsevier, 1976.
3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993.
4. M. L. Tobe, Inorganic Reaction Mechanism, Nelson, 1972.
5. K. Burjer, Co-ordination Chemistry Experimental Methods, Butterworths, 1973.
6. B. N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976.

Web resources

1. <https://www.intechopen.com/books/stability-and-applications-of-coordination-compounds/stability-of-metal-complexes>
2. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Inorganic_Chemistry_\(Saito\)/06%3A_Chemistry_of_Transition_Metals/6.06%3A_Reactions_of_Complexes](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Inorganic_Chemistry_(Saito)/06%3A_Chemistry_of_Transition_Metals/6.06%3A_Reactions_of_Complexes)
3. [https://chem.libretexts.org/Courses/Saint_Marys_College_Notre_Dame_IN/CHEM_431%3A_Inorganic_Chemistry_\(Haas\)/CHEM_431_Readings/13%3A_Spectroscopic_and_Magnetic_Properties/13.02%3A_Electronic_Spectra_of_Coordination_Compounds](https://chem.libretexts.org/Courses/Saint_Marys_College_Notre_Dame_IN/CHEM_431%3A_Inorganic_Chemistry_(Haas)/CHEM_431_Readings/13%3A_Spectroscopic_and_Magnetic_Properties/13.02%3A_Electronic_Spectra_of_Coordination_Compounds)

Rationale for Nature of the course

This course should enable the students to comprehend the basic concepts and structure of coordination complex, understand the reaction mechanism & the path-ways to prove it, electronic spectra of complexes and lanthanide and actinides complex also.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

To ensure the basic knowledge and structural elucidation of metal complexes and their stability which confirmed by spectral techniques. To understand the reaction pathway and its mechanism of metal complexes to ensure the stability of metal complexes. Students should learn the basic idea of term symbol and applied to the complexes and study their spectral properties.

Pedagogy:

- Chalk-Talk Class room Activities
- Seminar
- Assignment and Quiz through ICT

Lesson plan:

Unit	Topics	Hours	Mode
I	STABILITY OF COMPLEXES		BB/PPT/ AnimatedVideos
	Stability of complexes- Factors affecting stability of complexes,	3	
	Thermodynamic and kinetic stability aspects of complex formation, Stepwise and overall formation constants	4	
	Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum's half method, Potentiometric method	4	
	Spectrophotometric method, Ion exchange method, Polarographic method and Continuous variation method (Job's method)	4	
	METAL LIGAND BONDING		
II	Crystal field theory – Splitting of d orbitals under various geometries	2	BB/PPT/ AnimatedVideos
	Factors affecting splitting, CFSE, evidences for CFSE (Structural and thermodynamic effects), spectrochemical series, Jorgensen relation, site preferences.	2	
	Jahn Teller distortion – Dynamic and Static J.T. effect, and chelation.	2	
	Application of CFT – Magnetic properties, spectral properties and Kinetic properties, Limitations of CFT, Evidences for M-L overlap.	3	
	MOT – MO theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes.	3	
	Nephelauxetic effect, Magnetic properties of complexes. Comparison of CFT and MOT of bonding in octahedral complexes.	3	
III	ELECTRONIC SPECTRA OF COMPLEXES		BB/PPT/ AnimatedVideos
	Spectroscopic term symbols for d^n ions – derivation of term symbols and ground state term symbol, Hund's rule, Selection rules – breakdown of selection rules, spin orbit coupling, band intensities, weak and strong field limits – correlation diagram,	3	
	Energy level diagrams. Orgel diagram for weak field Oh and Td complexes – Splitting of energy level due to Jahn-Teller distortion.	3	
	Modified Orgel diagram – Limitations of Orgel diagram and Tanabe-Sugano (T-S) diagrams	3	
	Evaluation of Dq and B values for d^2 – d^8 complexes charge transfer spectra	3	
	Comparison between d-d bands and CT bands – Numerical problems, Lanthanides and Actinides- Spectral properties	3	

IV	INORGANIC REACTION MECHANISM-I		
	Stereochemical aspects- Stereoisomerism in inorganic complexes- Isomerism arising out of ligand distribution and ligand conformation, Chirality and nomenclature of chiral complexes;	3	BB/PPT/ AnimatedVideos
	Application of ORD and CD in the identification of complexes.	3	
	Macrocyclic ligands- Porphyrins, Corrins, Schiff's bases, crown ethers, etc.	3	
	Electron transfer reactions – Inner sphere (ISET) and outer sphere (OSET) electron transfer processes. Role of bridging ligand with ISET reaction – tunneling transfer – multiple bridging in the activated complex in the ISET process.	3	
	Complimentary and non-complimentary ET reactions. Cross reactions and marcus Hush theory.	3	
V	INORGANIC REACTION MECHANISM-II		
	Reaction mechanism of coordination compounds – Types of ligand substitution reactions – mechanism; Dissociative mechanism (D), Associative mechanism (A) interchange mechanism (I), Labile and Inert complexes.	3	BB/PPT/ AnimatedVideos
	Substitution Reaction in octahedral complexes – general mechanism, general rate law for D, A and I - distinction between D, A, I pathways, replacement of coordinated water, mechanism of acid hydrolysis, base hydrolysis – DCB mechanism – direct and indirect evidences in favour of the mechanism.	3	
	Anation Reactions. Substitution in square planar complexes – General mechanism, Trans effect, influences of entering and leaving groups.	3	
	Application of trans effect – synthesis and isomers of Pt(II) complexes – theories of trans effect and cis-trans isomerisation reaction.	3	
	Application of substitution reactions in the synthesis of Platinum and Cobalt complexes	3	

Course Learning outcome:

After successful completion of this course, the student will be able

CLO	CLO statement	Knowledge level
CLO1	To learn stability and stereochemistry of metal complexes	Up to K2
CLO2	To explain metal ligand bonding using CFT and MOT in various geometrical environments	Up to K4
CLO3	To interpret the electronic spectra for the determination of the structure of complexes	Up to K3
CLO4	To evaluate electron transfer reactions of octahedral and tetrahedral complex	Up to K4
CLO5	To analyses and apply the substitution reaction and trans effect in complex	Up to K4

Mapping of CLOs with PLOs

	PLO1	PLO 2	PLO 3	PLO4	PLO5
CLO1	2		3	1	2
CLO2	2		3	1	2
CLO3	2		3	1	2
CLO4	2		3	1	2
CLO5	2		3	1	2

3-Advance application; 2-Intermediate level; 1-Basic level

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education(LOBE) & Assessment

Formative Examinations I & II -Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

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K Levels	Section A & B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

Name of the course Designers

1. Dr. A. Xavier
2. Dr. P. Gajendran

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core	21P2CMC6	Physical Chemistry – II	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives: *The objective of this course is to make the student*

- To utilize the principles of quantum mechanics of simple systems in order to gain knowledge on the applications of quantum mechanics.*
- To infer knowledge on the quantum mechanical treatment of multi electron atoms.*
- To know the various basic theories of adsorption.*
- To understand the mode of distribution of energy among gaseous molecules and their dynamic properties*
- To know colligative properties of solution and application of phase rule for three component system*

Unit	Description	Hours	K-Level	CLO
I	QUANTUM CHEMISTRY-I Black body radiation-Planck's quantum theory-Wave particle duality-Uncertainty Principle. Operators-linear, commutation, Hermitian and Hamiltonian operators. Eigen functions and Eigen values-Postulates of quantum mechanics. Derivation of Schrodinger's time-independent wave equation and its application to particle in a one-dimensional box, particle in a three-dimensional box, harmonic oscillator, rigid rotor and hydrogen atom.	15	Up to K3	CLO-1
II	QUANTUM CHEMISTRY-II Born-Oppenheimer approximation-Hydrogen molecule ion. LCAO-MO and VB treatments of the hydrogen molecule. Anti-symmetry and Pauli's exclusion principle. Slater determinant wave function. The variation theorem and Perturbation theory. Applications of variation method and perturbation theory to the helium atom. Hybridization-determination of bond angles of sp , sp^2 and sp^3 hybridizations. Huckel pi electron (HMO) theory and its applications to ethylene, butadiene and benzene. A brief idea of Hartree and Hartree-Fock self-consistent field theory.	15	Up to K4	CLO-2
III	SURFACE CHEMISTRY Surface Phenomena, Gibbs adsorption isotherm, types of adsorption isotherms BET isotherms and derivation of BET isotherm equation, Adsorption with dissociation – competitive adsorption non-ideal adsorption. Thermodynamics of adsorption surface area determination. Kinetics of surface reactions involving adsorbed species, Langmuir-Hinshelwood mechanism, Langmuir-Rideal mechanism, Rideal-Eley mechanism.	15	Up to K3	CLO-3

IV	GASEOUS AND LIQUID STATE Equations of states-Molecular speeds-Max Well distribution of molecular velocities- one, two and three dimensions-Energy distribution-Maxwell-Boltzmann distribution law-Principle of equipartition of energy and heat capacity-Rotation, vibration and Translational degree of freedom-Molecular Collisions-Mean free path-Transport Properties-Thermal conductivity Viscosity and diffusion of gases. Liquid State-Theory of liquids-Internal Pressure-Liquid crystals-Nematic, Cholester.	15	Up to K4	CLO-4
V	COLLIGATIVE PROPERTIES & PHASE RULE Colligative properties and Raoult's law definition only - Experimental Determination - Lowering of vapour pressure – Elevations of boiling point – depression of freezing point – Osmosis – Osmotic pressure. Basic terminologies of phase rule: Three component system: three liquid system, one liquid and two solid systems - two liquid and one solid system – three solids system.	15	Up to K2	CLO-5

Books for study:

1. A.K. Chandra, Introduction to Quantum Chemistry, Tata McGraw Hill, **1997**.
2. B.R.Puri, L.R.Sharma and M.S.Pathania, Principles of Physical Chemistry, 47th edition, Vishal Publishing Co, **2016**.
3. P. Atkins and J. de Paula, Physical Chemistry, Ninth Edition, Oxford University Press, New Delhi, **2011**.

Books for reference:

1. R.K. Prasad, Quantum Chemistry, Wiley Eastern, **1993**.
2. P.W. Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford, **1983**.
3. H. Eyring, J. Walter and G. Kimball, Quantum Chemistry, John Wiley and Sons, New York, **1944**.
4. G.M. Barrow, Physical Chemistry, 6th edn, McGraw-Hill Inc., US, **1996**.
5. N. Kundu and S.K. Jain, Physical Chemistry, S. Chand & Company Ltd. **2000**.
6. K.S. Birdi Surface Chemistry Essentials, CRC Press, **2013**

Web resources:

1. https://en.wikipedia.org/wiki/Quantum_chemistry#:~:text=Quantum%20chemistry%2C%20also%20called%20molecular,central%20topics%20in%20quantum%20chemistry.
2. https://chem.libretexts.org/Courses/Mount_Royal_University/Chem_1201/Unit_1%3A_Quantum_Chemistry.
3. <https://byjus.com/jee/surface-chemistry/>
4. <https://dradchem.wordpress.com/tag/colligative-properties/>

Rationale for Nature of the course

The course enable the students to comprehend the fundamental knowledge and facts in quantum chemistry and advanced knowledge of surface chemistry, gaseous state, liquid state and phase rule.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The students able to understand and apply set of mathematical principles that attempt to explain the behavior of atoms, sub-atomic particles and properties of molecules in gaseous state. They can also differentiate, analyze classical and quantum mechanics. They could be familiar with properties of liquid state such as crystalline property, colligative properties and able to comprehend the phase rule of three component system.

Pedagogy

- Chalk-Talk class room activities
- Seminar
- Assignment and Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	QUANTUM CHEMISTRY-I		
	Black body radiation-Planck's quantum theory-Wave particle duality-Uncertainty Principle	3	Chalk and talk/PPT
	Operators-linear, commutation, Hermitian and Hamiltonian operators, Eigen functions and Eigen values	3	
	Postulates of quantum mechanics, Derivation of Schrodinger's time-independent wave equation application to particle in a one-dimensional	3	
	Simple harmonic oscillator	3	
	Rigid rotor and hydrogen atom	3	
II	QUANTUM CHEMISTRY-II		
	Born-Oppenheimer approximation-Hydrogen molecule ion LCAO-MO and VB treatments of the hydrogen molecule.	3	Chalk and talk/PPT/ Assignment/Quiz
	Anti-symmetry and Pauli's exclusion principle Slater determinant wave function. The variation theorem and Perturbation theory	3	
	Applications of variation method and perturbation theory to the helium atom. Hybridization-determination of bond angles of sp , sp^2 and sp^3	3	
	Huckel pi electron (HMO) theory and its applications to ethylene, butadiene and benzene	3	
	A brief idea of Hartree and Hartree-Fock self-consistent field theory.	3	
	SURFACE CHEMISTRY		
	Surface Phenomena, Gibbs adsorption isotherm, types of adsorption isotherms BET isotherms. Derivation of BET isotherm equation	5	Chalk and talk/PPT/ Group discussion
	Adsorption with dissociation – competitive adsorption non-ideal adsorption. Thermodynamics of adsorption surface area determination.	5	
	Kinetics of surface reactions involving adsorbed species, Langmuir-Hinshelwood mechanism Langmuir-Rideal mechanism, Rideal-Eley	5	
	GASEOUS AND LIQUID STATE		
	Equations of states-Molecular speeds-Max Well distribution of molecular velocities one, two and three dimensions-Energy	3	Chalk and talk/PPT/ Assignment/ Quiz
	Principle of equipartition of energy and heat capacity Rotational, vibrational and Translational degrees of freedom	3	
	Collisions number -Mean free path Transport properties-. Thermal conductivity Viscosity diffusion of gases	4	
	Liquid State-Theory of liquids Internal Pressure-Liquid crystals-	5	
V	COLLIGATIVE PROPERTIES & PHASE RULE		
	Colligative properties and Raoult's law definition Experimental Determination - Lowering of vapour pressure – Elevations of boiling	5	Chalk and talk/PPT/ Group discussion
	Experimental Determination depression of freezing point – Osmosis –	3	
	Basic terminologies of phase rule: - Three component system: three	3	
	one liquid and two solid systems Two liquid and one solid system	4	

Course Learning Outcomes:

After successful completion of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO-1	Organize basic concepts of quantum mechanics and to apply operators to solve simple eigen values problems and approximation methods used in solving	Up to K3
CLO-2	Connect various theories behind quantum mechanics to illustrate multi-electron system and to calculate the energy of simple multi-electron atoms and	Up to K4
CLO-3	Use kinetic behaviour of surface reactions in order to develop various	Up to K3
CLO-4	Categorize Maxwell distribution of molecular velocities and to illustrate liquid crystals and various transport properties of matter.	Up to K4
CLO-5	Describe the phase behaviour of three component systems in terms of molecular properties.	Up to K2

Mapping of CLOs with PLOs

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5
CLO-1	3		2	1	1
CLO-2	3		2	1	1
CLO-3	3	1	2		1
CLO-4	3	2	2	2	2
CLO-5	3	1	2	1	

3-Advance application; 2-Intermediate level; 1-Basic level

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

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			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

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2	CLO 2	Up to K4	2	K3& K4	1	K2	2 (K4&K4)	1 (K4)
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

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K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

Name of the course Designers

1. Prof. S. Vidhyasankar
2. Dr. M. HasmathFarzana

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Elective-II	21P2CME2	Synthetic methods, Green Chemistry & Renewable energy	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives: *The objective of this course is to make the student*

- To know the various modern synthetic strategies through retrosynthetic analysis and by tandem processes.*
- To use the appropriate reagents for the effective conversion.*
- To explore the knowledge of asymmetric synthesis and total synthesis of natural products*
- To know the importance and applications of green chemistry techniques*
- To understand the need of renewable energy resources*

Unit	Description	Hours	K-Level	CLO
I	Synthetic Methodology Umpolung, 1,3-Dipolar cycloaddition methodologies (Azide, nitrile oxide, azomethine ylides and carbonyl ylides). Concept of Tandem, cascade and domino reactions in organic synthesis. Protection and deprotection techniques for amines, carboxylic acids, carbonyl and hydroxyl groups. Retero synthetic methods: Synthons (acceptor and donor) - Retrosynthetic analysis - Disconnection approach – functional group interconversion, the importance of order of events in organic synthesis, one C-X, and two-group C-X disconnections, Self-study: Various types of cyclization and ring formation reaction: anionic, cationic, radical and transition metal mediated cyclizations.	15	Up to K4	CLO-1
II	Novel Reagents & Asymmetric synthesis Role of palladium and nickel catalysts in organic reactions including Pd (0), Ni (0), Pd (II) and Ni (II) complexes. Typical reactions involving Heck, Negishi, Suzuki-Miyaura, Kumada, Sonogashira, Stille and Hiyama coupling for carbon-carbon bond formation reactions. Selectivity: Chemo- regio- stereo- Resolution - Kinetic resolution reactions, Desymmetrization, Asymmetric induction, Chiral auxiliary. Generation of Asymmetric synthesis – Substrate –	15	Up to K4	CLO-2

	Auxiliary - Reagent and Catalyst control. Auxiliary controlled alkylation of chiral enolates, Enders RAMP/SAMP and chiral sulfoxide. Asymmetric oxidation [dihydroxylation, epoxidation Sharpless, Jacobsen, Shi]. Self-study: Buchwald-Hartwig coupling for the carbon-heteroatom bond formation reactions. Asymmetric reduction (Noyori, Corey, Pfaltz) - Boranes reduction.			
III	Total synthesis of natural products Alkaloids and Terpenoids: Classification, isolation and general methods of determining structure - Demonstration of various types of total syntheses using alkaloid (Epibatidine and Ibogamine), Prostaglandin (PGE1) and Terpenes (longifolene, cedrene and Jasnone).	15	Up to K4	CLO-3
IV	Green Chemistry Introduction to green chemistry - definition, origin, history, needs, goals, twelve principles of green chemistry. Usage of Conventional and Green solvents - Advantages, Limitations and drawbacks. Green Synthesis – Designing, Choice of starting materials, choice of reagents, choice of catalysts: bio catalysts, polymer supported catalysts, choice of solvents. Synthesis involving basic principles of green chemistry. Examples: synthesis of adipic acid, methyl methacrylate, paracetamol. Microwave, Ultrasonication and Ultrasound assisted reactions – esterification, reduction and coupling reactions.	15	Up to K3	CLO-4
V	Renewable energy resources Renewable energy sources: types of renewable energy sources. Solar cells: basic principles, types and their applications. Fuel cells: basic principles, types and their applications. Working principle and applications of Biofuel cells - brief introduction about hydroelectric, biomass, wind power and geothermal power and their applications and limitations-energy from some other natural source.	15	Up to K2	CLO-5

Books for study:

1. Finar, I.L., "Organic Chemistry", Vol. II, Sixth Edition, Pearson Education Pvt. Ltd., Singapore, 2006.
2. Smith, M. B., "Organic Synthesis", Second Edition, McGraw-Hill International Edition, New Delhi, 1994.
3. Sanghi, R. and Srivastava, M.M., "Green Chemistry (Environmental Friendly Alternatives)", First Edition, Narosa Publishing House, New Delhi, 2003. PG

Books for reference:

1. Ahluvalia, V.K., "Chemistry of Natural Products", First Edition, Vishal Publishing Co, Jalandhar, 2008.
2. Carrutherus, W., "Some Modern Methods in Organic Synthesis", Third Edition, Cambridge University Press, New York, 1997.

3. Nasipuri, M., "Stereochemistry of Organic Compounds", Third Edition, New Age International, New Delhi, 2007.
4. Norman, R. and Coxon, J. M. Principles of Organic Synthesis, Blackie Academic & Professional, 1988.
5. Eliel, E.L., "Stereochemistry of Carbon Compounds", First Edition, McGraw Hill, New Delhi, 2007.
6. Warren, S. Wyatt, P. "Organic Synthesis: The Disconnection Approach", 2nd edition, Wiley & Sons Ltd., 2008.

Web resources:

1. <https://nptel.ac.in/courses/104/105/104105087/>
2. <https://nptel.ac.in/courses/104/103/104103111/>
3. <https://nptel.ac.in/courses/104/103/104103067/>
4. <https://www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry.html>
5. <https://www.sciencedirect.com/topics/chemistry/green-chemistry>

Rationale for Nature of the course

This course will enable the students to comprehend the ideas of synthetic methods for synthesizing chiral/achiral molecules and can help them to disconnect the new target molecule. It inculcates the green techniques, total synthesis and ideas about renewable energy resources.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Retro synthetic analysis, green chemistry principles and techniques will impart skills that can be used to design new molecules in green manner. The knowledge of reagents and energy resources will be used for molecules transformations and alternate sources of energy.

Pedagogy:

- Chalk-Talk Class room Activities
- Seminar
- Assignment and Quiz through ICT

Lesson Plan

Unit	Topics	Hours	Mode
I	Umpolung, 1,3-Dipolar cycloaddition methodologies (Azide, nitrile oxide, azomethine ylides and carbonyl ylides)	3	PPT, Chalk and talk, Assignment
	Concept of Tandem, cascade and domino reactions in organic synthesis.	3	
	Protection and deprotection techniques for amines, carboxylic acids, carbonyl and hydroxyl groups.	2	
	Synthons (acceptor and donor) - Retrosynthetic analysis - Disconnection approach	2	
	Functional group interconversion, the importance of order of events in organic synthesis	3	
	one C-X, and two-group C-X disconnections	2	
II	Role of palladium and nickel catalysts in organic reactions including Pd (0), Ni (0), Pd (II) and Ni (II) complexes.	3	PPT, Chalk and talk, Assignment
	Typical reactions involving Heck, Negishi, Suzuki-Miyaura, Kumada, Sonogashira, Stille and Hiyama coupling for carbon-carbon bond formation reactions.	3	
	Selectivity: Chemo- regio- stereo- Resolution - Kinetic resolution reactions, Desymmetrization, Asymmetric induction,	3	
	Chiral auxiliary. Generation of Asymmetric synthesis – Substrate – Auxiliary - Reagent and Catalyst control.	2	
	Auxiliary controlled alkylation of chiral enolates, Evans oxazolidones, chiral hydrozones and chiral imines.	2	
	Enders RAMP/SAMP and chiral sulfoxide. Asymmetric oxidation [dihydroxylation, epoxidation Sharpless, Jacobsen, Shi]	2	
III	Alkaloids and Terpenoids: Classification, isolation and general methods of determining structure	2	PPT, Chalk and talk, Assignment
	Demonstration of various types of total syntheses using alkaloid (Epibatidine and Ibogamine)	5	
	Prostaglandin (PGE1)	2	
	Terpenes (longifolene, cedrene)	4	
	Jasmone	2	
IV	Introduction to green chemistry - definition, origin, history, needs, goals, twelve principles of green chemistry.	3	PPT, Chalk and talk, Group discussion
	Usage of Conventional and Green solvents - Advantages, Limitations and drawbacks.	2	
	Green Synthesis – Designing, Choice of starting materials, choice of reagents, choice of catalysts: bio catalysts, polymer supported catalysts, choice of solvents.	4	
	Synthesis involving basic principles of green chemistry. Examples: synthesis of adipic acid, methyl methacrylate, paracetamol.	3	
	Microwave, Ultrasonication and Ultrasound assisted reactions – esterification, reduction and coupling reactions.	3	
V	Renewable energy sources: types of renewable energy sources.	2	PPT, Chalk and talk, Group discussion
	Solar cells: basic principles, types and their applications.	2	
	Fuel cells: basic principles, types and their applications.	2	
	Working principle and applications of Biofuel cells	2	
	brief introduction about hydroelectric, biomass, wind power and geothermal power and their applications and limitations	4	
	energy from some other natural source	3	

Course Learning outcome: After successful completion of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO1	Devise the disconnection of a given organic molecule and can find the synthetic equivalents and synthetic route.	Up to K4
CLO2	Connect the knowledge of reagents for chemical transformations and discover the nature of chirality	Up to K4
CLO3	Illustrate the knowledge of structural elucidation for a natural product.	Up to K4
CLO4	Apply green chemistry techniques for a given conventional thermal reactions	Up to K3
CLO5	Identify the alternative energy resources for chemical conversions	Up to K2

Mapping of CLOs with PLOs

#	PLO-1	PLO-2	PLO- 3	PLO-4	PLO-5
CLO-1	2		3		
CLO-2	2		2		
CLO-3	2		2	2	
CLO-4	2		2	2	
CLO-5	2			2	

Advance application– 3; Intermediate level–2;

Basic level–1

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K4
Quiz	5	K4
Seminar	5	K4
Total	25	

Learning Outcome Based Education (LOBE) & Assessment
Formative Examinations I & II – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	SectionA		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2(K2/K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1(K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K4	2	K3 & K4	1	K3	2 (K4 & K4)	1(K4)
2	CLO 2	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K2& K3	1	K1	2 (K2& K2)	1(K3)
5	CLO 5	Up to K2	2	K1& K1	1	K1	2 (K1& K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100%

Name of the course Designer

- Dr. S. V. Karthikeyan

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Practical	21P2CMP3	Organic Estimation	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: To expose the students to experiments in organic estimations by employing volumetric skills.

List of experiments:

- Estimation of glucose by Lane & Eynon method
- Estimation of glucose by Bertrand's method
- Estimation of aniline
- Estimation of Phenol
- Estimation of ethylmethyl ketone
- Estimation of formaldehyde
- Estimation of glycine

Books for reference:

1. Jeffery G. H. J. Basset and others, Vogel's Text Book of Quantitative Chemical Analysis, ECBS, 5th Edition.
2. Ramanujam V.V., Inorganic Semi Micro Quantitative Analysis, The National Publishing Company, 1990.
3. O.P. Pandey, N. Bajpai, S. Giri, "Practical Chemistry" S. Chand and Co Ltd., ISBN: 9788121908122, 9788121908122, 2010.
4. Henry W. Schimpf "A text book of volumetric analysis", Biolife Publishers, ISBN: 978-1117262451, 1117262456, 2009.
5. Peter Mc Pherson, "Practical volumetric analysis" RSC publications, ISBN: 978-1849739146, 1849739145, 2014.
6. V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.

Web resources:

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
2. <https://byjus.com/chemistry/volumetric-analysis/>
3. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy02/>
4. <https://chemistry.tcd.ie/assets/pdf/Preliminary%20Course/Titration%20Demonstration.pdf>

Pedagogy : Demonstration and practical session.

Rationale for Nature of the course

This course will enable the students to comprehend the basic knowledge of organic estimations through volumetric analysis methods. They will acquire skills through titrimetric methods by connecting the principles of organic synthesis.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The knowledge of volumetric analysis and basic principles of organic synthesis develops the students approach towards the estimation of organic molecules. They can correlate the properties/reactivity of molecules quantitatively and the same will be tested.

Course learning outcome:

After successful completion of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO 1	To get domain knowledge in estimation of organic compounds	Up to K2
CLO 2	To design the basic laboratory techniques of volumetric analysis	Up to K3
CLO 3	To develop the skills for doing any titrations and recording data	Up to K3
CLO 4	To make scientific claims that is supported by their data and other observations	Up to K4
CLO 5	To communicate the finding	Up to K2

Mapping of CLOs with PLOs

#	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5
CLO-1	2	3	1	2	2
CLO-2	2	3	1	2	
CLO-3	3	3	1	3	1
CLO-4	2	2	1	2	1
CLO-5	2	1	1	1	1

Advance application– 3; Intermediate level–2;

Basic level–1

Evaluation:

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total Marks	40

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO 1	To get domain knowledge in estimation of organic compounds	Up to K2	10
CLO 2	To design the basic laboratory techniques of volumetric analysis	Up to K3	10
CLO 3	To develop the skills for doing any titrations and recording data	Up to K3	15
CLO 4	To make scientific claims that is supported by their data and other observations	Up to K4	20
CLO 5	To communicate the finding	Up to K2	5
Total Marks			60

Name of the course Designer

- Dr. S. V. Karthikeyan

DEPARTMENT OF CHEMISTRY				CLASS: I M.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Practical	21P2CMP4	Inorganic Estimation & Complex Preparation	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: To expose the students to experiments in inorganic estimations and complex preparation by employing volumetric skills and preparing complex.

Objectives: *The objective of this course is to make the student*

- (i) *To demonstrate basic laboratory technique of titration*
- (ii) *To develop the intellectual and psychomotor skills of the students by imparting knowledge in quantitative analysis.*
- (iii) *To examine the quantitative estimation of inorganic cations through volumetric techniques.*
- (iv) *To practice the preparation of simple co-ordination compounds*

LIST OF EXPERIMENTS

Complexometry:

1. Estimation of Magnesium by EDTA Method.
2. Estimation of Calcium by EDTA Method
3. Estimation of Zinc by EDTA Method.
4. Estimation of Nickel by EDTA method (direct and indirect methods)
5. Estimation of Copper by EDTA method

Inorganic Complexes Preparation

1. Preparation of hexathiourea-plumbous nitrate.
2. Preparation of thiourea cuprous chloride.
3. Preparation of trithiourea cuprous sulphate.
4. Preparation of pentathiourea-dicuprous nitrate.
5. Preparation of sodium hexanitrocobaltate

Books for reference:

1. O.P. Pandey, N. Bajpai, S. Giri, "Practical Chemistry" S. Chand and Co Ltd., ISBN: 9788121908122, 9788121908122, 2010.
2. Henry W. Schimpf "A text book of volumetric analysis", Biolife Publishers, ISBN: 978-1117262451, 1117262456, 2009.
3. Peter Mc Pherson, "Practical volumetric analysis" RSC publications, ISBN: 978-1849739146, 1849739145, 2014.

4. V. Venkateswaran , R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi,1997.
5. R.Gopalan, V. Ramalingam , Concise Coordination Chemistry’ Vikas Publishing House PVT LTD, Noida, 2010.

Web resources:

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
2. <https://byjus.com/chemistry/volumetric-analysis/>
3. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy02/>
4. <https://chemistry.tcd.ie/assets/pdf/Preliminary%20Course/Titration%20Demonstration.pdf>

Pedagogy : Demonstration and practical session.

Rationale for Nature of the course

This course will enable the students to comprehend the basic knowledge of inorganic estimations through volumetric analysis using EDTA and complex preparation. They will acquire skills through titrimetric methods by connecting the principles of inorganic synthesis.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The knowledge of volumetric analysis and basic principles of complex preparation develops the students approach towards the estimation of metal ions like Mg, Ca, Cu and Ni. The students will acquire hand on experience on preparation of simple inorganic complexes.

Course outcomes: After complete successful of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	To demonstrate the basic laboratory techniques of volumetric analysis of given samples.	Up to K2
CLO2	To estimate the amount of metal ions such as Zinc, Magnesium and Copper present in the given solution by EDTA volumetric method.	Up to K3
CLO3	To understand the preparation of inorganic complex	Up to K3
CLO4	To interpret analytical data	Up to K4
CLO5	To communicate the finding	Up to K2

Mapping of CLOs with PLOs

#	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5
CLO-1	2	3	1	2	2
CLO-2	2	3	1	2	
CLO-3	3	3	1	3	1
CLO-4	2	2	1	2	1
CLO-5	2	1	1	1	1

Advance application– 3; Intermediate level–2;

Basic level–1

Evaluation:

Continuous Internal Assessment	:	40 Marks
External Assessment	:	60 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	20
Observation/Record	10
Continuous class assessment	10
Total Marks	40

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO1	To demonstrate the basic laboratory techniques of volumetric analysis of given samples.	Up to K2	10
CLO2	Estimate the amount of metal ions such as like Zinc, Magnesium and Copper present in the given solution by EDTA volumetric method.	Up to K3	10
CLO3	To understand the preparation of inorganic complex	Up to K3	15
CLO4	To interpret analytical data	Up to K4	20
CLO5	To communicate the finding	Up to K2	5
	Total Marks		60

Name of the Course Designers

1. Dr. A. Xavier
2. Dr. P. Gajendran.

DEPARTMENT OF CHEMISTRY				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Non-Major Elective	21P2CNM2	Industrial Chemistry and safety measurements	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives: The objective of this course is to make the student

- To study about the different types of fertilizers and their role in plant growth.
- To know about dye, and its preparations of certain dyes.
- To study water pollution and radioactive pollution and control measures.
- To study about different types of glass and its raw materials.
- To know about the safety measures in Industries.

Unit	Description	Hours	K-level	CLO
I	Fertilizers Plant nutrients – their role in plant growth – classification of fertilizers – Natural and synthetic fertilizers – NPK fertilizers – Complex and Mixed Fertilizers. Examples – Urea – Potassium nitrate – Superphosphate of lime.	6	Up to K2	CLO-1
II	Dye Chemistry Definition – Requisites of a true dye – Chromophores and Auxochrome with examples – Theories of colour . Hair dye materials: natural products hair dye – Godrej, Garnier, Ingredients and preparation of Super Vasmol 33, Vatika.	6	Up to K2	CLO-2
III	Water and Radioactive Pollution Pollution: Introduction – pollution – definition- classification – Water pollution – Water pollutants – acid rain – Greenhouse effect – Ozone layer depletion – control of Water pollution – Radioactive pollution – cause of radioactive materials – control measures.	6	Up to K2	CLO-3
IV	Glass Industry Principal- raw materials used in manufacture of Glass - Effect of different constituents of Glass - special types of Glass - Silica Glass - Borosilicate Glass - Soda lime Glass - Coloured Glass - Safety Glass - Glass wool - Properties of Glass	6	Up to K2	CLO-4
V	Safety measures in Industries General safety and operational rules – Safe handling of chemicals: Gathering general Information on chemicals-Handling and transportation of chemicals-Chemical storage- Fire extinguishers: introduction-classes of fire- Types of fire extinguishers: CO ₂ extinguisher, powder and dry chemical extinguisher.	6	Up to K2	CLO-5

Books for study:

1. The Complete Book on Glass and Ceramics Technology, NIIR board of consultants and Engineers, 1st Edition, Asian Pacific Business Press, 2005
2. Jain & Jain - Engineering Chemistry 15th Edition, Dhanpath Rai publishing company (PVL), New Delhi, 2019.
3. S. S. Dara, S. S. Umare, A Textbook of engineering chemistry, 12th Edition, S. Chand & company Ltd. New Delhi, 2004.

Books for Reference:

1. M. G. Arora & M. Singh, Industrial Chemistry, 1st Edition, Anmol Publications, New Delhi, 1998.
2. Sharma, B. K., Industrial chemistry, 1st Edition, Goel Publishing House, 1994.
3. The Chemistry and Application of Dyes Editors: Waring, 1st Edition, David R., Hallas, Geoffrey (Eds.), 1990

Web resources:

1. <https://www.gardeners.com/how-to/fertilizer-ratios>
2. <https://chem.libertexts.org>
3. <https://www.livescience.com/22728-pollution-facts>
4. www.sciencenewsforstudents.org
5. <https://blog.koorsen.com/what-are-the-different-types-of-fire-extinguishers-their-uses>

Rationale for Nature of the course

This course will enable the students to enrich the understanding of basic preparation, properties of fertilizers, Ingredients and preparation of various dyes, water pollution, radioactive pollution and its control measures. Students gain the knowledge about glass industry and its types. They get the information about safety measures in Industries.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The basic understanding of fertilizers and its classification gained by chart work. The concepts of corrosion and its mechanism were explained by doing small experiments. The removal of hardness, Reverse osmosis, zeolite process was explained by industrial visit.

Pedagogy

- Chalk-Talk Class room Activities
- group Discussion
- seminar
- Quiz through ICT- Mode

Lesson Plan

Unit	Descriptions	Hours	Lecture Mode
I	Fertilizers		
	Plant nutrients – their role in plant growth – classification of fertilizers – Natural and synthetic fertilizers.	2	BB/Animated Video
	NPK fertilizers – Complex and Mixed Fertilizers.	2	BB/PPT/Anim
	Examples – Urea – Potassium nitrate – Superphosphate of lime.	2	BB/PPT
II	Dye Chemistry		
	Definition – Requisites of a true dye – Chromophores and Auxochrome with examples.	2	BB/PPT
	Hair dye materials: natural products hair dye – Godrej Garnier.	2	BB/PPT
	Ingrédients and preparation of Super Vasmol 33, Vatika.	2	BB/PPT
III	Water and Radioactive Pollution		
	Pollution: Introduction – pollution – definition- classification Water pollution – Water pollutants	2	BB/PPT
	acid rain – Greenhouse effect – Ozone layer depletion - control of Water pollution	2	BB/Animated video
	Radioactive pollution – cause of radioactive materials – control measures.	2	BB/PPT
IV	Glass Industry		
	Principal- raw materials used in manufacture of Glass - Effect of different constituents of Glass	2	BB/PPT
	Special types of Glass - Silica Glass - Borosilicate Glass - Soda lime Glass - Coloured Glass.	2	BB/PPT
	Safety Glass - Glass wool - Properties of Glass	2	BB
V	Safety measures in Industries		
	General safety and operational rules – Safe handling of chemicals: Gathering general Information on chemicals.	2	BB/PPT
	Handling and transportation of chemicals-Chemical storage- Fire extinguishers: introduction-classes of fire	2	BB/PPT
	Types of fire extinguishers: CO ₂ extinguisher, powder and dry chemical extinguisher.	2	BB/PPT
	Total Hours	30	

Course outcome: After complete successful of this course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO1	Elaborate the importance of fertilizers and its types.	Up to K2
CLO2	Explain the Ingredients and preparation of a dye and preparative methods of	Up to K2
CLO3	Discuss the control measures of water and radioactive pollution.	Up to K2
CLO4	Elaborate the different types of glass and its types.	Up to K2
CLO5	Outline the safety measures in industries.	Up to K2

PLO and CLO Mapping

	PLO-1	PLO -2	PLO -3	PLO -4	PLO-5
CLO-1	1	2	1	2	2
CLO-2	1	1	1	1	1
CLO-3	1	3	1	3	2
CLO-4	1	1	1	1	2
CLO-5	1	1	1	1	1

3-Advance application;

2-Intermediate level;

1-Basic level

Components of Formative Assessment	Marks	K level
Internal Test	10	As per below table
Assignment	5	K2
Quiz	5	K2
Seminar	5	K2
Total	25	

Learning Outcome Based Education(LOBE) & Assessment

Formative Examination I &II-Blue Print

Articulation Mapping - K Levels with Course Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K 2	2	K1, K1	2 (K2 &K2)	1(K1)
2	CLO y	Up to K 2	3	K1, K1,K1	2 (K2 &K2)	2(K1, K1)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

**Learning Outcome Based Education (LOBE) & Assessment Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)**

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)
			Short answers		Short Answers		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K 2	1	K1	1	2(K2&K2)	K1
2	CLO 2	Up to K 2	1	K1	1	2(K2&K2)	K1
3	CLO 3	Up to K 2	1	K1	1	2(K2&K2)	K1
4	CLO 4	Up to K 2	1	K1	1	2(K2&K2)	K1
5	CLO 5	Up to K 2	1	K1	1	2(K2&K2)	K1
No. of Questions to be asked			5		5		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

Distribution of Section-wise marks with K-levels

K Levels	Section A (No Choice)	Section B (Either / or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	10		50	60	46	46
K2	-	70		70	54	54
Total marks	10	70	50	130	100	100

Name of the course Designer

- Dr. R. Sathya

Department of Botany

Revised Curriculum

(Choice Based Credit system with Outcome Based Education)

Academic Year 2020-2021 onwards

III and IV semester (B.Sc. Botany)

I and II semester (M.Sc. Botany)

Diploma, PG Diploma and Certificate Courses

The Madura College (Autonomous); Madurai-11
Department of Botany

Vision

Producing Botany students as ambassadors of sustainable development in all spheres of human activity and leaving the earth to the successive generations as intact as possible.

Mission

- To sensitize the Botany students to the classification, structure, physiology, ecology, genetics and economic importance of plants
- To inculcate the students with an environment that fosters the development of appropriate scientific vocabulary, reasoning skills and effective oral and written communication ability for students
- To create holistic understanding of the allied subjects through interdisciplinary learning.

Programme Outcome for B.Sc., Graduates:

At the end of the programme the graduates will be able to

PO1	Integrate learned skills and knowledge derived from the study of the science and other related disciplines, acquiring the necessary depth and breadth required for a transdisciplinary perspective.
PO2	Demonstrate proficiency in using disciplinary-appropriate methods for research, critical analysis or creative work and provide scientific solutions to the problems of the society.
PO3	Communicate conclusions, interpretations and implications clearly, concisely and effectively, both orally and in writing for different types of audience.
PO4	Articulate and apply values, principles, ethics and ideals derived from an integrated understanding of their areas of study and demonstrate awareness of current societal and environmental challenges and ways of mitigating them.
PO5	Use modern tools, resources and software and be abreast with the emerging trends in their disciplinary area and practice life long learning.

Programme Educational Objectives (PEOs) (aligned with Graduate Attributes)-Bachelor of Science (B.Sc.,)

The students graduating with the B.Sc. Botany degree should be able to

- PEO-1 Apply the knowledge of habitual, functional and species diversity of plants that sustain other life forms and thereby ecosystems of various kinds.
- PEO-2 Able to formulate and mitigate the growing perils like habitual destruction, urban sprawling, pollution and eventually the global warming.
- PEO-3 Can spread the knowledge on ecological and economic importance of plants across different age groups from varieties of community to have egalitarian social edifice.
- PEO-4 Able to critically realize the role of plants in biogeochemical cycle and the human interference precluding their process.
- PEO-5 Willing to utilize and protect crops and the plant resources from forest with ethical adherence.

- PEO-6 Applying the knowledge on various biological interactions between plants and other life forms with life time situations.
- PEO-7 Students are able to be more resilient, empathetic and harmonious.
- PEO-8 Students can aim for higher studies, crack competitive examinations, gaining better placement, skillfully lead family by imparting moral values.
- PEO-9 Able to up bring the yield and quality of products by adopting conventional plant breeding methods and recent biotechnological advancements.

Programme Specific Outcomes (PSOs) at the end of the programme, the students will be able to

PSOs	PSO Statement	Graduate Attributes
PSO-1	Identify major groups of plants and compare the characteristics of lower and higher plants.	a. Knowledge in core competency
PSO-2	To use evidence based comparative botany approach to explain the evolution of organisms and understand the genetic diversity.	a. Knowledge in core competency
PSO-3	To explain various plant processes and functions, metabolism, concepts of genes and genome and how organisms function at the cell, tissue and organ levels.	b. Problem analysis
PSO-4	Understand adaptations, development and behavior of different forms of life.	a. Knowledge in core competency
PSO-5	Understand the networked- life on the earth and tracing the energy pyramids through nutrient flow.	b. Problem analysis
PSO-6	Demonstrate the experimental techniques and methods of their area of specialization in Botany.	k. Life-long learning
PSO-7	Comprehend the fundamental concepts and their applications of scientific principles are expected at the end of this course. Students will become critical thinker and acquire problem-solving capabilities.	a. Knowledge in core competency
PSO- 8	Strengthen their analytical, digital skills and integrate the fundamental concepts with modern tools.	b. Problem analysis e. Ethics i. Communication
PSO-9	Get avenues to become ecologists, biochemists, mushroom producers, molecular biologists, taxonomists, nursery managers, environmentalists, herbal product manufactures and genetics and also to sensitize students for inter and multidisciplinary research.	k. Life-long learning

EVALUATION (Theory)

Internal (Formative)	: 25 Marks
External (Summative)	: 75 Marks
Total	: 100 Marks

Continuous Internal Assessment: (Major & Allied: 25 marks)

S. No.	Components	Marks
1.	Test (Average of two tests conducted for 40 marks and converted into 10 marks)	10
2.	Assignment	05
3.	Quiz/Documentation/ Case lets/ICT based Assignment/ Mini Project	05
4.	Attendance	05
Total		25

Question Paper pattern for theory external examination (Major & Allied: 75 marks)

S.No.	Section	Marks
1.	A. Multiple Choice Question (10x1)	10
2.	B. Short Answer type (5x2)	10
3.	C. Either/or Type (5x5)	25
4.	D. open Choice Type (3 out of 5 questions, 3x10)	30
Total		75

EVALUATION (Practical)

Internal (Formative) : 40 Marks
 External (Summative) : 60 Marks
 Total : 100 Marks

Question Paper pattern for internal /model practical examination (Major & Allied: 40 marks)

S. No.	Components	Marks
1.	Major question (sections/dissections/experiments)	15
2.	Minor Question (sections/dissections/experiments)	08
3.	Spotters	12
4.	Record	05
Total		40

Question Paper pattern for external practical examination (Major & Allied: 60 marks)

S. No.	Components	Marks
1.	Major question (sections/dissections/experiments)	20
2.	Minor Question (sections/dissections/experiments)	15
3.	Spotters	20
4.	Record	05
Total		60

II. B.Sc., BOTANY

Third Semester

Semester wise Mapping of Courses with Programme Specific Outcomes (PSOs)

Programme Specific Outcomes	Herbal Botany (NME-1)	Horticulture/ Biofertilizer (SBE-1)	Allied Zoology	Allied Practical-I	Major Core-5 (Morphology and Taxonomy of Angiosperms)	Major Practical-III
PSO-1	2	2	1	3	3	1
PSO-2	3	2	2	3	3	1
PSO-3	3	3	3	3	2	2
PSO-4	2	-	-	3	2	3
PSO-5	3	3	2	2	3	2
PSO-6	-	-	-	-	3	
PSO-7	-	2	1	2	-	3
PSO-8	-	-	-	-	-	-
PSO-9	-	-	-	-	-	2

3- Advance application; 2- Intermediate level; 1- Basic level

Fourth Semester

Semester wise Mapping of Courses with Programme Specific Outcomes (PSOs)

Programme Specific Outcomes	Plants and Human Welfare (NME-1)	Biological techniques/ Organic Farming (SBE-1)	Allied Zoology	Allied Practical-II	Major Core-6 (Cell Biology and Biochemistry)	Major Practical-IV
PSO-1	1	1	2	3	3	1
PSO-2	1	2	2	3	3	1
PSO-3	3	-	3	3	2	-
PSO-4	2	2	-	3	2	-
PSO-5	3	3	1	3	3	3
PSO-6	3	-	-	-	3	
PSO-7	-	2	1	2	3	2
PSO-8	-	3	-	-	1	-
PSO-9	-	-	-	2	2	3

3- Advance application; 2- Intermediate level; 1- Basic level

THE MADURA COLLEGE (AUTONOMOUS); MADURAI - 11
DEPARTMENT OF BOTANY
Curriculum Structure for B.Sc. Botany (Major) to be implemented from 2020-2021

Sem	Course	Subject Code	Course Title	Hours / Week	Credits
I	Part I: Language – I	20U1TLA1	Tamil - I / Sanskrit - I / Hindi – I	6	3
	Part II: English – I	20U1NEN1	English – I	6	3
	VE & PE	20U1VNE1	Value Education and Professional Ethics	3	3
	Part III: Allied – I	20U1CAC1	Paper I - Chemistry	4	4
	Allied Practical	20U2CAP1	Allied Practical-I	2	1
	Major Core 1	20U1BMC1	Algae, Fungi and Lichens	3	3
	Major Core 2	20U1BMC2	Bryophytes and Pteridophytes	3	3
	Major Core Practical	20U2BMP1	Major Practical – I	3	2
	Total			30	22
II	Part I: Language – II	20U2TLA2	Tamil - II / Sanskrit - II / Hindi – II	6	3
	Part II: English – II	20U2NEN2	English – II	6	3
	E & GS	20U2EVS1	Environment & Gender Studies	3	3
	Part III: Allied – I	20U2CAC2	Paper II- Chemistry	4	4
	Allied Practical	20U2CAP2	Allied Practical-II	2	1
	Major Core 3	20U2BMC3	Gymnosperms and Palaeobotany	3	3
	Major Core 4	20U2BMC4	Plant Anatomy and Embryology	3	3
	Major Core Practical	20U2BMP1	Major Practical – II	3	2
	Extension (AEEP)				1
	Total			30	23
III	Part I: Language – III	20U3TLA3	Tamil - III / Sanskrit - III / Hindi – III	6	3
	Part II: English – III	20U3NEN3	English – III	6	3
	Non Major Elective (NME - I)	20U3BNM1	Herbal Botany	2	2
	Skill Based Elective (SBE - I)	20U3BSM1	Horticulture/ Biofertilizer	2	2
	Part III: Allied – II	20U3ZAC1	Paper I – Zoology	4	4
	Allied Practical	20U4ZAP1	Allied Practical-I	2	1
	Major Core 5	20U3BMC5	Morphology and Taxonomy of Angiosperms	5	5
	Major Core Practical	20U4BMP3	Major Practical – III	3	2
	Total			30	22

IV	Part I: Language – IV	20U4TLA4	Tamil - IV / Sanskrit - IV / Hindi – IV	6	3
	Part II: English – IV	20U4NEN4	English – IV	6	3
	Non Major Elective (NME - II)	20U4BNM2	Plants and Human Welfare	2	2
	Skill Based Elective (SBE - II)	20U4BSM2	Biological Techniques/ Organic farming	2	2
	Part III: Allied – II	20U4ZAC2	Paper II- Zoology	4	4
	Allied Practical	20U4ZAP2	Allied Practical-II	2	1
	Major Core 6	20U4BMC6	Cell Biology and Biochemistry	5	5
	Major Core Practical	20U4BMP4	Major Practical – IV	3	2
	Total			30	22
V	Skill Based Elective (SBE - III)	20U5BSM3	Mushroom Cultivation	2	2
	Major Core 7	20U5BMC7	Plant Physiology *	5	5
	Major Core 8	20U5BMC8	Genetics and Biostatistics #	5	5
	Major Core 9	20U5BMC9	Ecology and Biodiversity #	5	5
	Major Core Practical	20U6BMP5	Major Practical – V	3	2
	Major Core Practical	20U6BMP6	Major Practical – VI	3	2
	Major Elective I	20U5BME1	Molecular Biology	4	3
	Major Elective II	20U5BME2	Plant Breeding and Evolution	3	2
	Total			30	26
VI	Skill Based Elective (SBE - IV)	20U6BSM4	Environmental Impact Assessment	2	2
	Major Core 10	20U6BMC10	Microbiology and Plant Pathology *	5	5
	Major Core 11	20U6BMC11	Biotechnology #	5	5
	Major Core 12	20U6BMC12	Genomics & Bioinformatics #	5	5
	Major Core Practical	20U6BMP7	Major Practical – VII	3	2
	Major Core Practical	20U6BMP8	Major Practical – VIII	3	2
	Major Elective III	20U6BME3	Plant Genetic Engineering and Environmental Biotechnology	4	3
	Major Elective IV	20U6BME4	Ethnobotany & Pharmacognosy	3	2
	Total			30	26

*Major Core Practical- V & VII; # Major Core Practical- VI & VIII

DEPARTMENT OF BOTANY				CLASS: II B.Sc/B.Com				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	NME- I	20U3BNM1	Herbal Botany	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: This course will enable the students

1. To provide the knowledge on diversity and importance of indigenous medicinal plants and their role in traditional medicinal systems.
2. To enrich the knowledge on identification, medicinal properties and their mechanism of action of locally available medicinal plants.
3. To analyze the chemical principles and their drug values, conservation and utilization of endangered medicinal plants.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Herbal medicines: History and scope – Diversity of Indian Medicinal Plants - role of medicinal plants in traditional systems of medicines; Demands of Indian Medicinal herbs for drug industries and exports.	1	Up to K2	6
II	Pharmacognosy: Systematic position, morphology, chemical principles, medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Gooseberry and Black pepper.	2	Up to K2	6
III	Phytochemistry: Active principles and methods of their testing - identification and utilization of the medicinal herbs; <i>Catharanthus roseus</i> (antiproliferative), <i>Withaniasomnifera</i> (nervine tonic), <i>Andrographis paniculata</i> (Hepatoprotective) and <i>Centella asiatica</i> (memory booster).	3	Up to K2	6
IV	Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).	4	Up to K2	6
V	Herbal Drugs: Conservation needs of endangered and endemic medicinal plants – <i>Andrographis paniculata</i> , <i>Gloriosa superba</i> , and <i>Withaniasomnifera</i> . Modern methods of extraction of phytodrugs – <i>in vitro</i> production of andrographolides, colchicine and withanolides.	5	Up to K2	6

Books for the study

1. Chopra, R.N., Nayar, S.L and Chopra, I.C. (1956) Glossary of Indian medicinal plants, C.S.I.R., New Delhi.
2. Kanny, Lall, Dey and Raj Bahadur, (1984) The indigenous drugs of India, International Book - Distributors.
3. Agnes A, (1999) Herbal plants and Drugs Mangal Deep Publications. New Delhi.
4. Sivarajan, V.V. and Balachandran, I. (1994) Ayurvedic drugs and their plant source. Oxford IBH publishing Co. New Delhi.
5. Miller, Light and Miller, Bryan, (1998) Ayurveda and Aromatherapy. Banarsidass, New Delhi.

Books for References

1. Anne, G. (2000) Principles of Ayurveda, Thomsons, London.
2. Kokate, C.K. et al. (1999) Pharmacognosy, NiraliPrakashan, New Delhi.
3. Trivedi, P. C. (2006) Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
4. Sharma, R. (2004) Agro techniques of medicinal plants, Daya publishing House, New Delhi,
5. Farooqi, A.A. and Sreeramu. B.S. (2001) Cultivation of medicinal and aromatic crops, University press India.
6. Purohit, S.S., and Vyas. S.P. (2008) Medicinal plant cultivation”, scientific Approach, Agrobios, India, 2006.

Web Resources

1. https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5847565/>
3. <https://cb.imsc.res.in/imppat/home>
4. <http://www.ccras.nic.in/content/medicinal-plants>
5. <http://envis.frhlht.org/implad>

Rationale for Nature of the Course

This course will help the students to develop their knowledge on diversity and importance of indigenous medicinal plants and their role in traditional medicinal systems.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The concepts learned by the students related to medicinal properties and their mechanism of action help them to gain a position in pharmaceutical and its related industries.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. S. Karuppusamy, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	CLO Statement	Knowledge level
CLO-1	Understand the importance Indian medicinal plants for traditional medicines and commercial values.	Up to K2
CLO-2	Familiarize the knowledge on identification, properties and uses of local medicinal plants	Up to K2
CLO-3	Analyze the utilization and their medicinal values of common medicinal plants	Up to K2
CLO-4	Evaluate the scientific screening of medicinal plants for its purity of drugs and chemical principles	Up to K2
CLO-5	Synthesize the conservation methods of endangered medicinal plants and also modern extraction methods of Phyto drugs	Up to K2

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	2	3	3	3	3	3	2	2	2
CLO-2	3	3	2	3	3	2	1	1	2
CLO-3	3	3	3	3	2	2	2	1	1
CLO-4	2	2	3	3	2	3	3	2	1
CLO-5	3	3	2	2	3	2	2	1	1

3 – Advance application; 2 – Intermediate level; 1 – Basic level

Mapping Programme Outcomes with Course Learning Outcomes:

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	3	3	3	2
CLO-2	3	3	2	3	2
CLO-3	3	3	1	-	2
CLO-4	2	1	2	1	-
CLO-5	3	3	3	2	1

3 – Advance application; 2 – Intermediate level; 1 – Basic level

Lesson Plan

Unit	Description	Hours	Mode
I	History and scope of herbal medicines	1	Discussion
	Diversity of Indian Medicinal Plants	2	Power Point
	Role of medicinal plants in traditional medicine	2	Black Board
	Values of medicinal herbs in industries and exports	1	Power Point
II	Systematic position of selected medicinal plants	1	Discussion
	Chemical principles and medicinal uses of Tulsi and Ginger	2	Power point
	Medicinal properties of Fenu Greek	1	Black Board
	Medicinal values of Indian Goose berry and Black Pepper	2	Discussion
III	Methods of testing active principles in medicinal plants	2	Black board
	Identification of medicinal plants for utilization	1	Discussion
	Discussion on <i>Catharanthus</i> and <i>Withania</i>	1	Discussion
	Discussion on <i>Andrographis</i> and <i>Centella</i>	2	Discussion
IV	Drug adulteration	1	Quiz
	Drug evaluation – Biological methods	2	Black board
	Phytochemical screening of secondary metabolites	2	Power Point
	Types of secondary metabolites in medicinal herbs	1	Discussion
V	Conservation needs of endangered medicinal plants	1	Discussion
	Modern extraction of medicinal drugs	1	Black Board
	<i>In vitro</i> production of Andrographolides and colchicines	2	Power Point
	<i>In vitro</i> extraction of Withanolides.	2	Assignment
Total		30	

Blue Print – Model for Internal Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section B (Either/ Choice)	Section C (Open Choice)	Total
			Short Answer				
			No. of Questions	K - Level			
1	CLO x	Up to K 2	2	K1& K1	2(K2&K2)	1 (K1)	
2	CLO y	Up to K 2	1	K1	2(K2&K2)	2 (K1& K1)	
No. of Question to be asked			3		4	3	14
No. of Question to be answered			2		2	2	10
Mark for each question			2		7	10	
Total Marks for each section			6		14	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	30	40	66.67	100
K2	-	20	-	20	33.33	
Total Marks	10	20	30	60	100.00	100%

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section B (Either/ Choice)	Section C (Open Choice)
			Short Answer			
			No. of Questions	K – Level		
1	CLO 1	Up to K 2	1	K1	2(K2&K2)	1 (K1)
2	CLO 2	Up to K 2	1	K1	2(K2&K2)	1 (K1)
3	CLO 3	Up to K 2	1	K1	2(K2&K2)	1 (K1)
4	CLO 4	Up to K 2	1	K1	2(K2&K2)	1 (K1)
5	CLO 5	Up to K 2	1	K1	2(K2&K2)	1 (K1)
No. of Question to be asked			5		10	5
No. of Question to be answered			5		5	3
Mark for each question			2		7	10
Total Marks for each section			10		35	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	20	-	50	70	58.33	100
K2	-	50	-	50	41.67	
Total Marks	20	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	SBE- 1	20U3BSM1	Horticulture	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives: This course will enable the students

1. To extensively use the space for gardening and improve green cover.
2. To develop skills on usage of horticultural tools.
3. To gain knowledge on horticultural practices and value added products.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Divisions and types: Importance and scope of horticulture. A brief account on divisions of horticulture – pomology, olericulture, floriculture and ornamental horticulture. Types of gardens – formal, informal, landscape and terrace.	1	Up to K4	6
II	Plant propagation methods: Cutting (Drumstick), Budding (Mango), Grafting (Sapota), Layering: Air (Pomegranate) and ground (<i>Nerium</i>)	2	Up to K4	6
III	After care of plants: Weeding, top dressing - methods of pruning and topiary. Lawn making: types of lawn grasses and maintenance. Plants suitable for hedges.	3	Up to K4	6
IV	Floriculture and value additions: Floriculture- cultivation of commercial flowers – rose and jasmine. Flower arrangement – Ikebana. Value addition: Tomato – Jam and ketchup preparations.	4	Up to K4	6
V	Ornamental gardens: Green house, Landscape, terrarium, water garden, rockery plants, Bonsai techniques, hydroponics, arboratum, bambosetum and archidorium.	5	Up to K4	6

Books for Study

1. Manibhushan Rao, K, Text book of Horticulture, 1991, Mac Millan India Ltd., New Delhi.
2. Kumar, N., Introduction to Horticulture, 2010, Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.
3. Randhava, G.S, 1973 – Ornamental horticultural in India Today and Tomorrow Printers and Publishers, New Delhi.

Books for References

1. Yawalkar, K.S. 1961 – Vegetables crops of India – Agri, Horticultural Publishing House, Nagpur.
2. Hand Book of Horticulture, Dr. Chadha – ICAR Publications. 2001.
3. Fundamentals of Horticulture – Edmund Senn Andrews 1994 Tata McGraw Hill Publishing Co., Ltd., Delhi.

Web Resources

1. <https://www.horticulturepractices.com>
2. <https://www.horti.maintenance.com>
3. <https://www.horti.tools.com>
- 4.

Rationale for Nature of the Course

This course focuses on handling different tools used in horticulture and develops various propagation methods for producing new varieties.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The skills taught in the course will help them in choosing their own career focusing on self employment and they will become an entrepreneur.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Prof. V. Meenakshi Sundaram, Assistant Professor

Course Learning Outcome: On successful completion of the course the students will be able to

CLOs	CLO Statement	Knowledge Level
CLO -1	Identify and classify the major divisions of horticulture and demonstrate the various types of gardens	Up to K4
CLO -2	Demonstrate and apply the plant propagation methods to multiply stocks of vegetable, fruit and ornamental crops	Up to K4
CLO -3	Identify the appropriate garden maintenance procedure (after care of plants) and apply the same suitably in different seasons	Up to K4
CLO -4	Recall and demonstrate the techniques in floriculture and value addition to the yield	Up to K4
CLO -5	Discuss, illustrate and design ornamental gardens for modern society	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcome

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	3	-	1	2	-	3	3	3	3
CLO-2	3	-	1	2	-	3	3	3	3
CLO-3	3	-	1	2	-	3	3	3	3
CLO-4	3	-	1	2	-	3	3	3	3
CLO-5	3	-	1	2	-	3	3	3	3

Mapping Programme Outcomes with Course Learning Outcome

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	2	2	2	3
CLO-2	3	2	2	2	3
CLO-3	3	2	2	2	3
CLO-4	3	2	2	2	3
CLO-5	3	2	2	3	3

3-Advance application, 2- Intermediate level, 1- Basic level

Lesson Plan

Unit	Description	Hours	Mode
I	a) Importance and scope of horticulture	1	Black Board
	b) Major divisions of horticulture – brief account	1	PPT
	c) Types of gardens – formal and informal	2	Quiz
	d) Types of gardens – landscape and terrace	1	PPT
	e) Divisions and types	1	LMS
II	a) Cutting (Drumstick)	1	PPT
	b) Budding (Mango)	1	Black Board
	c) Grafting (Sapota)	1	Black Board
	d) Layering: Air (Pomegranate)	1	PPT
	e) ground (Nerium)	2	Power Point
III	a) Weeding	1	Black Board
	b) top dressing - methods of pruning and topiary	2	PPT
	c) Lawn making: types of lawn grasses and maintenance	2	PPT
	d) Plants suitable for hedges	1	Black Board & Group discussion
IV	a) Floriculture: cultivation of commercial flowers – rose	1	PPT
	b) jasmine	1	PPT
	c) Flower arrangement – Ikebana	1	Assignment
	d) Value addition: Tomato – Jam and ketchup	3	Black Board
V	a) Green house	1	PPT
	b) Landscape and terrarium water garden and rockery plants	1	Virtual lab
	c) Bonsai techniques	1	Virtual lab
	d) Hydroponics	1	Group discussion and
	e) Arboratum, bambosetum & archidorium	2	LMS
Total		30	

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K – Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K1	2(K2&K2)	1 (K3)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K4&K4)	1 (K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K4	2	K1&K2	2	K1& K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K4	2	K1&K2	1	K2	2(K3&K3)	2 (K3& K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-		10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	SBE- 1	20U3BSM1	Biofertilizers	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives: This course will enable the students

1. To understand the basis of biofertilizers and their cultivation.
2. To acquire knowledge of role of microbes in agriculture.
3. To study about mycorrhiza and their isolation and production.
4. To gain knowledge on the vermicompost techniques.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Biofertilizers: Definition, Scope and importance - General account of biofertilizers. Classification of biofertilizers- Cyanobacteria (BGA), Symbiotic, Nitrogen fixing, Phosphate solubilizers. Liquid fertilizers- sea weeds.	1	Up to K4	6
II	Nitrogen fixers: Symbiotic nitrogen fixers: <i>Rhizobium</i> - characteristics, type, isolation, mass production and field application. Non-Symbiotic nitrogen fixers: free-living <i>Azotobacter</i> - characteristics, type, isolation, mass production and field application.	2	Up to K4	6
III	Nitrogen fixation: <i>Nostoc</i> - morphology, mass production, Utilization and field application. <i>Azolla</i> and <i>Anabaena</i> ; association nitrogen fixation- factors affecting BGA algae growth - <i>Azolla</i> in rice cultivation.	3	Up to K4	6
IV	Mycorrhizal Biofertilizers: Importance of <i>mycorrhizal</i> inoculums, type of <i>mycorrhizae</i> and associated plants, mass inoculums production of VAM, field application of ectomycorrhizae and VAM.	4	Up to K4	6
V	Vermicomposting: Biological characteristics and types, Preparation of vermibed, Procedure for indoor vermicomposting and Economic importance of vermicompost- Preparation and importance of panchagavyaas- Biofertilizers- storage, Self- quality controlled and marketing..	5	Up to K4	6

Books for Study

1. Dubey R.C.,2005. A Text book of Biotechnology S.Chand and Co. New Delhi.
2. Subha Rao N.S 2000. Soil microbiology, Oxford and IBH Publishers, New Delhi.
3. Kumaresan V.2005 Biotechnology,Saras publication. New Delhi.

4. Sathe T.V 2004 Vermicultural and organic farming, Dayapublication.New Delhi.
5. John Jothi Prakash E 2004. Outlines of plant Biotechnology, Emkay publication. NewDelhi.

Books for References

1. Kanniyar, S. (2003). Biotechnology of Biofertilizers CHIPS,Texas.
2. Mahendra, K.Rai. (2005). Hand book of Microbial biofertilizers, The Haworth press. Inc. New Delhi.
3. Gupta P.K (1999). Soil plant water and fertilizer analysis. Agro Botanica. Bikaner.
4. Rai M.K (2006). Hand book of Microbial Biofertilizers. Food products Press, New York.

Web References

1. <https://en.wikipedia.org/wiki/Biofertilizer#References>
2. <http://www.amm-mcrc.org/publications/biofertilizers.pdf>
3. <https://en.wikipedia.org/wiki/Vermicompost>

Rationale for Nature of the Course

This course focuses on eco-friendly approach by understanding the concepts of bio-fertilizers and their role in field application.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The skills learned by the students will help them to prepare organic manure on their own by utilizing the degradable household wastes and there by equip themselves for self-employability.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. M. Karpaga Jothi, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	CO Statement	Knowledge level
CLO- I	Understand the various concepts of biofertilizers.	Up to K4
CLO-2	Explain the method of crop field application.	Up to K4
CLO- 3	Knowledge of the principles and practices of organic agriculture and its role sustainable crop production.	Up to K4
CLO- 4	Inculcate biofertilizer preparation and get a train in formulating biofertilizer.	Up to K4
CLO-5	Explore knowledge of the eco-friendly approach in farming.	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcome:

	PSO-1	PSO-2	PSO--3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	2	2	2	3	3	3	2	3	3
CLO-2	2	2	2	2	2	3	2	3	3
CLO-3	2	2	3	3	2	2	2	3	3
CLO-4	2	2	2	2	2	3	2	3	3
CLO-5	3	2	2	2	3	3	2	3	3

3-Advance application; 2- Intermediate level; 1- Basic level

Mapping Programme Outcomes with Course Learning Outcome:

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	3	1	2	3
CLO-2	1	2	1	2	3
CLO-3	1	2	-	1	3
CLO-4	2	3	1	2	3
CLO-5	2	3	1	2	3

3-Advance application; 2- Intermediate level; 1- Basic level

Lesson Plan

Unit	Description	Staff name	Hours	Mode
I	a) Definition, Scope and importance of biofertilizers.	-	2	Discussion
	b) Classification of biofertilizers.	-	2	Seminar
	c) Method of commercial cultivation of sea weeds.	-	2	Black Board
II	a) Characteristics of <i>Rhizobium</i>	-	2	Black Board
	b) Mass production and Field application <i>Rhizobium</i>	-	2	Discussion
	c) Characteristics of <i>Azotobacter</i> .	-	1	Black Board
	d) Mass production and Field application of <i>Azotobacter</i> .	-	1	Discussion
III	a) Mass production of <i>Nostoc</i>	-	2	Power point
	b) Utilization and field application of <i>Azolla</i> and <i>Anabaena</i> .	-	2	Discussion
	c) Factors affecting BGA algae growth	-	2	Black Board
IV	a) Importance of <i>mycorrhizal</i> inoculums.	-	1	Black board
	b) Type of <i>mycorrhizae</i> .	-	1	Seminar
	c) Mass inoculums production of VAM,	-	2	Power point
	d) Field application of Ectomycorrhizae and VAM.	-	2	Discussion
V	a) Biological characteristics of vermicompost.	-	1	Black board
	b) Preparation of vermibed.	-	1	Demonstration
	c) Procedure for indoor vermicomposting.	-	1	Demonstration
	d) Economic importance of vermicompost.	-	1	Discussion
	e) Preparation of panchagavyaas.	-	1	Demonstration
	f) Biofertilizers- Self- quality controlled and marketing.	-	1	Seminar
Total			30	

Blue Print – Model for External Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K – Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K1	2(K2&K2)	1 (K3)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K4&K4)	1 (K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K 4	2	K1&K2	2	K1&K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3&K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-		10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core 5	20U3BMC5	Morphology and Taxonomy of Angiosperms	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: This course will enable the students

1. To understand the morphology of plants and various systems of classification.
2. To recognize the members of angiosperm families by identifying their diagnostic features and learn their economic importance.
3. To study the phylogenetic aspects of plant taxonomy for understanding the inter-relationship among plants.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Plant Morphology: Types of root and its modifications - Stem: Types and their modifications - Leaves: Phyllotaxy, Types and its modifications - Inflorescence: Racemose, Cymose and Special types - Flower: Technical Description of Floral Parts, Floral Diagram and Floral Formula - Fruits: Simple (Fleshy and Dry), Aggregate and Composite.	1	Up to K4	15
II	Plant Taxonomy: Objectives and Goals - Various Hierarchical Categories - Contribution to Indian Botany by J.D. Hooker and J.S. Gamble - Systems of Classification with their Merits and Demerits: Artificial - Linnaeus; Natural - Bentham and Hooker; Modern - Cronquist; Outline of APG IV (2016).	2	Up to K4	15
III	Nomenclature: Key Preparation - Nomenclature: Binomial system, ICN - Principles and Rules, Typification and Various nyms - Herbarium: Preparation, Maintenance and Significance, Important Indian and World herbaria - Botanical Survey of India - Brief Outline on Modern Methods of Plant Identification: Chemotaxonomy, Numerical Taxonomy, Serotaxonomy and Molecular Techniques.	3	Up to K4	15
IV	Selected Families: Detailed studies on the vegetative, reproductive characters and economic importance of the following families: Nymphaeaceae, Brassicaceae, Malvaceae, Rutaceae, Meliaceae, Myrtaceae, Cucurbitaceae, Rubiaceae and Asteraceae.	4	Up to K4	15

V	Selected Families: Detailed studies on the vegetative, reproductive characters and economic importance of the following families: Sapotaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Aristolochiaceae, Euphorbiaceae, Orchidaceae, Commelinaceae and Poaceae.	5	Up to K4	15

Books for Study

1. Sharma, O.P., Plant Taxonomy, 2009, Tata McGraw Hill Education Private Limited, New Delhi.
2. Pullaiah, T. and Karuppusamy, S., Taxonomy of Angiosperms, 4th Ed, 2018, Regency Publication, New Delhi.
3. Lawrence, G.H.M., Taxonomy of Vascular Plants, 2012, Scientific Publishers. India.

Books for References

1. Naik, V.K., Principles of Plant Taxonomy, IBH Oxford.
2. Verma, B.K., Introduction to Taxonomy of Angiosperms, 2011, PHI Learning Pvt. Ltd., New Delhi.
3. Rendle, R.B., The Classification of Flowering Plants, Vols. I, II & III, Oxford-Clarendon.
4. Gamble, J.S., Flora of Presidency of Madras, Vols. I, II & III, 1986, Bishen Singh Mahendra Pal Singh, Dehra Dun.
5. Subrahmanyam, N.S., Modern Plant Taxonomy, 2011, Vikash Publishing House, New Delhi.
6. Singh, G, Plant Systematics - Theory and Practice, 2005, Oxford & IBH, New Delhi.
7. Pandey, B.P., Taxonomy of Angiosperms, 2017, S. Chand Publication, New Delhi.
8. Naik, V.N., Taxonomy of Angiosperms, 2000, Tata McGraw Hill Publishing Company Limited, New Delhi.
9. Singh, V. and Jain, D.K., Taxonomy of Angiosperms, 1981, Rastogi Publications.
10. Gurcharan Singh, Plant Systematics, 2nd Ed., 2005, Scientific Publications, Jodhpur.

Web Resources

1. <http://www.theplantlist.org/>
2. <https://www.biologydiscussion.com/>
3. <https://www.britannica.com/search?query=taxonomy+of+angiosperms>
4. <https://www.easybiologyclass.com/topic-botany/>

Rationale for Nature of the Course

The course will enable the students to acquire knowledge on morphology of plants, various systems of classification, plant identification, economically useful plant parts and their uses.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge acquired by the students will be used to identify plants based on morphological observations. It will help them to attain a position after higher studies in reputed institutions like Botanical survey of India and its related organizations.

Pedagogy

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Images, You Tube Videos, Google classroom & LMS (CANVAS).

Course Designer: Dr. N. Janakiraman, Assistant Professor

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply and analyse

CLOs	CLO Statement	Knowledge Level
CLO 1	The vegetative and reproductive morphology of angiosperms	Up to K4
CLO 2	The artificial, natural and modern systems of classifications	Up to K4
CLO 3	The ICN principles and modern methods of plant identification	Up to K4
CLO 4	The morphological description and illustration of selected dicotyledonous families	Up to K4
CLO 5	The morphological description and illustration of selected dicotyledonous and monocotyledonous families	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	2	3	2	3	-	2	-	3	2
CLO2	3	1	2	1	2	-	1	1	2
CLO3	3	2	3	2	3	-	2	2	1
CLO4	3	3	1	-	1	2	-	2	3
CLO5	3	3	1	-	2	2	1	2	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes:

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	2	1	1
CLO2	3	1	3	2	2
CLO3	2	2	2	3	3
CLO4	3	3	3	2	2
CLO5	1	2	1	2	2

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Lecture Schedule

Unit	Description	Hours	Mode
I	Plant Morphology – Introduction	1	Chalk and Talk, Power Point, Group Discussion, Seminar, Quiz, Virtual Images, You Tube Videos, Google classroom & LMS (CANVAS).
	Types of root and its modifications	2	
	Stem: Types and their modifications	2	
	Leaves: Phyllotaxy, Types and its modifications	2	
	Inflorescence: Racemose, Cymose and Special types	2	
	Flower: Technical Description of Floral Parts	2	
	Floral Diagram and Floral Formula	2	
	Fruits: Simple (Fleshy and Dry), Aggregate and Composite	2	
II	Plant Taxonomy - Objectives and Goals	1	Chalk and Talk, Power Point, Group Discussion, Seminar, Quiz, Virtual Images, You Tube Videos, Google classroom & LMS (CANVAS).
	Various Hierarchical Categories in Taxonomy	1	
	Contribution to Indian Botany by J.D. Hooker	1	
	Contribution to Indian Botany by J.S. Gamble	1	
	Artificial Classification – Linnaeus	2	
	Natural Classification - Bentham and Hooker	4	
	Modern Classification – Cronquist	2	
	Outline of APG IV Classification (2016)	3	
III	Taxonomic Key Preparation	2	Chalk and Talk, Power Point, Group Discussion, Seminar, Quiz, Virtual Images, You Tube Videos, Google classroom & LMS (CANVAS).
	Nomenclature: Binomial system	1	
	ICN - Principles and Rules, Typification and Various nyms	3	
	Herbarium: Preparation, Maintenance and Significance	2	
	Important Indian and World herbaria	1	
	Botanical Survey of India	1	
	Brief Outline on Modern Methods of Plant Identification	1	
	Chemotaxonomy and Numerical Taxonomy	2	
	Serotaxonomy and Molecular Techniques	2	
IV	Nymphaeaceae, Brassicaceae and Malvaceae	5	Chalk and Talk, Power Point, Virtual images.
	Rutaceae, Meliaceae and Myrtaceae	5	
	Cucurbitaceae, Rubiaceae and Asteraceae	5	
V	Sapotaceae, Acanthaceae and Lamiaceae	5	Chalk and Talk, Power Point, Virtual images.
	Amaranthaceae, Aristolochiaceae and Euphorbiaceae	5	
	Orchidaceae, Commelinaceae and Poaceae	5	

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K – Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K1	2(K2&K2)	1 (K3)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K4&K4)	1 (K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K 4	2	K1&K2	2	K1&K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3&K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-		10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core Practical	20U3BMP3	Major Practical III	2	3	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: This course will enable the students

1. To train students for identifying plants based on morphological observations.
2. To dissect the various members of angiosperm families by examining their vegetative and reproductive characters.
3. To enrich the knowledge on the use of economically important plants in our daily life.

Practicals:

1. Morphological observation of various plant parts and their modifications.
2. Dissection of floral parts of plants belonging to the dicotyledonous families Nymphaeaceae, Brassicaceae, Malvaceae, Rutaceae, Meliaceae, Myrtaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Sapotaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Aristolochiaceae and Euphorbiaceae.
3. Dissection of floral parts of plants belonging to the monocotyledonous families Orchidaceae, Commelinaceae and Poaceae
4. Field trips (minimum 2 days) to places within or outside the state under the guidance of teachers to study plants in their natural habitats.
5. Preparation and submission of minimum 10 herbarium sheets.
6. Identification of economically important plants and their uses.
7. Submission of record note book and field report note.

Rationale for Nature of the Course

The students acquire profound practical skills in the laboratory with scientific observations in the field of morphology and plant taxonomy thereby enriching a thorough understanding on the field aspects of identifying plants.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The course will help the students to develop their skills on the nuances of morphological aspects of angiosperms and the importance of economically important plants in our day today life which enables them to get a position in pharmaceutical industries.

Pedagogy

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs, You Tube Videos& Learning Management System (CANVAS).

Course Designer: Dr. N. Janakiraman, Assistant Professor

Lecture Schedule

S. No.	Description	Hours	Mode
1	Morphological observation of plant parts and their modifications	3	Plant specimens
2	Study the vegetative characters and dissect the floral parts of Nymphaeaceae, Brassicaceae and Malvaceae	6	Dissection
3	Study the vegetative characters and dissect the floral parts of Rutaceae, Meliaceae and Myrtaceae	6	Dissection
4	Study the vegetative characters and dissect the floral parts of Cucurbitaceae, Rubiaceae and Asteraceae	6	Dissection
5	Study the vegetative characters and dissect the floral parts of Sapotaceae, Acanthaceae, Lamiaceae	6	Dissection
6	Study the vegetative characters and dissect the floral parts of Amaranthaceae, Aristolochiaceae, Euphorbiaceae	6	Dissection
7	Study the vegetative characters and dissect the floral parts of Orchidaceae, Commelinaceae and Poaceae	6	Dissection
8	Preparation of herbarium	3	Preparation
9	Identification of economically important plants and their uses	3	Plants specimens and their products
Total		45	

Course Learning Outcomes

On successful completion of the course, the students will be able to know, understand, apply and analyse

CLOs	CLO Statement	Knowledge Level
CLO 1	The morphological aspects of various plant parts	Up to K4
CLO 2	The dissection of the floral parts of dicotyledonous families and study their reproductive structures	Up to K4
CLO 3	The dissection of the floral parts of monocotyledonous families and study their reproductive structures	Up to K4
CLO 4	The utilization of economically important plants in daily life	Up to K4
CLO 5	The preparation and maintenance of herbarium sheets	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	3	2	1	3	3	2	2	2	3
CLO 2	3	3	2	2	2	3	3	3	3
CLO 3	3	3	2	2	1	3	3	3	3
CLO 4	3	2	1	2	1	2	2	3	3
CLO 5	3	2	-	-	-	3	3	3	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes

#	PO 1	PO 2	PO3	PO4	PO5
CLO1	3	2	2	2	1
CLO2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO4	2	2	2	2	2
CLO 5	1	2	1	1	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

DEPARTMENT OF BOTANY				CLASS: II B.Sc./B.Com.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	NME- II	20U4BNM2	Plants and Human Welfare	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: This course will enable the students

1. To understand the role of plants in human welfare.
2. To know the importance of use of plant products in our daily life.
3. To evaluate the economic importance of plants.

UNITS	CONTENT	CLO	K LEVEL	HOURS
I	Major crops: Introduction, vernacular names, botanical name, morphology of useful parts and uses of the following: Cereals and millets - Rice, Maize and Pearl millet. Legumes - Black gram and Red gram. Fruits - Gooseberry and Mango; Vegetables - Bhendi and Onion.	1	Up to K2	6
II	Spices and Condiments: Introduction, vernacular names, botanical name, morphological useful parts and uses of the following –turmeric, clove, black pepper, cardamom, garlic and curry leaf.	2	Up to K2	6
III	Beverages : Introduction, vernacular names, botanical name, morphology of useful parts and uses of the following - e.g. Tea, Coffee and Cocoa	3	Up to K2	6
IV	Medicinal plants: Introduction, vernacular names, botanical name, morphological useful parts and uses of the following - Tulsi, Aloe ,Balloon vine, <i>Adhatoda</i> .	4	Up to K2	6
V	Plants and plant products of Industrial value: Fibre - cotton and jute, timber - teak and rose wood, rubber - <i>Hevea</i> , fatty oils e.g., sesame; essential oils - khus oil and lemongrass. Dyes – <i>Rubia</i> and Indigo. Sugar – sugarcane. Gums - gum arabic. Resins – <i>Abies</i>	5	Up to K2	6

Books for Study

1. Pandey B. P. (1978), Economic Botany, S. Chand Publishing Company., New Delhi. Verma V. (1974). A Text book of Economic Botany, Emcay publication. New Delhi.
2. Hill.A.(1976).Economic botany Tata McGraw Hill Publishing Co;Ltd.New Delhi.
3. Bendre A. Kumar A Economic Botany, Rastogi Publication, New Delhi.

Books for References

1. Kochar .S.L.(2011). Economic Botany in Tropics McMillan Publications New Delhi.
2. Wickens, G.E. (2001). Economic Botany. Principles & Practices, Kluwer Academic Publishers The Netherlands.
3. Sambhamurthy.A.V.S.&Subramanian .N.S: A textbook of Economic botany,Wiley Eastern ltd, New Delhi.

Web Resources

1. <https://www.econbot.org/economic-botany.html>
2. <https://www.loc.gov/economic-botanytb.html>
3. <https://www.britannica.com/science/economic-botany>

Rationale for Nature of the Course

The course focuses on understanding the values of medicinal plants for human welfare and helps them to utilize the locally available products in day today life.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The skills learned by the students help them to become an entrepreneur in the field of natural products obtained from medicinal plants.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Prof. R. Saranya, Assistant Professor

Course Learning Outcomes: On successful completion of the course the students will be able to

CLOs	CLO Statement	Knowledge Level
CLO-1	Describe the major crops and assess their use for human consumption.	Up to K2
CLO-2	Gain knowledge about economic uses of spices	Up to K2
CLO-3	Compare the uses of plants for materials, health and pleasure.	Up to K2
CLO -4	Apply the medicinal value of the plant products	Up to K2
CLO-5	Utilization of plant products in industries	Up to K2

Mapping Programme Specific Outcomes with Course Learning Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	2	3	3	2	3	3	3	2	3
CLO-2	3	3	3	3	3	3	3	3	2
CLO-3	2	3	3	3	2	3	3	2	2
CLO-4	3	3	3	3	3	3	2	2	2
CLO-5	3	3	3	3	3	3	2	3	3

3-Advance application; 2- Intermediate level; 1- Basic level

Mapping Programme Outcomes with Course Learning Outcome

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	-	3	2	3
CLO-2	2	3	2	3	2
CLO-3	2	3	2	3	1
CLO-4	1	3	2	-	1
CLO-5	-	1	1	-	1

3-Advance application; 2- Intermediate level; 1- Basic level

Lesson Plan

Unit	Description	Staff Name	Hours	Mode
I	a) Introduction, vernacular names, botanical name, morphology of useful parts and uses of Cereals and Millets: Rice, Maize, and Pearl millet.	-	2	Black Board
	b) Pulses: Black gram and Red gram. Fruits: Gooseberry.	-	2	Black Board
	c) Fruits: Mango. Vegetables: Bhendi and Onion.	-	2	Discussion
II	a) Spices and Condiments: Clove ,black pepper	-	2	Power point
	b) Spices and Condiments: cardamom ,garlic	-	2	Power point
	c) Spices and Condiments: garlic and curry leaf.	-	2	Discussion
III	a) Beverages: Tea	-	2	Black Board
	b) Beverages: Coffee	-	2	Power Point
	c) Beverages: Cocoa	-	2	Black Board
IV	a) Medicinal plants: Turmeric ,Aloe	-	2	Power point
	b) Medicinal plants: Aloe, Balloon vine.	-	2	Discussion
	c) Medicinal plants: Balloon vine, Adatoda.	-	2	Black Board
V	a) Plants and plant products of Industrial value: Fibre - cotton and jute, timber-teak and rosewood, rubber- Hevea, fatty oils e.g., sesame;	-	2	Black Board
	b) Plants and plant products of Industrial value: essential oils- khus oil and lemon grass. Dyes-Acacia and Indigo.	-	2	Assignment
	c) Plants and plant products of Industrial value: Sugar-sugarcane. Gums-gum Arabic. Resins- Abies.	-	2	Discussion
Total			30	

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section B (Either/ Choice)	Section C (Open Choice)
			Short Answer			
			No. of Questions	K – Level		
1	CLO 1	Up to K 2	1	K1	2(K2&K2)	1 (K1)
2	CLO 2	Up to K 2	1	K1	2(K2&K2)	1 (K1)
3	CLO 3	Up to K 2	1	K1	2(K2&K2)	1 (K1)
4	CLO 4	Up to K 2	1	K1	2(K2&K2)	1 (K1)
5	CLO 5	Up to K 2	1	K1	2(K2&K2)	1 (K1)
No. of Question to be asked			5		10	5
No. of Question to be answered			5		5	3
Mark for each question			2		7	10
Total Marks for each section			10		35	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	20	-	50	70	58.33	100
K2	-	50	-	50	41.67	
Total Marks	20	50	50	120	100.00	100%

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section B (Either/ Choice)	Section C (Open Choice)	Total
			Short Answer				
			No. of Questions	K - Level			
1	CLO x	Up to K 2	2	K1& K1	2(K2&K2)	1 (K1)	
2	CLO y	Up to K 2	1	K1	2(K2&K2)	2 (K1& K1)	
No. of Question to be asked			3		4	3	14
No. of Question to be answered			2		2	2	10
Mark for each question			2		7	10	
Total Marks for each section			6		14	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10		30	40	66.67	100
K2		20		20	33.33	
Total Marks	10	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	SBE- II	20U4BSM2	Biological Techniques	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: This course will enable the students

1. To acquire knowledge on the working principle and methodology of various techniques in biological sciences.
2. To understand the scope and applications of major bio-techniques.
3. To demonstrate the operation of bio-instruments mentioned in the syllabi and provides hands-on-experiences.

UNITS	CONTENT	CLO	K LEVEL	HOURS
I	Microscopy: Microscope: Compound, bright field, dark field, Phase contrast, and fluorescence microscope, Electron microscope- SEM, TEM. Micro-preparations- Fixation and Staining. Microtome- Components and functions.	1	Up to K4	6
II	Colorimetry and Photometry: pH meter principle and applications. Beer- Lamberts Law, colorimeter and spectrophotometer. EM spectrum, UV spectroscopy, NMR.	2	Up to K4	6
III	Chromatography: Principle and applications- mobile and stationary phases, Rf value, Paper chromatography, TLC Gel filtration chromatography and HPLC.	3	Up to K4	6
IV	Electrophoresis: Principle and applications- Separation of macromolecules by Agarose Gel (AG), Poly Acrylamide Gel (SDS- PAGE) and Two dimensional Gel Electrophoresis.	4	Up to K4	6
V	Centrifugation: Centrifuge: principle, parts and applications, types (bench-top & ultra). Velocity gradient, isopycnic & differential centrifugation.	5	Up to K4	6

Books for Study

1. Jayaraman, J. (2019). Laboratory Manual in Biochemistry (Revised). Wiley Eastern Ltd., New Delhi.
2. Krishnamurthy, K. V. (1988). Methods in Plant Histo-chemistry. S. Viswanathan & Co., Madras.
3. Dwivedi, J. N. and Singh, R. B. (1985). Essential of Plant Technique. Scientific Publications, Jodhpur.

Books for References

1. Jensen, W. A. (1962). Botanical Histochemistry: Principles and Practice. W.H. Freeman and Co., San Francisco, USA.
2. Johansen, D. A. (1940). Plant Microtechnique. McGraw Hill, New York.
3. Sass, J. E. (1967). Botanical Microtechnique. 3rd ed. Oxford & IBH Publishing Co., New Delhi.
4. Skoog, A. and West, M. (1980). Principles of Instrumental Analysis –W. B. Saunders Co., Philadelphia, USA.
5. Wilard, H. H., Meritt, L. L. Jr. and Dean, J. A. (1965). Instrumental Methods of Analysis. 4th ed. Van Nostrand Inc. Princeton, New Jersey.
6. Williams, B. L. and Wilson, K. (1983). A Biologist's Guide to Principles Techniques of Practical Biochemistry. Edward Arnold, London. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.

Web Resources

1. <https://www.biologydiscussion.com/biology/someimportant-techniques-used-in-biology/2627>
2. <https://www.biologydiscussion.com/biology/someimportant-techniques-used-in-biology/15683>
3. <https://www.biotek.com>
4. <https://www.microscopemaster.com>; <https://www.azom.com>
5. <https://www.onlinelibrary.wiley.com>; <https://www.khanacademy.org>

Rationale for Nature of the Course

The course focuses on understanding the working principles, methodologies and application of various instrumentation techniques applied in the field of biology.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The techniques learned from the course help the students to get a position in various scientific laboratories and its allied fields.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. P. Kannan, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	CLO Statement	Knowledge level
CLO-1	Understand the working principles and components of various microscopy and microtome.	Up to K4
CLO-2	Familiarize the knowledge on standard methodologies followed in colorimetry and photometry.	Up to K4
CLO-3	Demonstrate the operation protocols in most frequently used chromatography used in research studies.	Up to K4
CLO-4	Evaluate the advanced scientific significances of electrophoresis.	Up to K4
CLO-5	Synthesize by develop unique skills by hands-on-training on various centrifugation techniques.	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcome

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	2	3	3	3	3	3	2	2	2
CLO-2	3	3	2	3	3	2	1	1	2
CLO-3	3	3	3	3	2	2	2	1	1
CLO-4	2	2	3	3	2	3	3	2	1
CLO-5	3	3	2	2	3	2	2	1	1

3- Advance application; 2- Intermediate level; 1-Basic level

Mapping Programme Outcomes with Course Learning Outcome

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	3	3	3	2
CLO-2	3	3	2	3	2
CLO-3	3	3	1	-	2
CLO-4	2	1	2	1	-
CLO-5	3	3	3	2	1

3- Advance application; 2- Intermediate level; 1- Basic level

Lesson Plan

Unit	Description	Staff Name	Hours	Mode
I	Compound microscopy-components	-	1	Discussion
	Bright, dark, phase-contrast & fluorescent microscopy	-	2	Power point
	SEM and TEM compare studies	-	2	Power point
	Microtome components and functions	-	1	Demonstration
II	Colorimeter components, EMS, Spectrophotometer	-	2	Discussion
	UV spectroscopy & NMR	-	3	Power point
	pH meter components	-	1	Power point
III	Paper chromatography	-	1	Black board
	Gel type- components and its application	-	1	Black board
	Thin Layer Chromatography	-	2	Power point
	HPLC	-	2	LMS
IV	Macromolecules separation-overview	-	1	Discussion
	Agarose gel electrophoresis	-	2	Black board
	Polyacrlamide gel electrophoresis	-	2	Power point
	Two Dimensional electrophoresis	-	1	LMS
V	Centrifuge- Principle and Application	-	1	Discussion
	Parts and types of Centrifuge	-	1	Black board
	Velocity Centrifugation	-	2	Power point
	Isopycnic & Differential Centrifugation	-	2	Video-clips
Total			30	

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K – Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K1	2(K2&K2)	1 (K3)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K4&K4)	1 (K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

Blue Print – Model for Internal Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K 4	2	K1&K2	2	K1& K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3& K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-		10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	SBE- II	20U4BSM2	Organic Farming	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives: This course will enable the students

1. To impart knowledge on the eco-friendly aspects of organic farming and importance of sustainable agriculture.
2. To educate students on the marketing of organic farm products.

UNITS	CONTENT	CLO	K LEVEL	HOURS
I	Soil: Physical and chemical properties - Soil pollution: fertilizers, pesticides, herbicides, non-degradable solids - Biomagnification - Consequences of land pollution, damage to soil and crops, heavy metal contamination -Impact of monoculture.	1	Up to K4	6
II	Organic Farming: Basic concept - Integrated plant nutrient supply management - Integrated pest and disease management, biopesticides against microbial parasites, predators and pests - Integrated soil and water management - Sustainable agriculture practices: crop rotation, crop diversification, mixed cropping.	2	Up to K4	6
III	Management of Organic Wastes: Organic manures: organic residue, chemical nature, green manure, importance - Animal based organic manure: cow dung, poultry waste - Vermicompost: Methods, production and utilization - Preparation of Panchakavya, Dasagavya, Amirthakaraisal.	3	Up to K4	6
IV	Biofertilizers: Classification, Nitrogen fixers: <i>Rhizobium</i> , Cyanobacteria, <i>Azolla</i> and VAM - Production, field application and benefits.	4	Up to K4	6
V	Organic Protection: Operational structure of NPOP - IPR and Patenting issues - Principles of Biosafety - GMO and regulations - Organic products: Inspection and Certification - Accredited certifying agents (National and International) - Quality assurance: Logo and labeling and marketing.	5	Up to K4	6

Books for Study

1. Ranjan Kumar Biswas, 2014. Organic farming in India. New Delhi Publishers, India.
2. Reddy, S.R., 2017. Principles of organic farming. Kalyani Publishers, India.

Books for Reference

1. Sharma, A.K., 2003. Biofertilizers for sustainable agriculture, Agrobios.
2. NIIR Board, 2004. The Complete Technology Book on Biofertilizer and Organic Farming, National Institute of Industrial Research.
3. Palaniappan, S.P., and K. Annadurai, 2008. Organic Farming: Theory and Practice. Scientific Publishers.
4. Sarath Chandran, Unni M.R and Sabu Thomas, 2018. Organic farming. Woodhead Publishing, UK.

Web Resources

1. http://ec.europa.eu/agriculture/organic/organic-farming/whatorganic_en
2. <http://attra.ncat.org/organic.html#list>
3. <http://www.epa.gov/agriculture/tbio.html>

Rationale for Nature of the Course:

The course focuses on soil profile and management of organic wastes generated in various domestic and industrial supplies.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The skills obtained from the course will help the students to prepare organic manure by utilizing the various wastes generated in different sectors.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. P. Janci Rani, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	Course Learning Outcome Statement	Knowledge Level
CLO 1	Acquire familiarity on the various properties of soil	Up to K4
CLO 2	Develop entrepreneur skills to practice organic farming	Up to K4
CLO 3	Comprehend management practices suitable for organic farming	Up to K4
CLO 4	Explore knowledge on the use of biofertilizers for crop improvement	Up to K4
CLO 5	Understand the marketing and quality control aspects of organic products	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CLO 1	-	2	2	3	2	1	3	2	3
CLO 2	2	2	3	3	3	3	3	3	3
CLO 3	-	3	3	2	3	3	2	2	3
CLO 4	1	3	3	3	2	3	3	3	3
CLO 5	2	2	3	3	3	3	3	3	3

3-Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO 1	3	2	1	3	1
CLO 2	3	3	2	3	2
CLO 3	2	2	1	3	3
CLO 4	3	2	3	3	2
CLO 5	3	3	3	3	3

3-Advance Application; 2 - Intermediate Level; 1 - Basic Level

Lesson Plan

Unit	Description	Name of Staff	Hrs	Mode
1	a) Physical and chemical properties of soil	-	1	Black Board
	b) Soil pollution: fertilizers, pesticides, herbicides, non-degradable solids	-	2	Power Point
	c) Biomagnification, Consequences of land pollution, damage to soil and crops, heavy metal contamination	-	2	Seminar
	d) Impact of monoculture	-	1	Black Board
2	a) Basic concept of organic farming	-	1	Black Board
	b) Integrated plant nutrient supply management	-	1	Power Point
	c) Integrated pest and disease management, biopesticides against microbial parasites, predators and pests	-	2	Discussion
	d) Integrated soil and water management	-	1	Discussion
	e) Sustainable agriculture practices: crop rotation, crop diversification, mixed cropping	-	1	Power Point
3	a) Organic manures: organic residue, chemical nature, green manure, importance	-	1	LMS (CANVAS)
	b) Animal based organic manure: cow dung, poultry waste	-	1	Power Point
	c) Vermicompost: Methods, production and utilization	-	2	Discussion
	d) Preparation of Panchakavya, Dasagavya, Amirthakaraisal	-	2	LMS (CANVAS)
4	a) Biofertilizers: Classification	-	2	Black Board
	b) Nitrogen fixers: <i>Rhizobium</i> , <i>Cyanobacteria</i> , <i>Azolla</i> and VAM	-	2	Power Point
	c) Production of biofertilizers, field application and benefits	-	2	Black Board
5	a) Operational structure of NPOP, IPR and Patenting issues	-	2	Power Point
	b) Principles of biosafety, GMO and regulations	-	2	LMS (CANVAS)
	c) Organic products: Inspection and certification, Accredited certifying agents (National and International)	-	1	Black Board
	d) Quality assurance: logo and labeling and marketing.	-	1	Discussion

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K – Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K1	2(K2&K2)	1 (K3)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K4&K4)	1 (K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K 4	2	K1&K2	2	K1& K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3&K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-		10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major core 6	20U4BMC6	Cell Biology and Biochemistry	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course objectives: This course will enable the students to

1. gain an overview of cells, cell types, various cell organelles and their structure, chemical composition and functions,
2. understand and appreciate the structure, organization, functionalities and importance of nucleus and chromosomes and their roles in cellular activities,
3. examine the features of basic chemical bonds and the energy associated with them and
4. understand the structure, functions and the importance of various biomolecules.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Ultra Structure of Cell: Cell and cell doctrine. Prokaryotic and Eukaryotic cells. Differences between pro and eukaryotic cells. Ultra-structure of a plant cell. Plant cell envelopes - Ultra structure, chemical composition and the functions of cell wall and cell membranes including plasma membrane (Fluid Mosaic Model).	1	Up to K4	15
II	Cell organelles: Structure, chemical composition and functions of vacuole, golgi complex, endoplasmic reticulum, chloroplast, mitochondrion, ribosomes and microbodies (peroxisome and glyoxisome). Endosymbiosis theory. Extra nuclear genome - mitochondrial DNA and plastid DNA, plasmids.	2	Up to K4	15
III	Nucleus and Chromosomes: Structure, chemical composition and functions of nucleus. Chromosomes: morphology, organization of DNA in a chromosome (nucleosome model), euchromatin and heterochromatin, giant - polytene and lambrush. Cell inclusions (Cystolith and Raphides). Cell cycle, Cell divisions (mitosis and meiosis) and their significance.	3	Up to K4	15
IV	Basic concepts – atoms; chemical bonds – ionic, hydrogen, covalent; structure and properties of water. pH and Buffer. Bio molecules – structure, classification and properties of carbohydrates, monosaccharides - glucose, disaccharides – sucrose, polysaccharides – starch.	4	Up to K4	15
V	Biomolecules: Protein - Primary, secondary, Tertiary and Quaternary structure and Properties. Lipids – Classification and Properties, Structure of fatty acid – Simple (fats and oils), Compound (phospholipids) and Derived (cholesterol). Enzymes - Structure, Properties, Nomenclature and classification, Mechanism of Enzyme action (Induced Fit Model), Factors affecting enzyme action.	5	Up to K4	15

Books for Study

1. Sharma, A. K. and A. Sharma. (1999). Plant Chromosomes: Analysis, Manipulation and Engineering. Harward Academic Publishers, Australia.
2. Shukla, R.S. and Chandel, P.S (2007). Cytogenetics, Evolution, Biostatistics and Plant Breeding. S. Chand & Company Ltd., New Delhi.
3. Rastogi, S.C. (2015) Cell Biology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi.
4. Jain J.L 1999 Fundamentals of Biochemistry S. Chand & co Ltd. New Delhi.
5. Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.
6. Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication.

Books for Reference

1. Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press.
2. Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd.
3. Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology – Concepts and Experiments. 8th Edn. John Wiley and Sons.
4. Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education.
5. Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) Essential Cell Biology 5th Edn.,(paper back) W.W. Norton & Company p.864.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/books>
2. <https://www.khanacademy.org/science/biology/cellular-molecular-biology>
3. https://onlinecourses.swayam2.ac.in/cec20_ma14/preview
4. <https://micro.magnet.fsu.edu>
5. <https://cellbiology.med.unsw.edu.au>
6. <https://www.youtube.com/watch?v=bYpPMzzyZZ4>

Rationale for Nature of the Course

The students acquire a comprehensive theoretical knowledge in the field of cell biology and biochemistry.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The course will help the students to develop their knowledge on the nuances of cell systems and the micro and macro biomolecules, thereby to better understand the basics of research in cell systems.

Pedagogy

Chalk and Talk, PPT, Seminar, Discussion, Quiz, Virtual Labs, Google Classroom Discussion and CANVAS (Learning Management System).

Course Designer: Dr. S. Gnaana Saraswathi, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	CLO Statement	Knowledge level
CLO-1	Describe the cell and cell theory, ultra-structure of pro and eukaryotic cells, plant cell and its organelles	Up to K4
CLO-2	Analyse, relate and compare the extra nuclear genome and their significance	Up to K4
CLO-3	Explain and Justify the cell cycle, cell divisions and significance	Up to K4
CLO-4	Outline, explain, compare and differentiate the structure of an atom, and chemical bonds	Up to K4
CLO-5	Identify, describe and differentiate the structure, properties and biological significance of biomolecules namely carbohydrates, proteins and lipids. Discuss and organise their thought on the enzymes, their importance and enzyme action.	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	3	3	3	3	2	2	2	3	3
CLO-2	3	3	3	3	2	3	3	2	3
CLO-3	1	2	3	3	3	3	3	2	3
CLO-4	1	1	2	1	1	2	1	1	1
CLO-5	3	3	3	3	3	3	3	3	3

3 – Advance application; 2 – Intermediate level; 1 – Basic level

Mapping Programme Outcomes with Course Learning Outcomes:

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	3	3	3
CLO-2	2	3	3	3	3
CLO-3	2	2	3	3	2
CLO-4	2	2	2	2	2
CLO-5	3	3	3	1	3

3 – Advance application; 2 – Intermediate level; 1 – Basic level

Lecture Schedule

Sl. No.	Description	Staff Name	Hours	Mode
I	a) Introduction to cell biology, cell and cell doctrine	-	2	Discussion
	b) Pro and eukaryotic cells and differences	-	3	Black board
	c) Plant cell structure	-	2	PowerPoint
	d) Cell wall -structure, composition and functions	-	3	Assignment
	e) Cell membrane - overview	-	1	PowerPoint
	f) Plasma membrane – structure, Fluid mosaic model.	-	2	PowerPoint & videos
	g) Chemical composition and functions	-	2	LMS
II	a) Structure, chemical composition and functions of	-	1	Assignment
	b) Vacuole	-	1	Video(s) clips
	c) Golgi complex	-	1	PowerPoint
	d) Endoplasmic reticulum	-	1	Video-clips
	e) Chloroplast	-	2	Black board
	f) Mitochondrion	-	2	PowerPoint & videos
	g) Ribosomes	-	1	PowerPoint
	h) Peroxisomes	-	1	PowerPoint
	i) Glyoxysomes	-	1	LMS
	j) Endosymbiosis theory	-	1	Videos
	k) Mitochondrial DNA	-	1	PowerPoint
	l) Chloroplast DNA	-	1	Discussion
	m) Plasmid DNA	-	1	Discussion
			1	Assignment
III	a) Structure, chemical composition and functions of Nucleus	-	7	Black board
	b) Chromosome morphology and organisation	-	2	PowerPoint
	c) Cell inclusions	-	1	Discussion
	d) Cell cycle	-	2	PowerPoint & videos
	e) Mitosis	-	2	LMS
	f) Meiosis	-	1	Discussion
IV	a) Basic concepts and bonds	-	3	Discussion
	b) Structure and properties of water	-	3	Discussion
	c) pH and Buffers	-	2	PowerPoint
	d) Carbohydrates, structure and classification	-	2	Black board
	e) Mono, di and poly saccharides	-	5	Quiz
V	a) Proteins	-	5	Black board
	b) Lipids	-	5	PowerPoint
	c) Enzymes	-	5	Assignment
Total			75	

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K – Level		
1	CLO 1	Up to K 4	2	K1 & K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K 4	2	K1 & K2	1	K1	2(K2&K2)	1 (K3)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
4	CLO 4	Up to K 4	2	K1 & K2	1	K2	2(K4&K4)	1 (K4)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3&K3)	1 (K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K 4	2	K1&K2	2	K1& K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3& K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		-	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-		10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Core Practical	20U4BMP4	Major Practical IV	2	3	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To develop the practical skills by illustrating the ultra-structure of plant cell.
2. To understand the various organelles in plant cell system.
3. To observe cell divisions in plant systems.
4. To analyse the biomolecules through quantitative and qualitative methods.

Practicals:

1. Observation of the photomicrographs of plant cell and organelles – vacuole, golgi complex, chloroplast, endoplasmic reticulum, mitochondrion, ribosomes and microbodies.
2. Observation on the extra nuclear genomes.
3. Study of mitotic chromosome: squash preparation of mitotic cells of *Allium cepa* root tip.
4. Study of meiotic chromosome: smear preparation of meiotic cells in *Rheo* flower bud.
5. Complementary colour.
6. Estimation of starch.
7. Estimation of protein.
8. Paper chromatography

Rationale for the Nature of the Course

The students learn the practical skills through various techniques mentioned above using a standard scientific method.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The learners with the skills obtained in the laboratory can update themselves to get entry into plant biology laboratories as a project assistant.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Quiz, Virtual Labs, Google classroom and CANVAS (Learning Management System).

Course Designer: Dr. S. Gnaana Saraswathi, Assistant Professor.

Lecture Schedule

Sl. No.	Description	Hrs	Mode
1	Plant cell and organelles structure	15	Photomicrographs
2	Extra nuclear genomes	2	Photomicrographs
3	Mitotic division	6	Squash – root tip
4	Meiotic division	6	Smear – flower
5	Complementary colour	3	Experiment
6	Estimation of starch	4	Starch test
7	Estimation of protein	3	Lowry's method
8	Paper chromatography	3	Experiment
9	Qualitative test for carbohydrates, proteins & lipids	3	Experiment
Total		45	

Course Learning Outcomes

On successful completion of the course, the students will be able to know, understand, apply and analyse

CLOs	CLO Statement	Knowledge Level
CLO-1	The structure of plant cell types	Up to K4
CLO-2	The extra nuclear genome structures	Up to K4
CLO-3	Identify and record the cell structure and cell organelles	Up to K4
CLO-4	Illustrate the cell division	Up to K4
CLO-5	Estimate and Distinguish the biomolecules	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	3	2	1	3	3	2	2	3	3
CLO-2	3	3	2	2	2	3	3	3	3
CLO-3	3	3	3	2	1	2	3	3	3
CLO-4	3	3	3	2	1	2	3	3	3
CLO-5	3	3	3	2	1	2	3	3	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	3	1	2	2
CLO-2	3	3	2	2	3
CLO-3	3	3	3	3	2
CLO-4	2	2	2	2	3
CLO-5	1	2	2	3	2

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Add-on I	20U3BAD1	Crop Varieties	2	2	50	50	100

Course objectives: The course will enable the students

1. To impart knowledge on the cultivation practices and characteristic qualities of crop varieties
2. To acquaint and keep abreast with the global trends in essential commodities.

Unit I Cereals and millets (6 hours)

Brief account on list of varieties, region and practices of cultivation, characteristic qualities and market value of Rice, Wheat, Corn Maize, millets.

Unit II Pulses (6 hours)

Brief account on list of varieties, region and practices of cultivation, characteristic qualities and market value of Bengal gram, pigeon pea, soybean, garden pea, black gram and green gram

Unit III Nuts (6 hours)

Brief account on list of varieties, region and practices of cultivation, characteristic qualities and market value of Groundnut, Almond, Cashew nut, Pista and Walnut.

Unit IV Fruits (6 hours)

Brief account on list of varieties, region and practices of cultivation, characteristic qualities and market value of Mango, Banana, grapes, Apple, Sapota and Guava

Unit V Vegetables (6 hours)

Brief account on list of varieties, region and practices of cultivation, characteristic qualities and market value of Potato, Brinjal, Tomato, Onion, Cabbage and Beans

Books for Study

1. Pandey B. P. (1978), Economic Botany, S. Chand Publishing Company., New Delhi. Verma V. (1974). A Text book of Economic Botany, Emcay publication. New Delhi.
2. Hill.A.(1976).Economic botany Tata McGraw Hill Publishing Co;Ltd.New Delhi.
3. Bendre A. Kumar A Economic Botany, Rastogi Publication, New Delhi.

Books for References

1. Kochar .S.L.(2011). Economic Botany in Tropics McMillan Publications New Delhi.
2. Wickens, G.E. (2001). Economic Botany. Principles & Practices, Kluwer Academic Publishers The Netherlands.
3. Sambhamurthy.A.V.S.&Subramanian .N.S: A textbook of Economic botany,Wiley Eastern ltd, New Delhi.

Course Designers

Prof. S. ChellaPandian, Associate Professor

Prof. V. Meenakshi Sundaram, Assistant Professor

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Add-on II	20U4BAD2	Industrial Botany	2	2	50	50	100

Course objectives: This course will enable the students

1. To familiarize the critical processing steps in the plant based industries.
2. To understand methods for large scale cultivation of organisms and production of its derived bio-products for human mankind.

Unit I Phycolloid Industry (6 hours)

Sources, physico-chemical properties, extraction methods, quality check industrial production and utilization of Agar-agar, Carrageenan and Alginic acid.

Unit II Beverage Industry (6 hours)

Varieties, chemical compositions, post harvest processing, Global market value of Tea and Coffee.

Unit III Sugar industry (6 hours)

Sugarcane varieties, production methods of cane sugar and beet sugar, refinement of jaggary, palm sugar.

Unit IV Oil industry (6 hours)

Brief account on Saturated and Unsaturated fats. Sources, lipid profile, extraction methods, processing and quality check of Sesame oil and Groundnut oil.

Unit V Alcohol industry (6 hours)

Brewing and fermenting Steps in beer production. Steps in wine production.

Books for Study

1. Pandey B. P. (1978), Economic Botany, S. Chand Publishing Company., NewDelhi. Verma V. (1974). A Text book of Economic Botany, Emcay publication. New Delhi.
2. Bendre A. Kumar A Economic Botany, Rastogi Publication, New Delhi.

Books for References

1. Sambhamurthy.A.V.S.S&Subramanian .N.S: A textbook of Economic botany,Wiley Eastern ltd, New Delhi.
2. Kochar .S.L.(2011). Economic Botany in Tropics McMillan Publications New Delhi.

Course Designers

Dr. P. Kannan, Assistant Professor

Prof. V. Meenakshi Sundaram, Assistant Professor

DEPARTMENT OF BOTANY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III & IV	Self study	20U3BMSS	Secondary Metabolites	2	-	50	50	100

Course Objectives: This course will enable the learners

1. To study the various class of secondary metabolites and their specific significances.
2. To understand the pathways for the synthesis of secondary metabolites.

Unit I Isoprenoids (6 hours)

Sources, Role in plants and human utilization of rubber, steroids, essential oils, carotenoid pigments

Unit II Nitrogen compounds (6 hours)

Sources, Role in plants and human utilization alkaloids, glucosinalates, glycosides, nonprotein aminoacids.

Unit III Phenolic acids (6 hours)

Sources, Role in plants and human utilization lignin, tannins, coumarins, aflatoxins and flavonoids

Unit IV Bacterial products (6 hours)

Sources, Role in plants and human utilization of endotoxins and exotoxins

Unit V Fungal products (6 hours)

Sources, Role in plants and human utilization polyketides, nonribosomal peptides and terpenes.

Books for Study

1. Jain J.L 1999 Fundamentals of Biochemistry S. Chand & co Ltd. New Delhi.
2. Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.
3. Rastogi, S.C. (2015) Cell Biology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi.
4. Buchanan BB, Gruissen W & James RL 2000. Biochemistry and Molecular Biology of plants. I. K International pvt. Ltd. New Delhi.

Course Designers

Dr. P. Kannan, Assistant Professor

Prof. V. Meenakshi Sundaram, Assistant Professor.



**THE MADURA COLLEGE (AUTONOMOUS)
MADURAI – 625 011**

Diploma in Gardening

Programme Co-ordinator

Dr. S. GNAANA SARASWATHI

Assistant Professor

Department of Botany,

The Madura College (Autonomous),

Madurai – 625 011.

Programme Description

The diploma programme on gardening aims at guiding and inculcating the domain knowledge as well as professional skills to the takers, in a step-by-step manner, through the process of deciding the type of garden they wish to initiate and maintain, knowing the soil and its properties, suitable plants for that soil for a great gardening.

The programme throws light upon the basics of gardening and why gardening is important. It also gives the knowledge of the soil composition in the taker's yards and reframe it for better gardening by compost preparation out of vegetable and fruit wastes. The programme will also highlight upon ecotherapy aspects and efficient stress management through gardening.

Programme Duration

The duration is for one year, split into two semesters. The total 120 hours are split into two theory papers for 60 hours (each 30 hours) and two practicals for 60 hours (each 30 hours).

Semester	Department of Botany				Diploma Programme			
	Course Type	Course Code*	Course Title	Credits	Total hours	CIA	EXT	Total
I	Diploma	21DB1C1	Gardening Basics	2	30	50	50	100
	Diploma	21DB1P1	Practical	2	30	50	50	100
II	Diploma	21DB1C2	Garden Designing	2	30	50	50	100
	Diploma	21DB1P2	Practical	2	30	50	50	100

DEPARTMENT OF BOTANY				Diploma Programme				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
I	Diploma	21DB1C1	Gardening Basics	2	30	50	50	100

Programme Objectives

The course objectives are to

1. Impart **domain knowledge** and **professional skills** on gardening techniques.
2. provide the basics to create a garden in an available space.
3. integrate and apply the programme information to grow plants, all the way to the production / harvest and
4. promote awareness of **ecotherapy** through gardening for **effective stress management**.

Unit I (6 Hr)

Introduction – history of gardening – scope – importance – benefits. Description – plant system. Gardening – stress management – Ecotherapy.

Unit II (6 Hr)

Soil structure – top soil and sub soil – soil profile – types of soil – soil pH, water and plant growth. Soil improvement – mulching – organic and inorganic; manures, fertilisers and lime – benefits and drawbacks.

Unit III (6 Hr)

Garden tools and equipment. Preparation of compost using vegetable and fruit wastes. Coco peat and its applications. Site– bag – pot preparation. Containers used for gardening purpose.

Unit IV (6 Hr)

Ideal conditions for planting. Drainage and its importance. Methods of seed sowing – traditional – drilling – dibbling – broadcasting and transplantation.

Unit V (6 Hr)

Plants for acidic and alkaline soils, shady areas, sunny and dry areas, scented flowers, climbers, focal points and colourful foliage. Plant propagation – cuttings.

Lecture Schedule for theory

S. No	TOPICS	Staff Dr. SG	Hours	Mode
Unit 1	Introduction – history of gardening. Scope and importance of gardening. Benefits of gardening. Description – plant system. Gardening for stress management, Ecotherapy.		2 1 1 1 1	you tube videos Chalk and talk PPT
Unit 2	Soil structure – top soil and sub soil. Soil profile – types of soil – soil pH, water and plant growth. Soil improvement – mulching – organic and inorganic. Manures, fertilisers and lime – benefits and drawbacks.		2 2 1 1	you tube videos chalk and talk PPT
Unit 3	Garden tools and equipment. Preparation of compost using vegetable and fruit wastes. Coco peat and its applications. Site – bag – pot preparation. Containers for gardening purpose		2 1 1 1 1	you tube videos chalk and talk
Unit 4	Ideal conditions for planting. Drainage and its importance. Methods of seed sowing – traditional Drilling, dibbling, broadcasting Transplantation		1 1 2 1 1	you tube videos Chalk and talk
Unit 5	Plants for acidic and alkaline soils Shady areas, sunny and dry areas Scented flowers and climbers Focal points and colourful foliage. Plant propagation - cuttings		1 1 1 1 2	you tube videos Chalk and talk PPT

DEPARTMENT OF BOTANY				<i>Diploma Programme</i>				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
I	Diploma	21DB1P1	Gardening Basics Practical	2	30	50	50	100

The following practicals will be conducted in the laboratory and botanical garden of our college.

Practicals

1. Description the plant system.
2. Determination of pH of garden soil.
3. Determination of texture of garden soil.
4. Determination of field capacity of garden soil.
5. Determination of soil moisture of garden soil.
6. Determination of carbonate content of garden soil (qualitative analysis).
7. Nitrate content analysis of garden soil (qualitative analysis).
8. Phosphate content analysis of garden soil (qualitative analysis).
9. Sulphate content analysis of garden soil (qualitative analysis).
10. Chloride content analysis of soil (qualitative analysis).
11. Determination of alkalinity of water for gardening purposes.
12. Garden tools explanation.
13. Preparation of compost using vegetable and fruit wastes.
14. Plant propagation.

Schedule for the practicals

S. No	TOPIC	Staff Name	Hours	Mode
1.	Description of the plant system	Dr. SG	2	Practical, you tube videos
2.	Determination of pH of garden soil.		2	Practical at lab, you tube videos
3.	Determination of texture of garden soil.		2	Practical at lab, you tube videos
4.	Determination of field capacity of garden soil		2	Practical at lab, you tube videos
5.	Determination of garden soil moisture		2	Practical at lab, you tube videos
6.	Determination of carbonate content of garden soil		2	Practical at lab, you tube videos
7.	Determination of nitrate content of garden soil.		2	Practical at lab, you tube videos
8.	Determination of phosphate content of garden soil		2	Practical at lab, you tube videos
9.	Determination of sulphate content of garden soil		2	Practical at lab, you tube videos
10.	Determination of chloride content of garden soil		2	Practical at lab, you tube videos
11.	Determination of alkalinity of water		2	Chalk and talk You tube videos
12.	Garden tools explanation		3	
13.	Compost preparation using vegetable and fruit wastes		3	Practical at garden, You tube videos
14.	Plant propagation.		2	Practical at garden, You tube videos

DEPARTMENT OF BOTANY				<i>Diploma Programme</i>				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
II	Diploma	21DB1C2	Garden Designing	2	30	50	50	100

Unit I (6 Hr)

Introduction – principles of designing. An overview of modern garden design ideas. Kitchen garden – suitable plants – methodology and maintenance.

Unit II (6 Hr)

Home Garden Planning – the skill of designing – selection – arrangement – planting for borders. Potted plants and maintenance.

Unit III (6 Hr)

Indoor gardening – suitable annuals, perennials, foliage and flowering plants. Indoor pollution absorbing plant species. Maintenance of indoor plants.

Unit IV (6 Hr)

Terrarium and Topiaries – introduction, definition, methodology, maintenance and suitable plants. Lawn making. Landscape gardening – an overview.

Unit V (6 hr)

Terrace gardening – introduction, design, methodology and maintenance. Garden types - vegetable, flower, herbal, raised, community, container, therapeutic, succulent, rock/zen, tire, xeriscaped, labyrinth, hedge, vertical and ornamental grasses.

Lecture Schedule for theory

S. No	TOPICS	Staff	Hours	Mode
Unit 1	Introduction – principles of designing. Modern garden design ideas. Kitchen garden – suitable plants – methodology and maintenance	Dr. SG	2 1 3	you tube videos Chalk and talk PPT
Unit 2	Home Garden Planning. Skill of designing – selection – arrangement – planting for borders. Potted plants and maintenance.		2 2 2	you tube videos chalk and talk PPT
Unit 3	Indoor gardening. suitable annuals, perennials, foliage and flowering plants. Indoor pollution absorbing plant species. Maintenance of indoor plants.		1 2 2 1	you tube videos chalk and talk
Unit 4	Terrarium and Topiaries – introduction and definition. Methodology, maintenance and suitable plants. Lawn making. Landscape gardening – an overview		2 2 1 1	you tube videos Chalk and talk
Unit 5	Terrace gardening – introduction, design, methodology and maintenance. Garden types - vegetable, flower, herbal, raised, community, container and therapeutic. Succulent, rock/zen, tire, xeriscaped, labyrinth, hedge, vertical and ornamental grasses.		2 2 2	you tube videos Chalk and talk PPT

DEPARTMENT OF BOTANY				Diploma Programme				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
II	Diploma	21DB1P2	Garden Designing Practical	2	30	50	50	100

The following practicals, from 1 to 5 will be conducted in the botanical garden of our college and for 5 and 6, the students will be taken to the nearby nurseries and terrace garden.

1. Raising seedling in trays.
2. Mother bed preparation for seed germination.
3. Demonstration and individual seedling transplantation in various containers / potters / polythene bags, coco peat and pots.
4. Demonstration of terrarium.
5. Field visit to nearby nurseries.
6. Field visit to terrace garden.

S. No	TOPIC	Staff	Hours	Mode
1	Raising seedling in trays.	Dr. SG	4	Practical at garden, videos
2	Mother bed preparation for seed germination.		2	Practical at garden, You tube videos
3	Seedling transplantation in various containers / potters / polythene bags, coconut fibre containers and pots.		4	Practical at garden
4	Demonstration of terrarium.		2	Demo, you tube video, practical at garden
5	Field study to nearby nurseries		6	Field visit
6	Field study to terrace garden		6	Field visit

Programme Designer and Co-ordinator:

Dr. S. Gnaana Saraswathi, Assistant Professor.

Books:

1. Sethi. DK (2016). Gardening in Urban India. DK publishers. India
2. Sujit C. (2018). Organic Home Gardening. Notion Press Publishers. India.
3. Hamilton N. (2008). Organic Gardening Techniques. New Holland Publishers. UK

Web References:

<https://www.gardeners.com/>

<https://www.plantedwell.com/gardening-websites-blogs/>

<https://www.gardeningchannel.com/>

Programme Outcomes:

By successfully completing this course the students will

1. know, how and where to create their own gardens and identify the best possible garden plants suitable of their soil and environment,
2. work with various containers and know the methods of planting and fertilising,
3. demonstrate mastery of content at levels of at least 60-70% through implementing in their home and spread awareness of gardening and its importance to their surroundings and
4. understand gardening reduces stress, improves mental health and a psychological well-being with positive effects on emotions and behaviour that a garden / gardening provides.

Rationale for the Nature of the Programme:

The programme will enable the learners to integrate the knowledge gained to design, construct and develop the nursery and garden thereby generate income for themselves. They will make use of the skills learnt to become entrepreneurs by expanding their business in gardening and landscape.

Activities having direct bearing on Skill development:

- soil testing,
- preparation of compost out of house-hold kitchen wastes,
- preparation of soil for planting,
- selection of plants for the garden,
- plant propagation,
- maintenance of garden plants
- nursery development

Activities having direct bearing Employability and Entrepreneurship:

By learning the above-mentioned skills, the learners will

- create their own nursery and sell the plants,
- be trainers for school and college students and
- design a garden / landscape for hotels, restaurants, resorts etc.

On successful completion of this one-year diploma programme, the students will become entrepreneurs.

Pedagogy

1. Chalk and talk.
2. Hands on training.
3. Power-point presentations.
4. You tube videos for theory and practical will be posted in **Googleclassroom**.
5. Quiz will be conducted through **Quizizz** platform,
6. Discussions and Interactions through questions will be conducted through **Insert Learning**.

In case of off-campus situations, the theory classes will be conducted online mode through **Google Meet**. However, the practical classes will be held on-campus, in the college.

Programme evaluation

Each paper consists of 100 marks including internal and external. There are two theory papers and two practicals and hence the total marks are 400.

CIA – 50 marks

30 marks for Practical skill assessment (Assignments) - growing plants in pots / field at home; Students to grow plants (one vegetable plant, one succulent and one ornamental plant) and submit to the department as a part of their assignment for 30 marks, each component carries 10 marks.

20 marks for presentation.

External – 50 marks

20 marks for Multiple choice questions; **30 marks** Descriptive type questions
Three questions out of six can be answered, each carrying 10 marks and the total is for 30 marks.

No pass minimum is required either in internal or in external. However, **a total of 40 marks** is required as a **pass minimum** including **both internal and external examination**.

Programme Audience and intake:

Open to all UG and PG students. The intake of students is restricted to 30-35 numbers.

Programme Fee: The fee is Rs. 600 /- per student / annum.

DEPARTMENT OF BOTANY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21B3C3	Life Skills	2	30	50	50	100

Course Objectives:

- To equip students with social and interpersonal skills that enables them to cope up with the demands of everyday life.
- To encourage critical thinking and enable students to gain self-confidence.
- To provide opportunity for learning employability skills, effective communication and focus on personality development.

Unit I

Core Life Skills: Introduction, Importance and Need, Components, Types and Categories - Problem solving, Critical thinking, Effective communication, Decision making, Creative thinking and Interpersonal relationship.

Unit II

Essential Skills for College Students: Time management, Study skills, Assertiveness, Stress management, Respecting the rules and policies, Displaying honesty, integrity and perseverance, Handling success and failure. Communication skills: Types and styles - Barriers in communication - Strategies for effective communication.

Unit III

Various Aspects of Personality Development: Attitude - Definition - Types - Positive, Negative, Neutral and Mixed - Advantages and Disadvantages - Ways to develop positive attitude. Body language, Learning ability, Leadership and Intellectual humility - Importance. Character building, Team work, Work ethics, Good manners and Etiquette, Self-esteem.

Unit IV

Emotional Intelligence: Five Domains - Self regulation, Self awareness, Motivation, Empathy and Social skills - Benefits - Good practices to cultivate and promote Emotional Intelligence at work place.

Unit V

Employability Skills: Resume Building - Art of participating in Group Discussion - Facing the Personal Interview (HR & Technical) - Frequently Asked Questions (FAQs) in Interview - Psychometric Tests - Mock Interview.

Books for Study:

1. Larry James (2016). The First Book of Life Skills, Embassy Books, Mumbai.
2. Shalini Verma (2014). Development of Life Skills and Professional Practice, Sultan Chand & Sons, New Delhi.

Books for Reference:

1. Barun K. Mitra (2017). Personality Development & Soft Skills, Oxford Publishers.
2. Daniel Goleman (2006). Emotional Intelligence, Bantam Books, New York.
3. Butterfield Jeff (2011). Soft Skills for Everyone, Cengage Learning India Pvt. Ltd., Delhi.
4. Goleman D. (1995). Emotional Intelligence. Bloomsbury Publishing India Pvt. Ltd., Delhi.

Course Designer: Dr. N. Janakiraman, Assistant Professor.

DEPARTMENT OF BOTANY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21B4C1	Herbal Products	2	30	50	50	100

Objectives

- To know the importance of herbal products
- To study the various processes & packaging methods of herbal Products
- To know the different applications of these products
- To be able to market and earn domestically & internationally

Unit-I 6 hrs

Herbal hair products: Preparation of Hair wash powder (Sekaikai), Hair dye, Hair oil, Shampoo & Conditioner.

Unit-II 6 hrs

Herbal washing powder: Preparation of body wash powder (Nalunku mavu), Herbal bath soap (Different kinds of flavor), Washing soap, dish wash soap & Herbal freshners.

Unit-III 6 hrs

Herbal beauty products: Preparation of Herbal Kajal (Kanmai), New born baby bindhi, Lip balm, Face pack (Facial), Anti dandruff powder & Body lotion.

Unit-IV 6 hrs

Medicinal products: Preparation of Herbal pain balm (External), Herbal paste (External), Cough drink, Ginger lemon juice & Herbal tea.

Unit-V 6 hrs

Herbal receipes: Preparation of Soup Mudakkathan (*Cardiospermum halicacabum*), Thuthuvalai (*Solanum trilobatum* L.), Mushroom, Kurinja keerai (*Gymnema sylvestre* R.Br.)

Preparation of herbal thuvaial -Pirandai (*Cissus quadrangularis*), Vallarai (*Centella asiatica*), Vegetables,

Pickles- Gooseberry, Mango, Ginger garlic. Mahani tuber & Fundamentals of marketing of Herbal products.

Reference Books

1. Home made Herbal cosmetics-Dr.S.Suresh Babu
2. Textbook of Herbal cosmetics-M.Vimaladevi

Text Book

1. Mooligai Samayal Kurippu- N.Hema

Course Designer: Dr. P. Jansirani, Assistant Professor.

DEPARTMENT OF BOTANY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21B5C1	Personality Development	2	30	50	50	100

Course outcomes:-

- To transform confident citizens in the future.
- To take the path of positive attitude.
- To focus on the solutions rather than problems.
- To conduct to themselves in a mature manner when they interact with the people.
- To recognize the need for and ability to engage in lifelong learning.

Course description:-

- This course makes the students groom their personality and prove themselves as good Samaritans of the society.
- This course insists in individuals or in group class presentations pertaining to the concept theories or issues in human development.

Unit-1

Personality: Definition- Determinants-Personality traits- Theories of personality and prove themselves as good Samaritans of the society.

Self awareness -Meaning-Benefits of self awareness-benefits of self awareness-Developing self – Awareness.

Unit-2

Goal setting: Meaning-Importance-Effective goal setting –Principles of goal setting – goal setting at the right level.

Disadvantages of self monitor-self monitoring and job performance.

Unit-3

Team building: Meaning –types of teams. Importance of Team building-creative effective team.

Leadership-Definition –Leadership style-Theories of leadership-Qualities of an effective leader.

Unit-4

Transaction Analysis-Meaning –EGO states –Types of Transactions – Johari Window-Life positions.

Emotional intelligence: Meaning-components of Emotional intelligence-How to improve Emotional Quotient.

Unit-5

Table manners: Meaning-Table etiquette in multicultural environment-Do and Don't of Table Etiquettes.

Dress code : Importance of dress code in educational institution ,work place, interview and for the selected occasions .

Interview -Definition-Types of skills-Employer Expectations-planning for the Interview-Interview Questions –Critical Interview Questions.

References:-

1. Dr.s.Narayana Rajan,Dr.B.Rajasekaran,G.Venkadasalapathi,V.Vijuresh Nayaham and herald M.Dhas ,Personality development,Publication Division,Manomaniam SundarnarUniversity,Tirunelveli.
2. Stephen P.Robbins,Organisational Behaviour,Tenth Edition,Prentice Hall of India Private Limited,2008
3. Jit.S.Chandan,Organisational Behaviour,Third Edition,Vikas Publishing House Private Limited,2008.
4. Dr.K.K.Ramachandran,and Dr.K.K.Karthick,From Campus to Corporate,Macmillan Publishers India limited,New Delhi,2010.

Course Designer: Dr. M. Karpagajothi, Assistant Professor.

DEPARTMENT OF BOTANY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Total Contact Hours	CIA	Ext	Total
	Certificate course	21B6C1	Apiculture	2	30	50	50	100

Course objectives

- To provide knowledge on the commercial significance of apiculture
- To impart the skills of bee keeping and honey bee identification.
- To acquaint with the honey production and their management practices

UNIT I 6hr

History of bee keeping - Definition, Introduction. Bee keeping – Worldwide and India. Traditional bee keeping, Modern beekeeping.

UNIT II 6hr

Honey bee species and identification - Introduction, Origin. Systematics and Distribution - Types and Species.

UNIT III 6hr

General management practices in bee keeping - Best management practice – Definition, Requirements to register, Swarms and Bee enquiries, Hive densities, Hive placement, Water provisions, Queens and Robbing behavior, Transportation of hives.

UNIT IV 6hr

Bee diseases – Introduction. Bee enemies – Wax Moth, Ants, Wasps, Microorganisms, Pests. Diagnosis and identification. Honey bee health, Colony collapse disorder.

UNIT V 6hr

Bee products – Introduction, Honey, Pollen, Royal jelly, Bee wax, Propolis & Venom. Significance of bee products - Value added honey products.

References:

1. Dewey M. Caron, 2013. Honey Bee Biology and Beekeeping, Revised Edition. Wicwas Press, Kalamazoo.
2. Ted Hooper, 2010. Guide to Bees & Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books, Oxford.
3. David Cramp, 2012. The Complete Step-by-step Book of Beekeeping: A Practical Guide to Beekeeping, from Setting Up a Colony to Hive Management and Harvesting the Honey. Lorenz Books. London.

Course Designer: Dr. S. Saravanan, Assistant Professor.

DEPARTMENT OF BOTANY				CLASS: I B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core Practical	20U1BMP1	Major Practical - I	3	3	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To observe morphological, anatomical and reproductive features of Algae, Fungi, Lichens and Bryophytes & Pteridophytes.
2. To train the students to prepare micro slides for observation under microscope.
3. To identify the genus and groups of supplied plant specimens of Algae, Fungi, Lichens, Bryophytes and Pteridophytes

Algae, Fungi, Lichens Practical

1. Study of the morphology of Algae, Fungi & Lichens mentioned in the syllabus.
2. Make micro- slide preparations of aerial and reproductive parts.
3. Submission of records.
4. Field visit to study fresh water/ marine water algal forms.

Bryophytes & Pteridophytes Practical

1. Study of the morphology of Bryophytes and Pteridophytes mentioned in the syllabus.
2. Make micro- slide preparations of aerial and reproductive structures.
3. Submission of records.
4. Field visit to study different forms of bryophytes and pteridophytes for a minimum of two days.

Rationale for Nature of the Course:

Exploring the economically potential lower plant divisions through the skills like systematic identification, knowledge on unique phytochemistry of these plant members

Activities having direct bearing on Employability

Systematic identification of the economically potential plant members by observing their vegetative and reproductive morphology

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply, and analyze		
CLO-1	the morphology and anatomy of vegetative and reproductive organs of Algae,	Up to K4
CLO-2	the morphology of mycelium and reproductive organs of Fungi	Up to K4
CLO-3	the thallus type and reproductive organs of Lichens	Up to K4
CLO-4	the vegetative and reproductive morphology of liverworts, hornworts and mosses of Bryophytes	Up to K4
CLO-5	.the morphology of plant body and reproductive parts of pteridophytes	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	2	1	2	2	2	3	3	1	3
CLO-2	2	2	1	1	2	2	2	2	2
CLO-3	-	2	3	2	3	3	2	1	3
CLO-4	2	1	1	1	2	2	3	3	2
CLO-5	-	2	-	1	1	-	2	2	2

3-Advance application; 2- Intermediate level; 1- Basic level

Mapping Programme Outcomes with Course Learning Outcome:

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	2	3	3
CLO-2	3	2	2	1	2
CLO-3	2	3	1	3	3
CLO-4	2	1	2	1	2
CLO-5	-	1	-	1	1

3-Advance application; 2- Intermediate level; 1- Basic level

LESSON PLAN

Sl. No.	Description	Hours	Mode
1	Description, Morphology and Anatomy of <i>Chara</i>	2	Observation of specimen, taking appropriate sections, demonstration and video clippings
2	Description, Morphology and Anatomy of <i>Sargassum</i>	2	
3	Description, Morphology and Anatomy of <i>Ulva</i>	2	
4	Description, Morphology and Anatomy of	2	
5	<i>Polysiphonia</i>	2	
6	Description, Morphology and Anatomy of <i>Gracilaria</i>	2	
7	Study the morphology and Anatomy of <i>Mucor</i>	2	
8	Study the morphology and Anatomy of <i>Peziza</i>	2	
9	Study the morphology and Anatomy of <i>Agaricus</i>	2	
10	Study the morphology and Anatomy of <i>Cercospora</i>	2	
11	Morphology and Anatomy of major groups of lichen	2	
12	Description and Micro- slide preparations of <i>Usnea</i>	2	
13	Morphology and anatomy of <i>Riccia</i>	2	
14	Morphology and Anatomy of <i>Funaria</i>	2	
15	Morphology and Anatomy of <i>Psilotum</i>	2	
16	Morphology and Anatomy of <i>Selaginella</i> Morphology and Anatomy of <i>Equisetum</i>	3	
17	Morphology and Anatomy of <i>Marsilea</i>	2	
18	Field visit to study fresh and marine algal forms, fungi, lichens, bryophytes and pteridophytes	10	

Course Designers:

Prof. V. Meenakshisundarm, Assistant Professor

DEPARTMENT OF BOTANY				CLASS: I B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core Practical	20U2BMP2	Major Practical - II	3	3	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To observe morphological, anatomical and reproductive features of gymnosperms
2. To trace the evolutionary links of gymnosperms studying fossil forms.
3. To understand the internal organizations of tissues of Angiosperms vegetative organs

Gymnosperms & Palaeobotany Practical

1. Observation of morphological features of plants discussed in the syllabus (*Cycas, Auracaria & Gnetum*)
2. Dissection and description of the parts of the plants in the syllabus
3. Micropreparation of slides of areal and below ground parts
4. Observation of fossil permanent slides (*Rhynia & Lepidodendron*)
5. Field study
6. Submission of records and field reports.

Plant Anatomy & Embryology Practical

1. Primary structure: Transverse section of Monocot and dicot stem
2. Primary structure: Transverse section of Monocot and dicot root
3. Transverse section of dorsiventral and isobilateral layers
4. Secondary structure of dicot stem
5. Anomalous structure : T.S. of *Achyranthus*
6. T.S. of mono and di thecous anthers
7. Dissection of dicot embryo
8. Observation of slides: shoot and root meristem, ovule types, embryo sac and pollen morphology
9. Demonstration of polyembryony and its applications
10. Demonstration of culturing embryo and endosperms for crop improvement

Rationale for Nature of the Course:

Documentation of various beneficial aspects of gymnosperms and tracing the evolutionary links by studying their fossil forms

Activities having direct bearing on Employability

Analyzing the anatomical properties of woods of gymnosperms and their fossil forms, and distinguishing the various levels internal organizations of vegetative organs of angiosperms; demonstration of polyembryony and culturing of embryo and endosperms for understanding crop improvement techniques

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply, and analyze		
CLO-1	the external and internal morphology of vegetative and reproductive organs of gymnosperms	Up to K4
CLO-2	The geological time scale and observation of plant fossil forms	Up to K4
CLO-3	The anatomy of stem, root and leaf of some dicotyledons and monocotyledons	Up to K4
CLO-4	the appropriate anatomical observations of anther, ovary and embryo	Up to K4
CLO-5	The demonstration of applications aspects of polyembryony and culturing of embryo and endosperms	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	3	1	2	1	3	3	3	1	3
CLO-2	3	2	2	1	2	3	2	2	2
CLO-3	-	3	3	2	3	3	3	3	2
CLO-4	3	2	2	1	2	2	3	3	2
CLO-5	-	2	-	3	1	-	2	2	2

3-Advance application; 2- Intermediate level; 1- Basic level

Mapping Programme Outcomes with Course Learning Outcome:

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	2	3	3	3
CLO-2	3	2	3	1	2
CLO-3	2	3	1	2	3
CLO-4	2	1	2	1	2
CLO-5	-	1	-	1	1

3-Advance application; 2- Intermediate level; 1- Basic level

Lesson Plan:

Sl.No	Description	Hours	Mode
1	Morphological features & Anatomy of <i>Cycas</i>	3	Observation of specimen, taking appropriate sections, demonstration and video clippings
	Morphological features & Anatomy of <i>Auracaria</i>	3	
	Morphological features & Anatomy of plants <i>Gnetum</i>	3	
	Asses and Characterization of fossil sides: <i>Rhynia</i> , <i>Lepidodendron</i> & <i>Cordaites</i>	4	
	Field study to be conducted to study various Gymnosperms	6	
2	Primary structure Transverse section of Monocot Stem, (Grass) & Root (<i>Zea mays</i>)	4	Observation of specimen, taking appropriate sections, demonstration and video clippings
	Primary structure Transverse section of Dicot Stem (<i>Tridax</i>) & Root (<i>Cicer</i>)	4	
	Transverse section of dorsiventral and isobilateral leaves (Grass & <i>Nerium</i>)	3	
	Secondary structure of dicot stem (<i>Achyranthes</i>) & Monocot (<i>Draceana</i>)	2	
	T.S. of mono and di thecous anthers	3	
	Dissection of dicot embryo & monocot embryo	3	
	Observations of Shoot and Root apical meristems	3	
	Observation of slides: ovule types, embryo sac and pollen morphology	3	
	Demonstration of polyembryony and culturing of embryo and endosperms for crop improvement	4	

Course Designers:

Dr. S. Karuppusamy, Assistant Professor

Prof. V. Meenakshisundaram, Assistant Professor

Nature of the course : Employability oriented

Rationale for the nature of the course:

Prospecting the economic potentiality of Algae, fungi and Lichens adopting the systematic identification methods.

Activities having direct bearing on employability

Identification of Algae, Fungi and Lichens by understanding their morphological and phytochemical characteristics adopted in their respective classifications

Course Outcome

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply and analyse		
CLO -1	the vegetative and reproductive morphology; classification and economic importance algae	Up to K4
CLO -2	the reproduction methods and the lifecycle patterns of some important algal genera	Up to K4
CLO -3	the general characters, types, nutrition, classification, and of fungi	Up to K4
CLO -4	the lifecycle of some type genera and the beneficial aspects of fungi	Up to K4
CLO -5	the occurrence, salient features, types, reproduction and economic importance of lichens	Up to K4

Nature of the course : Employability oriented

Rationale for the nature of the course:

Documenting the ecological and economic importance of Bryophytes and pteridophytes

Activities having direct bearing on employability

Identification of members Bryophytes and Pteridophytes using classifications.

Course Outcome

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply and analyse		
CLO -1	the occurrence, general characters, ecology and classification of bryophytes	Up to K4
CLO -2	the lifecycle of some types of genera and the economic importance of bryophytes	Up to K4
CLO -3	the Occurrence, general characters and classification, stellar organization. alternation of generations and economic importance of pteridophytes	Up to K4
CLO -4	the structure and lifecycle of <i>Psilotum</i> and <i>Selaginella</i>	Up to K4
CLO -5	the structure and lifecycle of <i>Equisetum</i> and <i>Marsilea</i>	Up to K4

Course Title: Gymnosperms and Palaeobotany

Course code: 20U2BMC3

Nature of the course: Employability oriented

Rationale for the nature of the course:

Enumeration of wood and essential oil sources from gymnosperms.

Activities having direct bearing on employability

External and internal morphological understanding of Gymnosperms and the fossil forms of gymnosperms with reference to geological time scale.

Course Outcome

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply and analyse		
CLO -1	the general characters, phylogeny, classification and economic importance of gymnosperms	Up to K4
CLO -2	the salient features of some orders and the type genus of gymnosperms	Up to K4
CLO -3	the salient features and lifecycle of <i>Auracaria</i> and <i>Gnetum</i>	Up to K4
CLO -4	the concepts of palaeobotany, geological time scale, age determination and types of fossil	Up to K4
CLO -5	the morphology and geological era of some fossil forms	Up to K4

Nature of the course: Employability oriented**Rationale for the nature of the course:**

Understanding the internal organizations of vegetative organs of angiosperms and tracing the events in the development of embryo and endosperms.

Activities having direct bearing on employability

Observation of anatomy of stem, leaf and roots of angiosperms.

Microscopical examinations of anther, ovary, embryo and endosperms of angiosperms

Demonstration of polyembryony and culturing of embryo and endosperms for crop improvement

Course Outcome

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply and analyse		
CLO -1	the characteristics of meristems and permanent tissues	Up to K4
CLO -2	the internal tissue organizations of dicotyledonous and monocotyledonous stem, root and leaf	Up to K4
CLO -3	the developmental events in anther and ovule	Up to K4
CLO -4	the development of embryo and endosperms	Up to K4
CLO -5	the polyembryony and the culturing of embryo and endosperms	Up to K4

THE MADURA COLLEGE (AUTONOMOUS), MADURAI - 11
DEPARTMENT OF BOTANY
Curriculum Structure for M.Sc. Botany (Major) to be implemented from 2021-2022

Sem	Course	Subject Code	Course Title	Hours / Week	Credits
I	Core-1	21P1BMC1	Plant Diversity- I*	5	4
	Core-2	21P1BMC2	Plant Diversity- II*	5	4
	Core-3	21P1BMC3	Plant Anatomy, Embryology and	5	4
	CElective-1	21P1BME1	Organic Farming	5	4
	Practical-1	21P1BMP1	Practical I**	4	2
	Practical-2	21P1BMP2	Practical II#	4	2
	NME-1	21P1NME1	Medicinal Botany	2	2
	Total Credits				22
II	Core-4	21P2BMC 4	Cell & Molecular Biology*	5	4
	Core-5	21P2BMC5	Genetics, Plant Breeding & Evolution*	5	4
	Core-6	21P2BMC6	Ecology & Conservation Biology#	5	4
	Elective-2	21P2BME2	Horticulture#	5	4
	Practical-3	21P2BMP3	Practical III**	4	2
	Practical-4	21P2BMP4	Practical IV#	4	2
	NME-2	21P2NME2	Food Science & Nutrition	2	2
	Total Credits				22
III	Core-7	21P3BMC 7	Taxonomy of Angiosperms*	5	4
	Core-8	21P3BMC 8	Plant Physiology*	5	4
	Core-9	21P3BMC 9	Biochemistry#	6	4
	CElective-3	21P3BME3	Microbiology and Plant pathology#	6	4
	Practical-5	21P3BMP5	Practical V**	4	2
	Practical-6	21P3BMP6	Practical VI##	4	2
	Total Credits				20
IV	Core-10	21P4BM10	Biostatistics & Biological Techniques#	5	4
	Core-11	21P4BM11	Forestry & Economic Botany#	5	4
	Core-12	21P4BM12	Genomics and Bioinformatics*	6	4
	CElective-4	21P4BME4	Applied Biotechnology*	6	4
	Practical-7	21P4BMP7	Practical VII**	4	2
	Practical-8	21P4BMP8	Practical VIII##	4	2
	PROJECT			--	6
	Total Credits				26
GRAND TOTAL OF CREDITS					90

BOTANY DEPARTMENT

Vision

- Producing Botany students as ambassadors of sustainable development in all spheres of human activity and leaving the earth to the successive generation as intact as possible.

Mission

- To sensitize the Botany students to the classification, structure, physiology, ecology, genetics and economic importance of plants
- To inculcate the students with an environment that fosters the development of appropriate scientific vocabulary, reasoning skills and effective oral and written communication ability for students
- To create holistic understanding of the allied subjects through interdisciplinary learning.

Programme specific learning outcomes (PSO) after the completion of the programme (M.Sc., Botany): the students will be able

PSO-1	To comprehend and apply knowledge in domain areas like medicinal botany and food science & nutrition and also non-domain areas of interest to the students.
PSO-2	To diagnose, circumscribe, identify compare and trace the evolutionary lineages based on the vegetative and reproductive characteristics; and biochemical and molecular characteristics of species of different plant divisions from various habitats.
PSO-3	To imply the conventional (plant breeding) and modern (Plant biotechnology) methods for crop improvements and conservation of threatened plants of various ecological impact.
PSO-4	To able to distinguish different microbes and utilize the microbial diversity for industries, sewage treatment and to study the remedies for infectious plant diseases.
PSO- 5	To understand and identify the primary and secondary metabolites and its role on dynamic plant physiology and inheritance; comprehend and solve the biological problems and practices of Biostatistics and Bioinformatics.

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core 1	21P1BMC1	Plant diversity – I	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives

1. To gain knowledge on the characteristic features, classification and distribution of algae, fungi, lichens and bryophytes.
2. To understand the methods of reproduction and life cycle of algae, fungi, lichens and bryophytes.
3. To enumerate the ecological and economic importance of algae, fungi, lichens and bryophytes.

UNIT	CONTENT	CLO	K LEVEL	HOURS
1	Algae: Introduction; criteria for algal classification; classification by Fritch; Algal habitats - freshwater algae, marine algae, soil algae, symbiotic algae and parasitic algae. ultra structure of prokaryotic and eukaryotic algal cells and their components - cell wall, protoplasm, eye spots, chloroplast, pyrenoid, nucleus. origin and evolution of sex in algae	1	Up to K4	15
2	Thallus organization, pigmentation, reserve food material, flagellation- life cycle patterns and phylogeny for the following major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae., fossil algae. economic importance of algae: food and feed - single cell protein - industrial products (Agar-Agar, carrageenan, alginic acid, vitamins and biofuel) – medicinal values and Diatomaceous earth. algal cultivation methods.	2	Up to K4	15
3	Fungi: General features; occurrence and distribution; mode of nutrition in fungi; culture of fungi. classification of fungi by Alexopoulos and Mims, 1979; general characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Phylogeny and interrelationships of major groups of fungi. homothallism and heterothallism. homokaryon and heterokaryon. reproduction, life cycle types, parasexual cycles.	3	Up to K4	15

4	Mycelial modifications; fruiting bodies- spore dispersal mechanism- physiological specialization and degeneration of sex in fungi. Economic importance of fungi; as medicines and in industries. Lichens: Introduction – classification of lichens – distribution – interrelationship – phycobionts – mycobionts – thallus organization – vegetative propagules- reproduction – lichens as indicator of pollution – economic importance of lichens.	4	Up to K4	15
5	Bryophytes: General features, distribution, classification (Watson, 1971), general characters of major classes. Hepaticopsida, Anthocerotopsida and Bryopsida. range of vegetative structure, evolution of gametophytes and sporophytes. Reproduction – Vegetative, asexual and sexual, spore dispersal mechanisms in bryophytes; ecological and economic importance of bryophytes. Origin and interrelationships, Fossil bryophytes.	5	Up to K4	15

Books for study

1. Alexopoulos, C. J. (1996) Introductory Mycology. Wiley Publishers, ISBN: 9780471522294.
2. Cooke, M. C. (2017) Fungi: Their Nature and Uses. Historical Books Ltd., London, ISBN: 978-1545335581
3. Bilgrami, K. S. (2010) A Textbook of Algae. CBS Publisher & Distributors, New Delhi, ISBN: 978-8123900490
4. Edwardlee, R. (2008) Phycology, 4th Edition, Cambridge University Press, London, ISBN: 0521682770.
5. Barsanti, L. and Guadtieri, P. (2014) Algae: Anatomy, Biochemistry and Biotechnology, 2nd Edition, CRC Press, ISBN: 1439867321.

Books for references:

1. Ahmadjian, V. and Hale, M. E. (1973) The Lichens. Springer Verlag, Berlin. ISBN: 978-0-12-044950-7
2. Johri, R. M., Lata, S. and Tyagi, K. (2012). A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.
3. Suresh Kumar (2014) Textbook of Bryophyta. K.K. Publication, New Delhi, ISBN: 978-8184115093
4. Stephenson, S. L. (2010) The Kingdom Fungi: An Introduction to Mushrooms, Molds and Lichens, 1st Edition, Timber Press, ISBN: 0881928917.
5. Schofield, W. B. (2001) Introduction to Bryology, 1st Edition, The Blackburn Press, ISBN: 1930665261.

Web Resources:

1. <https://www.easybiologyclass.com/?s=algae>
2. <https://www.britannica.com/search?query=fungi>
3. <https://www.britannica.com/science/lichen>

Rationale for Nature of the Course:

Demonstration and field visit to areas of mass cultivation of algae and fungi of nutritional, pharmaceutical, industrial and ecosystem restoration interests.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Observation of morphology and scientific identification of species of the respective plant divisions

Analyzing the ecological and economic significance of algae, fungi, lichens and bryophytes

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Documenting the ecological and utility aspects of lichens and bryophytes

CLOs	CLO Statement	Knowledge Level
<u>Students will be able to know, understand, apply and analyse</u>		
CLO -1	the vegetative and reproductive morphology; classification and phylogeny of lower algae	Up to K4
CLO -2	the ecology, exclusive cellular components and economic importance of algae	Up to K4
CLO -3	the general characters, culture methods, classification, phylogeny and economic importance of fungi	Up to K4
CLO -4	the some special considerations of fungi and thallus organizations, reproduction and economic importance of lichens	Up to K4
CLO -5	the salient features, major classes, ecology and economic importance of bryophytes	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	1	2	2	2
CLO-2	2	2	2	3	2
CLO-3	2	3	3	2	3
CLO-4	3	3	3	3	3
CLO-5	3	3	3	2	3

3-Advance application, 2- Intermediate level, 1- Basic level

Lesson Plan

Unit	Description	Hrs	Mode
I	a) Introduction to algae	2	Chalk and talk PPT, LMS and Group discussion
	b) Classification classification by Fritsch	2	
	c) Thallus organization, pigmentation	3	
	d) Reserve food material, flagellation	2	
	e) Life cycle patterns and phylogeny for the Cyanophyceae, Chlorophyceae	2	
	f) Xanthophyceae, Bacillariophyceae	2	
	g) Phaeophyceae and Rhodophyceae.	2	
II	a) Algal habitats - freshwater algae, marine algae, soil algae, symbiotic algae and parasitic algae.	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Ultra structure of prokaryotic and eukaryotic algal cells and their components - cell wall, protoplasm, eye spots, chloroplast, pyrenoid, nucleus.	3	
	c) Origin and evolution of sex in algae, fossil algae. economic importance of algae: food and feed - single cell protein - industrial products (Agar-Agar, carrageenan, alginic acid, vitamins and biofuel)- medicinal values and Diatomaceous earth.	5	
	d) Algal cultivation methods.	2	
III	a) General features; occurrence and distribution mode of nutrition in fungi	2	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Culture of fungi. classification of fungi by Alexopoulos and Mims, 1979;	3	
	c) General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.	2	
	d) Phylogeny and interrelationships of major groups of fungi.	2	
	e) Homothallism and heterothallism. homokaryon and heterokaryon.	3	
	f) Reproduction, life cycle types, parasexual cycles. economic importance of fungi; as medicines and in industries.	3	
IV	a) Mycelial modifications; fruiting bodies	2	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Spore dispersal mechanism- physiological specialization and degeneration of sex in fungi.	2	
	c) Lichens: Introduction- classification of lichens	2	
	d) Distribution – interrelationship- phycobionts – mycobionts	2	
	e) Thallus organization –vegetative propagules	2	
	f) Reproduction – lichens as indicator of pollution	3	
	g) Economic importance of lichens.	2	

V	a) Bryophytes: General features, distribution	1	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Classification of Bryophytes (Watson, 1971)	1	
	c) general characters of major classes. Hepaticopsida, Anthocerotopsida and Bryopsida.		
	d) Range of vegetative structure, evolution of gametophytes and sporophytes.	2	
	e) Reproduction – Vegetative, asexual and sexual,	3	
	f) Spore dispersal mechanisms in bryophytes	3	
	g) Ecological and economic importance of bryophytes	3	
	h) Origin and interrelationships, Fossil bryophytes.	2	

Course Designer: **Prof. S. Chella Pandian, Associate Professor**

PG Botany Blue Print

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core 2	21P1BMC2	Plant diversity – II	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

1. To acquaint with the classification, phylogeny, evolutionary trends and life cycle of Pteridophytes and Gymnosperms.
2. To understand the salient features of fossil forms of Pteridophytes and Gymnosperms.
3. To learn the concept of Palaeobotany and economic importance of fossil plants.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Pteridophytes: General features and classification (Reimer's, 1954) - Telome concept- life cycle and its origin of Pteridophytes - deviation mechanisms – apogamy and apospory - range of morphology, structure, reproduction and evolution of gametophytes and sporophytes. Fossil Pteridophytes – a brief account on <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Sphenophyllum</i> and <i>Calamites</i> .	1	Up to K4	15
II	Vegetative and reproductive morphology of living Pteridophytes – general characters of the following orders: psilophytales, lycophytales, equisetals, polypodiales and marsileales. stelar evolution – structure, development and evolution of sorus - heterospory and origin of seed habit - economic importance.	2	Up to K4	15
III	Gymnosperms: General characters – origin of gymnosperms – classification by Sporne, 1965 - salient features of fossil gymnosperms- pteridospermales, bennettitales, pentoxylales, cycadales, cordaitales and coniferales	3	Up to K4	15
IV	General account, distribution, morphology, anatomy, reproduction and phylogeny of cycadales, coniferales and gnetales- economic importance - woods of gymnosperms.	4	Up to K4	15
V	Palaeobotany: Concepts of palaeobotany - geological time scale – fossilization- impressions, compressions, incrustation, casts, molds and petrifications – age determination and methods of study of fossils – carbon dating- role of fossils in oil exploration – palaeopalynology –Birbal Sahni's contributions.	5	Up to K4	15

Books for study:

1. Sporne, K.R. 1970. The morphology of Pteridophytes (The structure of Ferns and Allied Plants), Hutchinson University, London.
2. Pandey, B.P. 1998. A Text Book of Botany Vol. II. S Chand, New Delhi.
3. Stuart WN (1998). Paleobotany and Evolution of Plants, New York Publications.
4. Parihar, N.S (1967). An introduction to Embryophyta vol. II. Pteridophyta. Central Book Depot, Allahabad.
5. Sporne, K.R (1976). Morphology of Pteridophytes. B.I. Publishers, New Delhi.
6. Smith, G.M. (1955). Cryptogamic Botany. Vol. III. McGraw Hill, New Delhi.
7. Rashid A (2013) An introduction to Pteridophyta – Diversity, Development and Differentiation (2nd edition), Vikas Publications.

Books for Reference:

1. Johri, R.M., Lata S., Tyagi K (2005), A text book of Gymnosperms, Dominant pub and Distributer, New Delhi
2. Vastishta PC Sinha AK Anikumar (2006). Pteridophyta (Revised edition), S. Chand and Company, Pvt. Ltd. New Delhi.
3. Vastishta PC Sinha AK Anikumar (2006). Gymnosperms (Revised edition), S. Chand and Company, Pvt. Ltd., New Delhi.
4. Rashid A (2013) An introduction to Pteridophyta – Diversity, Development and Differentiation (2nd edition), Vikas Publications.

Web Resources:

1. <https://www.britannica.com/search?query=Gymnosperms>
2. <https://www.easybiologyclass.com/classification-of-gymnosperms-by-sporne-short-notes/>
3. <https://www.britannica.com/plant/plant/Evolution-and-paleobotany>
4. <https://indiabiodiversity.org>

Rationale for Nature of the Course:

Identification of the members of pteridophytes and gymnosperms by observing their characteristic vegetative and reproductive morphology and by referring appropriate manuals/floras.

Conducting field study trip to their natural habitats and to visit vendors of these plant resources to understand their economic values

To document the utilization aspects of these plant divisions at the global level.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Comparative vegetative and reproductive morphological studies of pteridophytes and gymnosperms

Tracing the evolutionary lineages of living and fossil members these plant divisions with reference to floristic geological time scale

Prospecting the utility of pharmaceutical and timber resources for utilitarian values

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
<u>Students will be able to know, understand, apply and analyse</u>		
CLO -1	the general features, classification, evolution and economic importance of Pteridophytes	Up to K4
CLO -2	the comparative characteristics of Orders of Pteridophytes	Up to K4
CLO -3	the salient features, origin and classification of gymnosperms	Up to K4
CLO -4	the anatomy, reproduction, phylogeny and economic importance of gymnosperms	Up to K4
CLO -5	the concept of paleobotany, geological time scale, fossilization methods and study of fossils	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	2	3	1	2
CLO-2	2	1	3	2	2
CLO-3	3	3	3	3	3
CLO-4	3	3	1	2	3
CLO-5	3	3	2	3	3

3-Advance application, 2- Intermediate level, 1- Basic level

Lesson Plan

Unit	Description	Hrs	Mode
I	a) Pteridophytes: General features and classification (Reimer's, 1954) b) Telome concept- life cycle and its origin of Pteridophytes - deviation mechanisms – apogamy and apospory - range of morphology c) Structure, reproduction and evolution of gametophytes and sporophytes d) Fossil Pteridophytes – a brief account on <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Sphenophyllum</i> and <i>Calamites</i> .	2 5 5 3	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
II	a) Vegetative and reproductive morphology of living Pteridophytes b) General characters of the following orders: psilophytales, lycophtaes, equsetales, polypodiales and marsileales. c) Stelar evolution – structure, development and evolution of sorus d) Heterospory and origin of seed habit - economic importance.	4 6 2 3	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion

III	a) Gymnosperms: General characters – origin of gymnosperms	3	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Classification by Sporne, 1965	5	
	c) Salient features of fossil gymnosperms- pteridospermales, bennettitales, pentoxylales, cycadales, cordaitales and coniferales.	7	
IV	a) General account, distribution, morphology, anatomy, reproduction and phylogeny of Cycadales	6	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Coniferales and gnetales	6	
	c) Economic importance - woods of gymnosperms.	3	
V	a) Palaeobotany: Concepts of palaeobotany - geological time scale	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Fossilization- impressions, compressions, incrustation, casts, molds and petrifications – age determination and methods of study of fossils	5	
	c) Carbon dating- role of fossils in oil exploration – palaeopalynology –Birbal Sahni’s contributions.		

Course Designer: Dr. P. Kannan, Assistant Professor

PG Botany BluePrint

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment Summative

Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Core 3	21P1BMC3	Plant Anatomy, Embryology and Morphogenesis	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Objectives

1. To gain knowledge on the structure and functional development of plant cells and tissues.
2. To differentiate the normal and anomalous secondary growth in Dicots and Monocots.
3. To understand the formation and development of embryo and their applications for crop improvement.
4. To understand the critical steps in the differentiation of tissues and organs.

UNIT	CONTENT	CLO	K LEVEL	HOURS
1	Plant Anatomy: Meristems – characters, classification and theories – Apical cell theory, shoot apical meristem (SAM), root organization – root apical meristem (RAM). Secondary structure of dicot stem and root. Identification of common timbers - Heart wood and sap wood-strength, ability, grains, texture and defects. Anomalous secondary growth in Dicots and Monocots (Boerhaavia, Bougainvillea, Amaranthus, Mirabilis and Dracaena).	1	Up to K4	15
2	Embryology of Angiosperms: Development of microspores and megaspores – types and factors involved. Development of microgametophyte – pollen wall development - vegetative and generative cells; pollen viability test. Development of megagametophyte – structure and types of ovule. Development of monosporic, bisporic and tetrasporic types of embryo sac and their cellular organization. Endosperm – Origin, types, structure, development. Haustorial endosperms	2	Up to K4	15
3	Pollen-Pistil interaction and fertilization, types of stigma and style events on stigmatic surface, pollen tube growth, guidance and entry into ovule and embryo sac. Double fertilization – significance. Incompatibility – interspecific – homomorphic and heteromorphic, Causes and methods to overcome incompatibility. Classification of embryo development in Dicots and Monocots. Polyembryony – causes – Apomixis, Apospory. Their role in crop improvement programmes and seed development. Biochemical and physical factors in fruit development. Parthenocarpy. Prospects and significance of embryo, pollen and endosperm culture.	3	Up to K4	15

4	Morphogenesis: Concept of morphogenesis as a package of development; components – cell division, division planes, their importance; Cytoskeleton, pre-prophase band in orienting karyokinesis and cell plate. Origin, Structure, development and ontogeny of xylem and phloem. Role of sucrose in Vascular tissue differentiation. Vascular Cambium – Types, divisions, arrangement and seasonal activity, factors affecting cambial activity.	4	Up to K4	15
5	Leaf ontogeny – initiation, apical, intercalary, marginal and adaxial growth, plate meristem and development of vascular tissues, plastochronic index, zone of foliar inhibition in apices. Transfer cells – Structure, development and functions. Classical concept of flower; Floral anatomy and its role in classification, ABC model of ontogeny of flower. Plant galls - types, structure and development. Role of polarity in cell differentiation and symmetry (Polarity in cuttings, unicellular coenocytes, eggs and spores).	5	Up to K4	15

Books for study

1. Agarwal, S. B. 1990 Embryology of Angiosperms - a fundamental approach. Sahitya Bhawan, Agra.
2. Clowers, F. A. L. 1961 Apical Meristems. Blackwell Scientific Publication, Oxford.
3. Bhojwani S. S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi
4. Cutler, D.F. 1978, Applied plant Anatomy, Orient Longman Publishers, New Delhi
5. Dwivedi, J. N. 1998 Embryology of Angiosperms. Rastogi and Co., Meerut.
6. Easu, K. 1953 Plant Anatomy. John Wiley & Sons Inc., New York.
7. Easu, 1987. The Anatomy of seed plants. Wiley Eastern Ltd., New Delhi
8. Fahn, A. 1989 Plant Anatomy, Pergamon press, Oxford, New York.
9. Fosket, D.E. 1994. Plant Growth and Development – a molecular approach. Academic Press.
10. Johri, B.M. 1984 Embryology and Angiosperms. Springer Verlag, Berlin

Books for reference

1. Maheshwari, P. 2015. An Introduction to the Embryology of Angiosperms, Scholar Select Publishers.
2. Metcalfe and Chalk 1950 Anatomy of the Dicotyledons and Monocotyledons. Vol. I and II. Clarendon Press, Oxford, UK.
3. Pandey, A.K., 1997. Introduction to Embryology. CBS Publishers and Distributors, New Delhi
4. Pandey, B. P. 1989 Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
5. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House Pvt. Ltd., New Delhi
6. Paula J. Rudall, 2007. Anatomy of Flowering Plants: An Introduction to Structure and Development (3rd Edition), Cambridge University Press.
7. Ray F. Evert, 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. John Wiley & Sons.
8. Shivanna, K. R. 2003. Pollen Biology and Biotechnology. Oxford and IBH publishing house, New Delhi.
9. Singh, V., Pande, P. C. and Jain, D. K. 1987 Anatomy of Seed Plants. Rastogi Publications, Meerut. Embryology

Rationale for Nature of the Course:

Enumerating the sources and quality of fibres and timbers

Visiting the crop improvement centers to acquaint with the modern techniques

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Observation of internal morphology of different habits of angiosperms adopting hand and microtome sectioning of different dimensions (T.S, RLS and TLS), differential staining, tissue maceration and permanent slide preparations.

Analyzing the fibre and timber quality of the plants of interests

Understanding and applications of conventional crop improvement techniques

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
<u>Students will be able to know, understand, apply, and analyse</u>		
CLO -1	the characteristics and classifications of meristems, theories on apical meristems, secondary and anomalous secondary structures of stem and root	Up to K4
CLO -2	The micro and megasporogenesis; development of male gametophyte, ontogeny of types of embryo sac and endosperms	Up to K4
CLO -3	The pollen pistil interactions, double fertilization, classification of embryo development and polyembryony	Up to K4
CLO -4	the components of morphogenesis like cell division, cytoskeleton, cambial activity and xylem and phloem differentiation	Up to K4
CLO -5	the development of leaf, flower and galls; and role of polarity in plant development	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	2	3	1	2
CLO-2	2	1	3	2	2
CLO-3	3	3	3	3	3
CLO-4	3	3	1	2	3
CLO-5	3	3	2	3	3

Lesson plan

Unit	Description	Hours	Mode
I	Meristems – characters, classification and theories – Apical cell theory, shoot apical meristem (SAM), root organization – root apical meristem (RAM).	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	Secondary structure of dicot stem and root. Identification of common timbers - Heart wood and sap wood-strength, ability, grains, texture and defects.	5	
	Anomalous secondary growth in Dicots and Monocots (Boerhaavia, Bougainvillea, Amaranthus, Mirabilis and Dracaena).	5	
II	Development of microspores and megaspores – types and factors involved. Development of micro gametophyte – pollen wall development - vegetative and generative cells; pollen viability test.	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	Development of megagametophyte – structure and types of ovule. Development of monosporic, biosporic and tetrasporic types of embryosac and their cellular organization.	5	
	Endosperm – Origin, types, structure, development. Haustorial endosperms.	5	
III	Pollen-Pistil interaction and fertilization, types of stigma and style events on stigmatic surface, pollen tube growth, guidance and entry into ovule and embryo sac.	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	Double fertilization – significance. Incompatibility – interspecific – homomorphic and heteromorphic, Causes and methods to overcome incompatibility. Classification of embryo development in Dicots and Monocots.	5	
	Polyembryony – causes – Apomixis, Apospory. Their role in crop improvement programmes and seed development. Biochemical and physical factors in fruit development. Parthenocarpy. Prospects and significance of embryo, pollen and endosperm culture.	5	
IV	Morphogenesis: Concept of morphogenesis as a package of development; components – cell division, division planes, their importance; Cytoskeleton, pre-prophase band in orienting karyokinesis and cell plate.	8	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	Origin, Structure, development and ontogeny of xylem and phloem. Role of sucrose in Vascular tissue differentiation.	4	
	Vascular Cambium – Types, divisions, arrangement and seasonal activity, factors affecting cambial activity.	3	

V	Leaf ontogeny – initiation, apical, intercalary, marginal and adaxial growth, plate meristem and development of vascular tissues, plastochronic index, zone of foliar inhibition in apices. Transfer cells – Structure, development and functions. Classical concept of flower; Floral anatomy and its role in classification, ABC model of ontogeny of flower. Plant galls - types, structure and development. Role of polarity in cell differentiation and symmetry (Polarity in cuttings, unicellular coenocytes, eggs and spores).	4	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
		3	
		3	
		5	

Course Designer: Dr. S. Karuppusamy, Assistant Professor

PG Botany BluePrint

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Elective 1	21P1BME1	Organic Farming	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Objective:

1. To gain knowledge on various aspects of organic farming.
2. To understand the relevance of organic farming, its advantages and short comings against conventional high input agriculture.
3. To create awareness on the importance of organic farming in the present scenario and its impact on environment and human health.

Unit	Content	CLO	K level	Hours
I	Importance of organic farming: Introduction- Definition – Scope – principles and concepts – history of organic farming – Indian and global scenario – Agro-biodiversity: importance and measures to preserve traditional biodiversity – pre requisites for Organic farming. Green revolution – definition – impacts, Natural resources and their management.	1	Up to K4	15
II	Organic sources of nutrients – on farm and off farm sources – organic waste recycling methods- compost – compost making – <i>In situ</i> and <i>ex situ</i> manuring – soil and crop management – inter cropping, crop rotation, green manures, cover crops, mulching – bio fertilizers.	2	Up to K4	15
III	Indigenous practices of organic farming- role of livestock – cow in organic farming – Panchagavya – Dasagavya – Amirthakaraial – preparation – properties – general effects on crops.	3	Up to K4	15
IV	Organic certification:- NPOP guidelines – Certification agencies in India – crop production standards – Quality considerations – labeling and accreditation process – marketing and export opportunities – APEDA.	4	Up to K4	15
V	Bio-intensive nutrient management: application of Effective micro organism (EM) technology – phosphate rich organic manure (PROM). Weed management in organic farming – organic crop protection methods. Organic rice production – economic evaluation – benefits – organic enterprises.	5	Up to K4	15

Books for the study

1. Organic Farming Theory & Practice – Scientific publishers, Palaniappan SP. and K. Annadurai. 2010.
2. Organic Farming Manual- Storey Publishing, Ann Larkin Hansen- 2010
3. Organic Farming – Voyageur Press, 2014.

Books for Reference

1. Arunkumar Sharma 2008. A Hand book of organic Farming. Agrobios Publishers.
2. Dahama, A.K. 2009. Organic Farming for Sustainable Agriculture, Agrobios publishers.
3. Palaniappan SP. and K. Annadurai. 2008. Organic Farming: Theory and Practice. Scientific Publishers.
4. Veeresh, G.K. 2010. Organic Farming, Cambridge University Press, India.

Web Resources

<https://www.conserve-energy-future.com/organic-farming-benefits>.
<https://en.wikipedia.org/wiki/Compost>
<https://rodaleinstitute.org/why-organic/organic-farming-practices/composting>
<https://www.britannica.com/topic/organic-farming>
<https://www.biologydiscussion.com/essay/bio-fertilizers-types-and-importance-of-bio-fertilizers/1901>

Rationale for Nature of the Course:

Meeting the demand and necessity of balanced nutrients, due to population explosion, by adopting eco-friendly approaches.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Understanding the facts and prospects of agrobiodiversity, organic farming, organic certification, biointensive nutrient management

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply, and analyse		
CLO -1	The importance, scope, principles, concepts and Indian and global scenario of organic farming; green revolution, agroforestry and natural resources management	Up to K4
CLO -2	The organic sources of nutrients, organic waste recycling, manuring methods and crop management	Up to K4
CLO -3	The Indigenous practices of organic farming and its effects on crops	Up to K4
CLO -4	The Quality considerations, marketing and export opportunities of organic farming	Up to K4
CLO -5	The bio intensive nutrient management, weed management, rice production in organic farming	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	1	1
CLO-2	3	2	1	3	1
CLO-3	2	2	1	3	3
CLO-4	1	1	1	2	3
CLO-5	2	2	1	2	3

3-Advance application, 2- Intermediate level, 1- Basic level

Lesson Plan

Unit	Description	Hrs	Mode
I	a) Introduction and Scope of organic farming b) history of organic farming c) Indian and global scenario d) Agro-biodiversity e) preserve traditional biodiversity f) Green revolution g) Natural resources and their management.	2 2 2 2 3 2 2	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
II	a) Organic sources of nutrients b) organic waste recycling methods c) compost making d) <i>In situ</i> and <i>ex situ</i> manuring e) Soil and crop management f) inter cropping, crop rotation g) green manures h) mulching – bio fertilizers.	2 2 2 2 1 2 2 2	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
III	a) Indigenous practices of organic farming- b) role of livestock c) cow in organic farming d) preparation and properties of Panchagavya e) Dasagavya f) Amirthakaraial	3 2 1 3 3 3	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion

IV	a) Organic certification:– NPOP guidelines	3	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Certification agencies in India	2	
	c) Crop production standards	2	
	d) Quality considerations	3	
	e) labeling and accreditation process	2	
	f) marketing and export opportunities – APEDA.	3	
V	a) application of Effective micro organism (EM) technology	3	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b) Phosphate rich organic manure (PROM).	3	
	c) Weed management inorganic farming	3	
	d) Organic crop protection methods.	3	
	e) Organic rice production	3	

Course Designer: Dr. P. Jansi Rani, Assistant Professor

PG Botany BluePrint

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Practical 1	21P1BMP1	Practical-I**	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives:

1. To observe morphological, anatomical and reproductive features of Algae, Fungi, Lichens & Bryophytes.
2. To train the students to prepare micro slides for observation under microscope.
3. To train the students thru practices on organic farming and equip them become entrepreneur

Plant Diversity-I Practical

1. Study of the morphology of Algae (*Oscillatoria*, *Volvox*, *Caulerpa*, *Padina*, *Gelidium* & *Diatoms*)
2. Study of the morphology of Fungi (*Phytophthora*, *Rhizopus*, *Polyporus* and *Fusarium*) & Lichens (*Parmelia* and *Usnea*).
3. Study of the morphology of Bryophytes (*Riccia*, *Anthoceros* and *Polytrichum*)
4. Make micro- slide preparations of aerial and reproductive parts.
5. Demonstration of mass cultivation of freshwater and marine algae; and fungi
6. Field visit to study fresh water/ marine water algal forms and their mass cultivation sites
7. Field visit to study different forms of bryophytes for a minimum of two days.

Plant diversity II Practical

1. Study of the vegetative and reproductive morphology of Pteridophytes (*Angiopteris*, *Equisetum*, *Ophioglossum*, *Polypodium* and *Marselia*)
2. Observation of fossil pteridophytes
3. Study of the vegetative and reproductive morphology of Gymnosperms (*Cycas*, *Ginkgo*, *Taxus*, *Ephedra* and *Gnetum*).
4. Study of the 3D internal structure of pteridophytes and gymnosperms taking appropriate sections and micro-slide preparations.
5. Group discussion on the comparative morphology and geological time period of pteridophytes and gymnosperms at the class and order levels respectively.
6. Field visit to study local pteridophytes and gymnosperms.
7. Field visit to study different vegetations to observe pteridophytes and gymnsperms for a minimum of two days.
8. Collection and enumeration of economically important pteridophytes and gymnosperms

Rationale for Nature of the Course:

Prospecting the economically important pteridophytes and gymnosperms

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Observation of internal morphology of different habits of angiosperms adopting hand and microtome sectioning of different dimensions (T.S, RLS and TLS), differential staining, tissue maceration and permanent slide preparations.

Analyzing the fibre and timber quality of the plants of interests

Understanding and applications of conventional crop improvement techniques

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply, and analyse		
CLO -1	the external and internal morphology of Algae, Fungi, Lichens. Bryophytes, Pteridophytes and Gymnosperms	Up to K4
CLO -2	the phylogenetic relationships of within and between the members of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms	Up to K4
CLO -3	the knowledge on economic importance in Algae, Fungi, Lichens. Bryophytes, Pteridophytes and Gymnosperms	Up to K4
CLO -4	the fossil forms of these plant divisions	Up to K4
CLO -5	the demonstration of mass culturing of some economically important algal and fungal members	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	2	2	3
CO-2	3	2	2	2	2
CO-3	1	3	3	2	3
CO-4	3	2	2	3	3
CO-5	2	2	2	3	2

3-Advance application, 2- Intermediate level, 1- Basic level

Lesson Plan

Sl. No	Description	Hrs	Mode
I	a) Study of the morphology using micro-slide preparation of <i>Oscillatoria</i> , <i>Volvox</i> , <i>Caulerpa</i> , <i>Padina</i> , <i>Diatoms</i> , <i>Gelidium</i>	6	Experiments, demonstration videos and field trips
	b) Mass culturing some algal and fungal members	6	
	c) Micro-examination of the fungi <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Polyporus</i> , <i>Fusarium</i>	6	
	d) Study the morphology and anatomy of Lichens <i>Parmelia</i> , <i>Usnea</i>	6	
	e) Study of the morphology and anatomy of <i>Riccia</i> , <i>Anthoceros</i> , <i>Reboulia</i> , <i>Polytrichum</i>	6	
I	a) Microslide preparations and observations of <i>Angiopteris</i>	3	Experiments, demonstration and videos
	b) Microslide preparations and observations of <i>Equisetum</i>	3	
	c) Microslide preparations and observations of <i>Ophioglossum</i>	3	
	d) Microslide preparations and observations of <i>Polypodium</i>	3	
	e) Microslide preparations and observations of <i>Marselia</i>	3	
	f) Microslide preparations and observations of <i>Cycas</i>	3	
	g) Microslide preparations and observations of <i>Ginkgo</i>	3	
	h) Microslide preparations and observations of <i>Taxus</i>	3	
	i) Microslide preparations and observations of <i>Ephedra</i>	3	
	j) Microslide preparations and observations of <i>Gnetum</i>	3	

Course Designer (s): **Dr. P. Kannan, Assistant Professor**
Dr. P. Janci Rani, Assistant Professor;
Prof. R. Saranya, Assistant Professor

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major Practical 2	21P1BMP2	Practical-II#	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To observe vegetative and reproductive morphological, features of Pteridophytes and Gymnosperms
2. To train the students to prepare appropriate microsections for the observation of 3D structure of tissues in the vegetative and reproductive structures of gymnosperms and angiosperms
3. To observe spotters of Anatomy, Embryology and morphogenesis interest

Plant anatomy, Embryology and Morphogenesis

1. Tissue maceration – cell wall pattern of xylem vessels
2. Micro-slide preparation and observation of SAM and RAM
3. Micro-slide preparation and observation of primary structure of dicot stem, root and leaf; monocot stem, root and leaf
4. Micro-slide preparation and observation of secondary structure of dicot stem and root.
5. Pollen morphology
6. Pollen germination
7. Pollen viability test
8. Anatomical observation of anther and ovary
9. Separation of pollinium
10. Modes of pollination of different species in the campus
11. Studying pollination mechanisms of different species
12. Dissection of embryo
13. Demonstration of pollen, embryo and endosperm cultures
14. Demonstration of crop improvement techniques
15. Demonstration of permanent slide preparations.

Rationale for Nature of the Course:

Anatomical analysis for the identification and quality of wood and fibre

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Demonstration of permanent slide preparations which will help the students to commercially prepare for educational institutions.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CO Statement	Knowledge Level
<u>Students will be able to know, understand, apply, and analyse</u>		
CO -1	the internal morphology of apical meristems, primary structure of dicot stem and root, monocot stem and root	Up to K4
CO -2	the normal and anomalous secondary structure of dicot stem	Up to K4
CO -3	the pollen morphology, germination and its viability	Up to K4
CO -4	the structure and types of ovules, structure of dicot and monocot embryo	Up to K4
CO -5	the demonstration of culturing pollen, embryo and endosperms; demonstration of crop improvement techniques	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	-	2	1	3	2
CO-2	-	1	2	2	2
CO-3	-	2	3	2	3
CO-4	-	2	2	2	3
CO-5	-	3	2	3	2

3-Advance application, 2- Intermediate level, 1- Basic level

Lesson plan

S. No	Description	Hrs	Mode
II	1. Tissue maceration – cell wall pattern of xylem vessels	4	Experiments, demonstration and videos
	2. Micro-slide preparation and observation of SAM and RAM	2	
	3. Micro-slide preparation and observation of primary structure of dicot stem, root and leaf; monocot stem, root and leaf	6	
	4. Micro-slide preparation and observation of secondary structure of dicot stem and root.	6	
	5. Pollen morphology	2	
	6. Pollen germination	4	
	7. Pollen viability test	4	
	8. Anatomical observation of anther and ovary	4	
	9. Separation of pollinium		
	10. Modes of pollination of different species in the campus	2 6	
	11. Studying pollination mechanisms of different species	6	
	12. Dissection of embryo	2	
	13. Demonstration of pollen, embryo and endosperm cultures	4	
	14. Demonstration of crop improvement techniques	4	
	15. Demonstration of permanent slide preparations.	4	

Course Designers: Dr. S. Karuppusamy

Prof. V. Meenakshi Sundaram

DEPARTMENT OF BOTANY				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Non-Major Elective-1	21P1BNM1	Medicinal Botany	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Objectives

- To gain knowledge on indigenous and traditional medicinal systems
- To understand the medicinal plant diversity and their conservation.
- To know the medicinally important phytochemicals and their extraction methods.

Unit	Content	CLO	K level	Hours
I	Introduction - Historical background - scope; Indigenous medicinal systems in India - Siddha, Ayurveda, Unani, homeopathy - ethnomedicine. Need to preserve traditional knowledge systems	1	Up to K2	6
II	Importance of Indian medicinal plants - bioprospection - hotspots-endemic medicinal plants - importance of medicinal plants of Tamil Nadu; Senna, Gymnema, Curcuma, Catharanthus, Aloe and Gloriosa.	2	Up to K2	6
III	Phytochemicals and their types, extraction and purification methods of plant constituents - medicinal importance of alkaloids, glycosides, flavonoids and volatile oils	3	Up to K2	6
IV	Collection and harvest technology of medicinal herbs - factors responsible for deterioration of medicinal drugs-storage, processing - packaging of crude drugs.	4	Up to K2	6
V	Conservation of medicinal plants - in situ and ex situ methods - centres of medicinal plant conservation in India - IBPGRI, CIMAP-CDRI, NBGRI, TBGRI and TAMPCLOL.	5	Up to K2	6

Rationale for Nature of the Course:

Gained knowledge on indigenous medicinal systems and the medicinal plant diversity
Skill on extraction of phytochemicals and conservation of medicinal plants

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Industrial visit to acquaint with the skills on extraction methods.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CO Statement	Knowledge Level
Students will be able to know, understand, apply, and analyse		
CLO -1	the indigenous and traditional medicinal systems in India	Up to K2
CLO -2	the medicinal plant diversity with important medicinal plants	Up to K2
CLO -3	the extraction methods of various phytochemicals	Up to K2
CLO -4	the practical skills on collection and storage of crude drugs	Up to K2
CLO -5	the methods of conservation of medicinal plants and contributions of medicinal plant centres of India	Up to K2

Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	3	1	1	3
CLO2	1	3	1	3	3
CLO3	2	1	1	2	2
CLO4	3	3	1	2	3
CLO5	2	2	1	3	3

Lesson Plan

Unit	Description	Hours	Mode
I	Introduction - Historical background - scope; Indigenous medicinal systems in India - Siddha, Ayurveda, Unani, homeopathy - ethnomedicine. Need to preserve traditional knowledge systems.	2	Chalk and talk PPT, LMS and Group discussion
		2	
		2	
II	Importance of Indian medicinal plants - bioprospection - hotspots- endemic medicinal plants - importance of medicinal plants of Tamil Nadu; Senna, Gymnema, Curcuma, Catharanthus, Aloe and Gloriosa.	4	Chalk and talk PPT, LMS and Group discussion
		2	
III	Phytochemicals and their types, extraction and purification methods of plant constituents - medicinal importance of alkaloids, glycosides, flavonoids and volatile oils. Biochemical and physical factors in fruit development. Parthenocarpy. Prospects and significance of embryo, pollen and endosperm culture.	3	Chalk and talk PPT, LMS and Group discussion
		3	
IV	Collection and harvest technology of medicinal herbs - factors responsible for deterioration of medicinal drugs-storage, processing - packaging of crude drugs.	6	Chalk and talk PPT, LMS and Group discussion
V	Conservation of medicinal plants - <i>in situ</i> <i>Ex situ</i> methods - centres of medicinal plant conservation in India - IBPGRI, CIMAP-CDRI, NBGRI, TBGRI and TAMPCLOL.	2	Chalk and talk PPT, LMS and Group discussion
		4	
	Total	75	

Course designer: Prof. S. Karuppusamy, Assistant Professor

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – PG BOTANY NME FORMATIVE EXAMINATIONS (CIA-I & II)
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO x	Up to K2	1	K1	1	K2/K2	1	K1
CLO y	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – PG BOTANY NME - SUMMATIVE EXAMINATIONS

Units	CLOs	K- Level	Section A		Section B		Section C Essay
			Short Answers		Paragraph (Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K2	2	K1 & K1	2	1 K2	1 K1
2	CLO 2	Up to K2	2	K1 & K1	2	1 K2	1 K1
3	CLO 3	Up to K2	2	K1 & K1	2	1 K2	1 K1
4	CLO 4	Up to K2	2	K1 & K1	2	1 K2	1 K1
5	CLO 5	Up to K2	2	K1 & K1	2	1 K2	1 K1
No. of Questions to be asked			10			10	5
No. of Questions to be answered			5			5	2
Marks for each question			2			7	10
Total Marks for each section			10			25	20

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Section D (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	-	60	46.15	100
K2	-	70	-	-	70	53.85	
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
Total Marks	10	35	50	-	130	100.00	100

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core 4	21P2BMC4	Cell and Molecular Biology	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To understand the structural, biochemical and functional basis of cell and its components.
2. To explain the molecular basis of inheritance that governs plant development.
3. To study the general principles of gene expression and its regulation.

Units	Contents	CLO	K Level	Hours
I	Cell Theory - Ultra structure & organization of Prokaryotic and Eukaryotic cells - Plant cell structure and functions: Cell wall, Plasma membrane, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes, Plastids and Vacuoles - Ontogeny of mitochondria and chloroplast - Molecular basis for cell wall mediated signaling mechanisms and cell-to-cell interaction in a parasitic plant and its hosts - Endocytosis and Exocytosis.	CLO 1	Up to K4	15
II	Cell Growth and Division - Mitosis and Meiosis - Phases of cell cycle, cell cycle control and regulation system - Regulation of plant cell cycle - Classification, physical and chemical structure of Nucleic acids - Forms of DNA and types of RNA, siRNA, PNA, RNAi, Mitochondrial and Chloroplast DNA - DNA synthesis and Replication models, Termination of replication, Enzymes of DNA replication, Methylation of DNA, DNA binding protein, Histones - Programmed cell death.	CLO 2	Up to K4	15
III	Central Dogma of Life - RNA Synthesis and Processing - Transcription factors and Machinery, Formation of initiation complex, Transcription activator and repressor, RNA Polymerases - Initiation, Elongation and Termination - Post transcriptional modification (Capping, Polyadenylation and Splicing) - RNA editing - RNA transport. Genetic Code - Protein Synthesis and Processing: Aminoacylation of tRNA, Aminoacyl tRNA synthetase, Formation of initiation complex, Initiation factors and their regulation, Elongation and elongation factors, Termination and	CLO 3	Up to K4	15

	Translational proof-reading, Translational inhibitors - Post translational modification of proteins.			
IV	Control of gene expression at transcription and translation level - Regulating the expression of prokaryotic (lac and trp operon) and eukaryotic gene (<i>rbcL</i> gene in plants), Role of chromatin in gene expression and gene silencing. Recombination: Homologous, Non homologous and Site specific recombination - Molecular Chaperons - Heat Shock proteins - Oncogenes and anti-oncogenes.	CLO 4	Up to K4	15
V	Development of cell signaling, hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers and regulations of signaling pathways - Transposons and types - Gene mapping methods: Linkage maps, Tetrad analysis, Mapping with molecular markers, Mapping by somatic cell hybrids - DNA repair mechanisms: Photo activation, Excision repair, Recombination repair, SOS repair, Adaptive responses and their regulation.	CLO 5	Up to K4	15

Books for Study:

1. Ajoy Paul, (2009). Text book of Cell and Molecular Biology, Books and Allied (P) Ltd Kolkata.
2. Verma P.S. and Agarwal V.K. (2007). Cell Biology, Genetics, Molecular Biology and Evolution, S. Chand and company Ltd, New Delhi.
3. David Freifelder, (1985). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.

Books for References:

1. Archana Sharma. (1985). 2nd Ed. Chromosomes. Oxford and IBH Publishing Company.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter (2002). Molecular biology of the cell (IV Edn). Garland Science, Taylor and Francis group, New York.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
5. Gardner, E.J., Simmons, M.J. and Snustad, D.P. (1991). Principles of Genetics (III Edn). John Wiley and Sons Inc., India.
6. Geoffrey M. Cooper. (1997). The Cell - A Molecular approach. ASM Press, Washington.
7. Gerald Karp (2008). Cell and Molecular biology: Concepts and experiments (V Edn). John Wiley & Sons, India.
8. Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology. Blackie and sons, London.
9. Kumar, H.D. (1999). Molecular Biology. Vikas Publishing House Pvt. Ltd. New Delhi.
10. Walker J.M and Rapley, R (2006). Molecular Biology and Biotechnology (4th Edn) Panima Publishing Corporation, New Delhi.

11. Wayne M Becker, Lewis J Kleinsmith, Jeff Hardin. (2007). The world of the cell (VI Edn). Pearson.
12. B. Buchanan, W.Gruissem, R. Jones (Eds). (2000). Biochemistry & Molecular Biology of Plants, American Society of Plant Physiology, Rockville, MD.

Web Resources:

1. <https://epgp.inflibnet.ac.in/>
2. <https://www.sciencedirect.com>
3. <https://epathshala.nic.in/>
4. <https://www.biologydiscussion.com>

Rationale for Nature of the Course:

This course will enable the students to know the basis of cellular components, molecular basis of inheritance and the general principles of gene expression and its regulation.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The knowledge learned by the students will help them to understand the various cellular organelles and their function, different phases of cell cycle, central dogma of life, gene expression control and gene mapping.

Pedagogy:

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs, Video Clippings, Google Classroom & LMS (CANVAS).

Course Designer:

Dr. N. Janakiraman, Assistant Professor

Lecture Schedule

Unit	Description	Hours	Mode
1	Cell theory, Ultra structure & organization of Prokaryotic and Eukaryotic cells	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Plant cell structure and functions: Cell wall, Plasma membrane	2	
	Nucleus, Mitochondria, Golgi bodies	3	
	Lysosomes, Endoplasmic reticulum, Peroxisomes, Plastids and Vacuoles	3	
	Ontogeny of mitochondria and chloroplast	2	
	Molecular basis for cell wall mediated signaling mechanisms and cell-to-cell interaction in a parasitic plant and its hosts	2	
	Endocytosis and Exocytosis	1	
2	Cell Growth and Division, Mitosis and Meiosis	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Phases of cell cycle, cell cycle control and regulation system	2	
	Regulation of plant cell cycle	1	
	Classification, physical and chemical structure of nucleic acids	2	
	Forms of DNA and types of RNA, siRNA, PNA, RNAi	2	
	Mitochondrial and Chloroplast DNA	1	
	DNA synthesis and Replication models	2	
	Termination of replication, Enzymes of DNA replication	1	
	Methylation of DNA, DNA binding protein	1	
	Histones, Programmed cell death	1	
3	Central Dogma of Life, RNA Synthesis and Processing	1	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Transcription factors and Machinery	1	
	Formation of initiation complex, Transcription activator and repressor	1	
	RNA Polymerases, Initiation, Elongation and Termination	3	
	Post transcriptional modification (Capping, Polyadenylation and	3	
	Genetic Code, Protein Synthesis and Processing, Aminoacylation of	2	
	Formation of initiation complex, Initiation factors and their regulation, Elongation and elongation factors	2	
	Termination and Translational proof-reading, Translational	2	
4	Control of gene expression at transcription and translation level	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Regulating the expression of prokaryotic (lac and trp operon) and	4	
	Role of chromatin in gene expression and Gene silencing	2	
	Recombination: Homologous, Non homologous and Site specific recombination	3	
	Molecular Chaperons, Heat Shock proteins	2	
	Oncogenes and anti-oncogenes	2	
5	Development of cell signaling, hormones and their receptors	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers and regulations of signaling pathways	3	
	Transposons and types	2	
	Gene mapping methods: Linkage maps, Tetrad analysis, Mapping	4	
	DNA repair mechanisms: Photo activation, Excision repair, Recombination repair, SOS repair, Adaptive responses and their regulation.	4	

Course Learning Outcomes:

On successful completion of the course, the

CLOs	CLO Statement	Knowledge Level
<u>Students will be able to know, understand, apply, and analyse</u>		
CLO 1	The various components of cell and their functions	Up to K4
CLO 2	The different phases of cell cycle and their regulation	Up to K4
CLO 3	The molecular basis of inheritance that governs plant development	Up to K4
CLO 4	The general principles of gene organization and expression at transcriptional and translational level	Up to K4
CLO 5	The cell signaling pathways and gene mapping	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	2	3	3	1	2
CLO 2	2	3	3	2	2
CLO 3	1	3	3	2	3
CLO 4	1	2	3	2	2
CLO 5	1	2	3	2	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

PG Botany Blue Print

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment

Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core 5	20P2BMC5	Genetics, Plant Breeding and Evolution	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Objectives

1. To study the principles and various patterns of inheritance
2. To explain the regions of gene recombination and mutational significance
3. To demonstrate the physical and genetic mapping of chromosomes
4. To understand the conventional and modern plant breeding methods
5. To comprehend the principles and mechanisms of evolution

S.No.	Units	CLO	K Level	Hours
1	Genetics: Mendel's Laws of inheritance. Gene interactions and modified dihybrid ratios (complementary, epistasis, hypostasis, lethal genes). Quantitative inheritance. Sex determination in plants and theories of sex determination. Sex linked inheritance. Sex influenced and sex limited characters. Chromosome theory of inheritance. Multiple alleles and pseudoalleles. Extrachromosomal inheritance. Cytoplasmic male sterility in plants. Population genetics - gene frequencies, mutation, selection, migration and genetic drift.	CLO 1	Up to K4	15
2	Gene concept - Factor concept of Mendel, One gene -One enzyme hypothesis. Benzer's concepts of Cistron, muton and recon. Types and description of gene family (housekeeping genes, transposons overlapping genes, pseudogenes, gene cluster). Gene mutation- Molecular basis of mutation, physical and chemical mutagens and their mode of action. Detection of mutation by CLB and Muller methods – Biochemical mutants in bacteria and <i>Neurospora</i> .	CLO 2	Up to K4	15
3	Bateson's concept of coupling and repulsion. Morgan's concept of linkage, linear arrangement of genes, linkage groups, complete and partial linkage, linkage maps, three point test crosses, interference coefficient of coincidence and negative interference. Recombination in fungi (tetrad analysis in <i>Neurospora</i>) Molecular mechanism of recombination. Molecular markers and construction of linkage maps. Correlation of genetic and physical maps. QTL mapping.	CLO 3	Up to K4	15

4	Plant Breeding: Centers of origin of cultivated plants. Domestication syndrome in cultivated plants. Breeding plants for improving yield, quality and resistance to insect pests and diseases. Plant breeding work in India with special reference to Rice, cotton and Sugar cane. Role of polyploidy in plant improvement. Heterosis breeding with examples. Application of Tissue culture techniques in plant breeding. Role of molecular markers in plant breeding- RAPD, RFLP, VNTR, SSR, and ISSR. Marker assisted selection. Germplasm maintenance of rice and sugarcane. Role of IBPGR, Italy and NBPGR, New Delhi in germplasm conservation.	CLO 4	Up to K4	15
5	Evolution: Darwin concept of variation, adaptation, struggle, fitness and natural selection. Origin of basic biological molecules, Abiotic synthesis of organic monomers and polymers, Concept of Oparin and Haldane, Experiment of Miller. The first cell. Origin of prokaryotic and eukaryotic cells. Evolution of unicellular eukaryotes. Concepts of neutral evolution, molecular divergence and molecular clocks – Micro and macro evolution. Concept of Wallace and his contributions.	CLO 5	Up to K4	15

Text Books

1. Allard R W (2010). Principles of Plant Breeding (2nd Edn.). John Wiley and Sons, Inc.
2. Benjamin A Pierce (2008). Genetics: A conceptual approach (4th Edn). W H Freeman and Company. Company Ltd.
3. Brian K H and Benedict H (2014) Evolution (5th Edn). Jones & Bartlett Publishers.
4. Daniel L Hartl. (2017). Genetics: Analysis of genes and genomes (8th Edn). Jones and Bartlett publishers.
5. David R Hyde (2010). Genetics and molecular biology (1st Edn.). Tata McGraw Hill.
6. Gardener, E.J. 8th Ed. Principles of Genetics, Johanwiley, New York.
7. Ghahal G S and Gosal S S (2002). Principles and procedures of Plant Breeding. Narosa Publishing House.
8. Gupta, P.K. (2007). Genetics. Rastogi Publication, Meerut, India.
9. Hartl, .D.L & Jones E. W. 2000.Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
10. Maxtoshi Nei, Sudhir Kumar (2000). Molecular Evolution and phylogenetics. Oxford University Press.

Reference Books

1. Roderic D M Page, Edward C Holmes (1998). Molecular Evolution: A phylogenetic approach. Blackwell Science Ltd.
2. Sharma J R (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers
3. Singh B D (2015). *Plant Breeding: Principles and methods*. Kalyani Publications.
4. Snustad, D. P. & Simmons M.J. 2003. Principles of Genetics. John Hailey & Sons Inc. U. S.A.
5. William S Klug, Michael R Cummings (2018). *Concepts of Genetics* (12th Edn). Pearson Education Pvt. Ltd., Singapore.

Rationale for Nature of the Course

This course will enable the students to know the principles of inheritance, genetic recombination, molecular basis of mutation, chromosome mapping, plant breeding methods and various concepts of evolution.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge acquired by the students will help them to understand the concept of genetics, conduct various plant breeding methods for crop improvement and know the evolutionary mechanisms.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer:

Prof. V. Meenakshi Sundaram, Assistant Professor

Lecture Schedule

Unit	Description	Hours	Mode
1	a) Introducing the genetic terms	1	Chalk and talk PPT, LMS and Group discussion
	b) Mendel's laws of inheritance	2	
	c) Gene interactions and modified dihybrid ratios	3	
	d) Sex linked inheritance	2	
	e) Chromosome theory and Multiple alleles	2	
	f) Extrachromosomal inheritance	2	
	g) Population genetics	3	
2	a) Gene concept	2	Chalk and talk PPT, LMS and Group discussion
	b) Benzers concept of Cistron, muton and recon. Gene components	3	
	c) Mutation – types	2	
	d) Mutation – molecular basis	3	
	e) Mutation – mode of action	3	
	f) Mutation – detection tests	2	
3	a) Linkage – introduction and types	1	Chalk and talk PPT, LMS and Group discussion
	b) Linkage – Batesons concept of coupling and repulsion	2	
	c) Crossing over	2	
	d) Tetrad analysis	2	
	e) Molecular mechanisms of recombination	2	
	f) Linkage maps – genetic and physical	2	
	g) QTL mapping	2	
4	a) Centres of origin of cultivated plants.	2	Chalk and talk PPT, LMS and Group discussion
	b) Breeding for yield and quality	2	
	c) Breeding for diseases resistant.	2	
	d) Plant breeding work in India	2	
	e) Heterosis	2	
	f) Role of molecular markers	3	
	g) Role of plant breeding institutions in germplasm conservation	2	
5	a) Darwin concept	3	Chalk and talk PPT, LMS and Group discussion
	b) Origin of biomolecules	2	
	c) Origin of cell	2	
	d) Evolution of unicellular eukaryotes	2	
	e) Concepts of neutral evolution	1	
	f) Molecular divergence and clock	2	
	g) Micro and macro evolution	1	
	h) Concept of wallace	2	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse and evaluate

CLOs	CLO Statement	Knowledge Level
CLO 1	The inheritance basis of qualitative and quantitative characters in a population and deviation from the common pattern of inheritance	Up to K4
CLO 2	Concept of modern gene concept and the molecular mechanisms of mutation and its respective biochemical responses	Up to K4
CLO 3	The Linkage and crossing over, various methods of chromosome mapping using crossing over and molecular markers	Up to K4
CLO 4	The methods in conventional and modern breeding techniques for crop improvement and conservation of species and genetic diversity	Up to K4
CLO 5	The various concepts of origin of cell and evolution	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	2	3	3	1	2
CLO 2	2	3	3	2	2
CLO 3	1	3	3	2	3
CLO 4	1	2	3	2	2
CLO 5	1	2	3	2	3

PG Botany BluePrint

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment

Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K-Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	20

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core 6	21P2BMC6	Ecology and Conservation Biology	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

The course will enable the students to

1. acquire knowledge of various ecological aspects and communities,
2. associate and analyze the values and dynamics of various ecosystems,
3. detect the energy sources and the natural and man-made damage caused to the environment
4. integrate the biodiversity, hotspots, remote sensing and environmental laws and
5. identify and evolve suitable conservation strategies for value specific species and ecosystem.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Aim and scope of Ecology – Autecology - Population ecology - Characteristics of population. Positive and negative interactions of species – Synecology – Qualitative and Quantitative characters of community. Niche–definition and types. Methods of studying plant community. Contemporary Ecological Issues: Pollination Crises and Urban Ecology.	1	Up to K4	15
II	Concept and dynamics of ecosystem: Types of Ecosystem, Components, Food chain, Food web and Energy Flow – Trophic level, Ecological Pyramids. Biogeochemical cycles – Hydrological, Carbon, Nitrogen, and Phosphorous cycles. Characteristic features, structure and functions of Forest, Grassland, Pond, Estuary and Manmade (Crop land) ecosystems. Ecological amplitude of a species and adaptation – <i>r</i> & <i>k</i> selection, Ecads, Ecotypes, Ecospecies, Raunkaier's Life Forms.	2	Up to K4	15
III	Utilization of energy resources – Non-renewable and renewable. Environmental pollution – Air, water, soil, thermal and radiation. Causes, consequences and control of pollution on global environment, Ozone depletion, Greenhouse effect, Climate change and Global warming. Ecological indicators. Biomagnifications and Eutrophication. Disaster management – Floods, Earth quake, Cyclone, Tsunami and Landslides. Man-animal conflict, Habitat Fragmentation and Animal Corridors.	3	Up to K4	15

IV	Biodiversity – levels – threats–hotspots. Endemism– Red Data Book – IUCN categories, continuous and discontinuous distribution of vegetation. Phytogeography: Phytogeographical regions of world – types of vegetation in India. Range – Dispersal and Migration Barriers hypothesis, Continental Drift hypothesis, Land-Bridges hypothesis, Age and Area hypothesis. Introduction to Remote Sensing and GIS. Earth Summit –Kyoto Protocol. Environmental Laws.	4	Up to K4	15
V	Conservation Biology: Introduction–current practices in conservation – ecosystem approaches – species-based – <i>In-situ</i> conservation: biosphere reserves, national parks, sanctuaries and <i>Ex-situ</i> conservation: afforestation, sthalavrikshas, sacred groves, social forestry, agro forestry, botanical gardens, cryopreservation, gene banks, seed banks, pollen banks, DNA banks, tissue culture and biotechnological strategies. Social movements for conservation - Chipko movement and Narmada BachoAndolan.	5	Up to K4	15

Books for study:

1. Odum, E. P. 1971. Fundamentals of Ecology. W. B. Saunders & Co., PhiladelphiaUSA.
2. Odum, E. P. 1975. Ecology. 2nd ed. Oxford & IBH Publications, New Delhi.
3. Vashista, P. C. 1974. A Textbook of Plant Ecology. Vishal Publications, Jullunder.
4. Krishnan Kannan 1997. Fundamentals of Environmental Pollution. S. Chand and Co. Ltd., New Delhi.
5. Kershaw, K. A. 1973. Quantitative and Dynamic Plant Ecology. Edward Arnold Publishers Ltd., London.
6. Odum, E.P. 1996. Fundamentals of Ecology. Nataraj Publishers. Dehradun.

Books for Reference:

1. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.
2. Krishnamoorthy, K.V. 2009. An advanced Text book on Biodiversity –Principles and practice, Oxford & IBH Publishing co, PVT. Ltd., New Delhi.
3. Kumar, H.D. 1999. Biodiversity and sustainable conservation. Oxford and IBM publishing Company, NewDelhi.
4. Melchias, G.2001, Biodiversity and Conservation, Oxford and IBM publishing company Pvt., Ltd. New Delhi.
5. Schulze,E., Beck,E., and Muller-Hohenstein, 2005. Plant Ecology, Springer, Berlin-Heidelberg.
6. Heywood, V. H. 1995 Global Biodiversity Assessment. UNEP, Cambridge University Press, London.

Web Resources:

1. <https://www.c2es.org/>
2. <https://www.iucnredlist.org/>
3. <https://www.unep.org/>
4. <https://www.epa.gov/>
5. <https://ndma.gov.in/>

Rationale of the Course:

The course focuses on how to protect and restore the environment or the diversity of life on Earth. The course will provide answers to specific questions that can be applied to management decisions with regard to conservation.

Activities having direct bearing on Skill development/Employability/ Entrepreneurship

The knowledge acquired by the students will enable them to get entry level jobs as junior consultant in environmental consulting, volunteer coordinator in non-profit organizations and research or teaching assistants in institutions.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
<u>Students will be able to know, understand, apply and analyze</u>		
CLO-1	The autecology and population ecology; various interactions and ecological issues	Up to K4
CLO-2	The types and dynamics of ecosystem; biogeochemical cycles and ecological amplitude of a species	Up to K4
CLO-3	The renewable and non-renewable energy sources; pollution and its impact; and disaster management	Up to K4
CLO-4	The levels and threats of biodiversity; phytogeography of world and India; hypothesis and tools of phytogeography	Up to K4
CLO-5	The In situ and ex situ conservation methods and social movements for conservation	Up to K4

3 – Advance application

2 – Intermediate level

1 – Basic level

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	3	3
CLO-2	1	2	2	2	2
CLO-3	2	2	2	2	2
CLO-4	1	1	2	2	3
CLO-5	3	2	3	2	2

3 – Advance application

2 – Intermediate level

1 – Basic level

Lesson Plan

Unit	Description	Hours	Mode
I	a) Introduction - Ecology - Autecology	2	Chalk and talk PPT, LMS and Group discussion
	b) Population ecology - Characteristics of population.	2	
	c) Positive and negative interactions of species – Synecology	2	
	d) Qualitative and Quantitative characters of community.	2	
	e) Niche - definition and types. Methods of studying plant community.	2	
	f) Contemporary Ecological Issues:	3	
	g) Pollination Crises and Urban Ecology.	2	
II	a) Concept and dynamics of ecosystem:	1	Chalk and talk PPT, LMS and Group discussion
	b) Types of ecosystem, components, Food chain, Food web and Energy Flow – Trophic level, Ecological Pyramids.	3	
	c) Energy flow in the ecosystems.	1	
	d) Biogeochemical cycles – Hydrological, Carbon, Nitrogen, and Phosphorous cycles.	3	
	e) Characteristic features, structure and functions of Forest, Grassland, Pond, Estuary and Manmade (Crop land) ecosystems.	4	
	f) Ecological amplitude of a species and adaptation – r & k selection, Ecads, Ecotypes, Ecospecies, Raunkaier's Life Forms.	3	
III	a) Utilization of energy resources – Non-renewable and renewable.	2	Chalk and talk PPT, LMS and Group discussion
	b) Environmental pollution – Air, water, soil, thermal and radiation. Causes, consequences and control of pollution on global environment	3	
	c) Ozone depletion, Greenhouse effect, Climate change and Global warming.	2	
	d) Ecological indicators. Biomagnifications and Eutrophication.	3	
	e) Disaster management – Floods, Earth quake, Cyclone, Tsunami and Landslides.	2	
	f) Man-animal conflict, Habitat Fragmentation and animal Corridors.	3	

IV	a) Biodiversity levels, threats, hotspots.	2	Chalk and talk PPT, LMS and Group discussion
	b) Endemism– red data book – IUCN categories, continuous and discontinuous distribution of vegetation.	2	
	c) Phytogeographical regions of world – types of vegetation in India.	1	
	d) Range – Dispersal and Migration Barriers hypothesis.	1	
	e) Continental Drift hypothesis, Land- Bridges hypothesis, Age and Area hypothesis	3	
	f) Introduction to Remote Sensing and GIS	3	
	g) Earth Summit- Kyoto Protocol	2	
	h) Environmental Laws.	1	
V	a) Conservation Biology: Introduction, current practices in conservation, ecosystem approaches, species-based approaches	3	Chalk and talk PPT, LMS and Group discussion
	b) <i>In situ</i> conservation: biosphere reserves, national parks, sanctuaries.	2	
	c) <i>Ex-situ</i> conservation: afforestation, sthalavrikshas, sacred groves.	2	
	d) Social forestry, agro forestry, botanical gardens, cryopreservation.	2	
	e) Gene banks, seed banks, pollen banks, DNA banks.	2	
	f) Tissue culture and biotechnological strategies.	2	
	g) Social movements for conservation- chipko movement and Narmada Bacho Andolan	2	
		2	
Total		75	

Pedagogy:

Chalk and Talk, PPT, Group Discussions, Seminars, Interactions, Quizzes, Virtual Labs, Google classroom and Learning Management System (CANVAS).

Course designer: **Dr. S. Gnaana Saraswathi**, Assistant Professor.

PG Botany BluePrint

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment
Formative – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Elective-2	21P2BME2	Horticulture	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Objectives

1. To understand the importance and divisions of horticulture.
2. To acquire knowledge on plant propagation and fruit crop cultivation.
3. To learn about vegetable cultivation and kitchen gardening.
4. To get to know about landscaping and components of gardens.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Introduction of Horticulture: Importance and scope - Horticulture - Divisions - Horticulture – Climate, Soil profile and texture and nutritional needs – Manures and fertilizers – Organic manures – Inorganic fertilizers – Biofertilizers – Methods of applications of manures and fertilizers – irrigation methods – Surface irrigation – Sub irrigation – trib irrigation methods – Plant protection and pest control for horticulture crops.	1	Up to K4	15
II	Plant propagation: Conventional propagation methods and by specialized vegetative structures - Artificial methods: Cutting - types (root, stem, leaf cuttings), advantages and disadvantages - Layering: types - (simple, compound, tip, trench, mound, air-layering) advantages and disadvantages - Grafting: types (inarching, splice, whip/tongue, cleft, bark, epicotyl) advantages and disadvantages - Budding: Types - (T-budding, shield, patch, and ring budding) advantages and disadvantages - Stock – scion relationships.	2	Up to K4	15
III	Fruit crops: Training and pruning methods for fruit plants – Induction of flowering, flower thinning - fruit setting and fruit development – parthocarpy, Seedlessness in horticultural fruits – Importance of plant growth regulators in fruit crops – Cultivation and harvesting methods of important fruit crops; <i>Mango, Sapota, pomegranate, grapes and guava.</i>	3	Up to K4	15

IV	Flower and vegetable crops: Floriculture – Cultivation of commercial flower crops – <i>Rose, Jasmine, Chrysanthemum, Crossandra, and Gerberas</i> – Cut flowers – Vase life period – Packages for export of cut flowers - Flower decoration – Dry and wet decoration - Classification of vegetables – Cultivation of important vegetables - <i>Tomato, Potato, Onion, Cabbage and Snake guard</i> – Layout for a model kitchen garden – Suitable vegetable crops for home gardens.	4	Up to K4	15
V	Landscape designing: Principles and methods of landscape designing – Types of garden – Garden components – Shrubs and shrubberies, ornamental hedges, edges, flower beds, borders and carpet beds – Climbers and creepers – Foliage plants - Succulents and cacti – Ornamental palms – Orchids - Topiary and trophy - Rockeries and arches – Lawn making and maintenance – Water garden - Layout for college garden - Indoor gardening – Hanging baskets - Bonsai plants – Training and pruning - Terrace garden.	5	Up to K4	15

Books for study

1. Kumar N (1987), Introduction to Horticulture, Rajalakshmi publishers, Nagercoil,
2. Edmond JB. (1977) Fundamentals of Horticulture. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
3. Kumaresan V (20114) Horticulture saras publication. Nagarcoil.

Books for Reference

1. Manibushan Rao K (1991), Textbook of Horticulture. Macmillan publishing Co., New York.
2. Rao KM (2000), Text book of Horticulture. Macmillan India Ltd, New Delhi. 2000
3. George A (2002), Horticulture Principles and Practices. 2nd Ed. Pearson Education, Delhi.
4. Sheela VL (2011). Horticulture MJP Publishers, Chennai.
5. Prakash J and Bhandary K.R. Floriculture Technology, Trades and Trends. Oxford and IBH publication ,New Delhi,
6. Edward A (2000). The Principles of Floriculture ,White Forgotten Book publication
7. Alex Laurie & Victor H. Ries Floriculture Fundamentals and Practices . The Ohio State University Second Edithion New McGRAW-HILL Book Company

Web Resources

1. <https://en.wikipedia.org/wiki/Horticulture>
2. <https://en.wikipedia.org/wiki/Landscape>

Rationale for Nature of the Course:

Selling of fruit and fruit crops, advisory to several gardens, exporting value added products

Lesson Plan

Unit	Description	Hrs	Mode
I	a) Importance and scope of horticulture	1	Chalk and talk PPT, LMS and Group discussion
	b) Divisions of horticulture	2	
	c) Soil profile and texture	2	
	d) Organic manures and Inorganic fertilizers	2	
	e) Methods of applications of manures and fertilizers	2	
	f) Method of Surface irrigation	1	
	g) Method of Sub irrigation	1	
	h) Method of trib irrigation	2	
	i) Plant protection and pest control for horticulture crops.	2	
II	a) Cutting - types (root, stem, leaf cuttings)	3	Chalk and talk PPT, LMS and Group discussion
	b) Layering: types - (simple, compound, tip, trench, mound, air-layering)	3	
	c) Grafting: types (inarching, splice, whip/tongue, cleft, bark, epicotyl)	3	
	d) Budding: Types - (T-budding, shield, patch, and ring budding)	3	
	e) Stock – scion relationships	3	
III	a) Training and pruning methods for fruit plants	2	Chalk and talk PPT, LMS and Group discussion
	b) fruit setting and fruit development	1	
	c) Importance of plant growth regulators in fruit crops	3	
	d) Cultivation and harvesting methods of <i>Mango pomegranate, grapes and guava</i> .	3	
	e) Cultivation and harvesting methods of <i>grapes and guava</i>	3	
	f) Cultivation and harvesting methods of <i>pomegranate</i> ,	3	
IV	a) Cultivation of <i>Rose, Jasmine, Chrysanthemum, Crossandra, and Gerberas</i>	5	Chalk and talk PPT, LMS and Group discussion
	b) Packages for export of cut flowers	1	
	c) Flower decoration – Dry and wet decoration	2	
	d) Cultivation of <i>Tomato, Potato, Onion, Cabbage and Snake guard</i>	5	
	e) Layout for a model kitchen garden	2	
V	a) Principles and methods of landscape designing	2	Chalk and talk PPT, LMS and Group discussion
	b) Types of garden	2	
	c) Shrubs and shrubberies,	2	
	d) Ornamental hedges, edges, flower beds, borders and carpet beds-	2	
	e) Topiary and trophy	2	
	f) Rockeries and arches	2	
	j) Maintenance of Water garden	1	Chalk and talk PPT, LMS and Group discussion
	k) Hanging baskets	1	
	l) Bonsai plant	1	
		75	

Course designer: Dr.M. Karpaga Jothi, Assistant Professor

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Demonstration of several horticultural practices and propagation techniques of economic crops

Understand the types and landscape gardening through visits to several popular gardens

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course outcome

CLOs	CLO-Statement	Knowledge level
Students will be able to know, understand, apply and analyse		
CLO1	the divisions of horticulture, facts and applications of biofertilizers, irrigation methods.	Up to K4
CLO2	the advantages and disadvantages of various methods of plant propagation	Up to K4
CLO3	the horticultural practices of fruit crops	Up to K4
CLO4	the floriculture and landscape gardening	Up to K4
CLO5	the types of garden, principles and methods of landscape designing	Up to K4

Mapping programme specific outcomes with Course Learning Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	3	1	1	3
CLO2	1	3	1	3	3
CLO3	2	1	1	2	2
CLO4	3	3	1	2	3
CLO5	2	2	1	3	3

PG Botany Blue Print

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

Learning Outcome Based Education (LOBE) & Assessment

Formative – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

Learning Outcome Based Education (LOBE) & Assessment

Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Practical	21P2BMP3	Practical III	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives:

1. To observe chromosomes and different stages of cell divisions.
2. To demonstrate the methods of isolation and quantification of DNA.
3. To solve problems related to Genetics and construct genetic mapping.
4. To apply plant breeding techniques for crop improvement.

Practicals - Cell and Molecular Biology

1. Squash preparation of onion root tips to study mitosis
2. Smear preparation of maize or onion flower buds to study meiosis
3. Illustration of various cell organelles
4. Karyotyping and Idiogram
5. Isolation of plant genomic DNA and its quantification by UV-spectrophotometer
6. Isolation of plasmid DNA
7. Restriction digestion of DNA and its analysis by agarose gel electrophoresis
8. Isolation of RNA and its quantification by UV-spectrophotometric method
9. SDS-PAGE analysis of seed storage proteins (globulins) from legumes
10. Blotting techniques
11. RFLP genetic mapping
12. PCR techniques
13. Recombination mapping in bacteria
14. Calculation of recombination frequency

Practicals - Genetics, Plant Breeding and Evolution

1. Problem solving on dihybrid phenotypic, genotypic and test cross ratios
2. Incomplete dominance in plants
3. Interaction of factors and modified dihybrid ratios
4. Multiple alleles in plants, blood group inheritance in humans
5. Sex linked inheritance in *Drosophila* and plants
6. Quantitative inheritance in plants
7. Tetrad analysis in *Neurospora*
8. Complementation analysis to find out complementation groups in viruses
9. Chromosome mapping from three point test cross data
10. Calculation of chiasmatic interference
11. Calculate gene and genotypic frequency by Hardy-Weinberg equation
12. Techniques in plant hybridization

Rationale for Nature of the Course:

The course focuses on the practical skills in laboratory on observation of chromosomes, different stages of cell division in plants, genomic DNA isolation, problems related to Genetics and various plant breeding techniques.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The knowledge and skills acquired by the students will enable them to understand the types of cell division in plants, isolation of genetic material and solve the problems related to Mendelian concepts in Genetics. The various plant breeding methods for crop improvement will help them to equip themselves on self-employability.

Pedagogy:

Live Demonstration, Group Experiment, Chalk and Talk, Power Point, Problem Solving, Virtual Labs & You Tube Videos.

Course Designers:

Prof. V. Meenakshi Sundaram, Assistant Professor

Dr. N. Janakiraman, Assistant Professor

Lecture Schedule

Practical	Description	Hours	Mode
1	Squash preparation of onion root tips to study mitosis	2	Group Experiment
2	Smear preparation of maize or onion flower buds to study meiosis	2	Group Experiment
3	Illustration of various cell organelles	2	Photograph
4	Karyotyping and Idiogram	2	Virtual Lab
5	Isolation of plant genomic DNA and its quantification by UV-spectrophotometer	2	Group Experiment
6	Isolation of plasmid DNA	2	Group Experiment
7	Restriction digestion of DNA and its analysis by agarose gel electrophoresis	2	Group Experiment
8	Isolation of RNA and its quantification by UV-spectrophotometric method	2	Group Experiment
9	SDS-PAGE analysis of seed storage proteins (globulins) from legumes	2	Group Experiment
10	Blotting techniques	2	Demonstration
11	RFLP genetic mapping	2	Virtual Lab
12	PCR techniques	4	Group Experiment
13	Recombination mapping in bacteria	2	Virtual Lab
14	Calculation of recombination frequency	2	Problems
15	Problem solving on dihybrid phenotypic, genotypic and test cross ratios	4	Problems
16	Incomplete dominance in plants	2	Problems
17	Interaction of factors and modified dihybrid ratios	2	Problems
18	Multiple alleles in plants, blood group inheritance in humans	2	Problems

19	Sex linked inheritance in <i>Drosophila</i> and plants	2	Problems
20	Quantitative inheritance in plants	2	Problems
21	Tetrad analysis in <i>Neurospora</i>	2	Virtual Lab
22	Complementation analysis to find out complementation groups in viruses	2	Virtual Lab
23	Chromosome mapping from three point test cross data	2	Problems
24	Calculation of chiasmatic interference	2	Problems
25	Calculate gene and genotypic frequency by Hardy-Weinberg equation	2	Problems
26	Techniques in plant hybridization	6	Group Experiment

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse and evaluate

CLOs	CLO Statement	Knowledge Level
CLO 1	The techniques in observation of cell organelles, cell divisions, karyogram and idiogram	Up to K4
CLO 2	The DNA isolation and physical mapping techniques	Up to K4
CLO 3	The phenotypic and genotypic ratios from the given crosses of different allelic or gene interactions	Up to K4
CLO 4	The construction of genetic methods of chromosome mapping	Up to K4
CLO 5	The demonstration of various plant breeding techniques for crop improvement	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	2
CLO 2	2	2	2	2	2
CLO 3	2	3	2	3	3
CLO 4	3	2	3	2	2
CLO 5	2	2	2	3	3

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Practical	21P2BMP4	Practical IV	2	4	40	60	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course objectives

The course will enable the students to

1. understand and analyze adaptations that prevail in various plant groups,
2. study the distribution of various plant communities in the college campus for conservation,
3. determine the various chemicals present in the soil and water samples and
4. observe the flora in their original (natural) habitats through field visits.

Practicals Ecology and Conservation Biology

1. Study of morphological and anatomical adaptations of hydrophytes and xerophytes.
2. Analysis of vegetation to find out frequency, density and abundance of different species by using quadrat method in the college campus.
3. Analysis of vegetation by using line transects to find out frequency, density and abundance of different species.
4. Determination of field capacity and pH of soil types.
5. Determination of soil moisture and texture of soil types.
6. Determination of carbonate and nitrate content of various soil types.
7. Determination of phosphate, sulphate and chloride content of various soil types.
8. Determination of free carbon dioxide of water samples.
9. Determination of alkalinity of water samples.
10. Determination of dissolved oxygen in water samples (Winkler method).
11. Experiment on soil conductivity.
12. To locate the hotspots, phyto-geographical regions and distribution of endemic plants in the map of India.
13. Field study of any one or two of the following area (s) (not less than a period of 2 days) to document environmental assets and to study the ecosystems and different types of vegetation (Forest / Grassland / Mountain / National parks / Sanctuary / Botanical garden / Lake / Pond / River / Waterfalls / Estuary / Mangrove / Sea coast) and submit a report of the study trip (during the internal practical examination).

Rationale of the Course:

The practical course focuses on the skills and practices to be inculcated in the students relevant to the theory studied, to analyse information practically in the laboratory and in the field using standard scientific protocols and methodologies.

Activities having direct bearing on Skill development /Employability/ Entrepreneurship:

The knowledge and skills acquired by the students will enable them to get entry level jobs as junior consultant and project officers in environmental consulting / agencies and volunteer coordinator in non-profits.

Pedagogy: Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Quiz, Virtual Labs, Google classroom and Learning Management System (CANVAS).

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
<u>Students will be able to know, understand, apply, and analyze</u>		
CLO-1	The outline and associate the adaptations and distribution of plant communities for effective conservation	Up to K4
CLO-2	the information, to infer the various chemicals present in the soil, thereby manage soil efficiently for plant growth.	Up to K4
CLO-3	The quality of various water samples.	Up to K4
CLO-4	Discuss the various method of plant propagation	Up to K4
CLO-5	Explain the landscape	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	3	2	2	3
CLO-2	1	2	2	2	3
CLO-3	1	2	3	2	3
CLO-4	1	2	2	2	3
CLO-5	1	2	2	2	2

Lesson Plan

Practical	Description	Hours	Mode
1.	Study of morphological and anatomical adaptations of hydrophytes and xerophytes.	3	Chalk and talk CANVAS
2.	Analysis of vegetation to find out frequency, density and abundance of different species by using quadrat method in the college campus.	3	Chalk and talk Google classroom
3	Analysis of vegetation by using line transects to find out frequency, density and abundance of different species.	4	Chalk and talk CANVAS
4	Determination of field capacity and pH of soil types.	3	Chalk and talk Google classroom
5	Determination of soil moisture and texture of soil types.	2	Chalk and talk CANVAS
6	Determination of carbonate and nitrate content of various soil types.	3	Chalk and talk You tube videos
7	Determination of phosphate, sulphate and chloride content of various soil types.	3	Chalk and talk You tube videos CANVAS
8	Determination of free carbon di oxide of water samples.	3	Chalk and talk You tube videos CANVAS
9	Determination of alkalinity of water samples	2	Chalk and talk You tube videos CANVAS
10	Determination of dissolved oxygen in water samples (Winkler method).	3	You tube videos CANVAS
11	Experiment on soil conductivity	3	You tube videos
12	To locate the hotspots, phyto-geographical regions and distribution of endemic plants in the map of India	3	Chalk and talk You tube videos
13	Field study of any nearby area to document environmental assets and study the ecosystems and different types of vegetation (Forest / Grassland / Mountain / National parks / Sanctuary / Botanical garden / Lake / Pond / River / Waterfalls / Estuary / Mangrove / Sea coast) submit a report (during the internal practical examination).	25	Field visit
	Total	60	

Course Designer: **Dr. S. Gnaana Saraswathi**, Assistant Professor.

DEPARTMENT OF BOTANY				CLASS: I PG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Non-Major Elective-2	21P2BNM2	Food Science and Nutrition	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

The course will enable the students to

1. familiarize themselves with an overview of food components, cooking methods and utensils and their advantages and disadvantages,
2. assess food safety laws and standards,
3. acquire basic knowledge on various flavors, additives, colorants and pigments sources,
4. promote the traditional healthy recipes and their positive impact on health system and
5. identify and aware of the bioavailability of nutrients as well the ongoing nutritional transition and their implications.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Introduction – Food – Food Science – Nutrition – Nutrients and Nutritional Status. Role of carbohydrates, proteins, fats, minerals, vitamins, water and antioxidants. Advantages of cooking utensils – Earthenware, Stainless steel, Iron and Aluminum.	1	Up to K2	6
II	Food safety laws and standards. International Organization for Standardization (ISO). Bureau of Indian Standards (BIS) and AGMARK. Prevention of Food Adulteration Act (PFA).	2	Up to K2	6
III	Flavors - Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives - Acid, bases, buffer systems, chelating agent, antimicrobial agent and sweeteners. Natural and artificial food colorants. Pigments from animal and plant tissues.	3	Up to K2	6
IV	Interactions of nutrition, immunity and infection, food allergies and intolerance, food toxicity, naturally occurring toxicants in food. Preparations of some nutrient rich recipes; ulundankali, raagithithipal, kambu porridge, sesame balls, peanut chikkas.	4	Up to K2	6

V	Bioavailability of nutrients. Nutrient losses during cooking and processing. Changing trends in life style patterns due to change in food habits and sleep pattern among the present generation. Nutrigenomics, nutraceuticals and bioactive compounds. Awareness of ongoing nutritional transition and its implications.	5	Up to K2	6

Text Books:

1. Subhangini A Joshi. 1992. Nutrition and Dietetics. Hill Publishing Company.
2. Srilakshmi, B. 2018. Food Science. New Age International Publishers.
3. Srilakshmi, B. 2010. Food Science and Nutrition. New Age International Publishers.
4. Sunetra Roday. 2012. Food Science and Nutrition. Oxford Publishers.
5. Deepak Mudgil and Sheweta Barak Mudgil. 2015. Objectives of Food science and Technology. Scientific publishers.

Reference Books:

1. Fellows P. J (2002). Bureau of Indian standards: Specifications and standard methods. Volume I to XII. Food Processing Technology- Principles and Practices, 2nd Edition. Woodhead Publishing Ltd.
2. Food and Agriculture Organization. (1980). Manual of Food Quality Control. Additive Contaminants Techniques. Rome.
3. Graf E and Saguy I S, (1991). Principles and practices for the safe processing of foods. Butterworth Heinemann Ltd., Oxford.
4. Mahindru, S N (2000). Food Additives- Characteristics Detection and Estimation. Tata Mc Graw Hill Publishing Co. Ltd.
5. ICMR (1990). Nutrient Requirements and Recommended Dietary Allowances for Indians. FAO/WHO/UNU (2004).
6. Nutrition in Developmental Transition. NFI-WHO (SEARO) Symposium. NFI (2006).

Web Resources:

1. <https://www.nin.res.in/>
2. <https://www.nutritionfoundationofindia.res.in/>
3. <https://www.myindiandietitian.com/>
4. <https://www.springer.com/journal/13197/>
5. <https://www.foodandnutritionjournal.org/>

Rationale of the Course:

The course helps the students to gain the basic understanding of food and nutritional needs from birth to adulthood, by providing the necessary theoretical background.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge gained through this course will help the students to change their life style to healthy food and sleep habits so as to ensure their physical and mental well-being.

Pedagogy:

Chalk and Talk, PPT, You tube videos, Group Discussion, Seminar, Interaction and Quiz.

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge Level
Students will be able to know, and understand		
CLO-1	the facts about food and cooking utensils	Up to K2
CLO-2	the food safety laws and standards	Up to K2
CLO-3	the information to analyze and be aware of food stuff	Up to K2
CLO-4	the traditional and junk food and their impact on health	Up to K2
CLO-5	the information for healthy life	Up to K2

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	-	-	-	-
CLO-2	2	-	-	-	-
CLO-3	3	-	-	-	-
CLO-4	2	-	-	-	-
CLO-5	3	-	-	-	-

3 – Advance application

2 – Intermediate level

1 – Basic level

Lesson Plan

Unit	Description	Hours	Mode
I	a) Introduction – Food – Food Science – Nutrition – Nutrients and Nutritional Status.	2	Chalk and talk PPT and You tube videos
	b) Carbohydrates, proteins, fats, minerals vitamins, water and antioxidants	2	
	c) cooking utensils	2	
II	a) Food safety laws and standards	1	Chalk and talk PPT and You tube videos
	b) International Organization for Standardization (ISO).	1	
	c) Bureau of Indian Standards (BIS), AGMARK.	2	
III	d) Prevention of Food Adulteration Act (PFA).	2	Chalk and talk PPT and You tube videos
	a) Flavors: Taste and nonspecific saporous sensations.	1	
	b) vegetable, fruit and spice flavor	1	
	c) Food additives: Acid, bases, buffer systems, chelating agent, antimicrobial agent and sweeteners	2	
	d) Natural and artificial Food colorants	1	
IV	e) Pigments from animal and plant tissues.	1	
	a) Interactions of Nutrition, Immunity and Infection	2	Chalk and talk PPT and Group discussion
	b) Food allergies and intolerance, food toxicity	1	
	c) Naturally occurring toxicants in food	1	
	d) Preparations of some nutrient rich recipes; ulundankali, raagithithipal, kambu porridge, sesame balls, peanut chikkas.	2	
V	a) Bioavailability of nutrients. Nutrient losses during cooking and processing.	2	
	b) Changing trends in life style patterns with special emphasis on sleep pattern (Sleep) among present generation.	2	Chalk and talk PPT and You tube videos
	c) Nutrigenomics, nutraceuticals and bioactive compounds.	1	
	d) Awareness of ongoing nutritional transition and its implications.	1	
	* All the lecture topics will have relevant video animations to make the class interesting and effective.		
Total		30	

Course Designer: **Dr. S. Gnaana Saraswathi**, Assistant Professor.

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – PG BOTANY NME FORMATIVE EXAMINATIONS (CIA-I & II)
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO x	Up to K2	1	K1	1	K2/K2	1	K1
CLO y	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – PG BOTANY NME - SUMMATIVE EXAMINATIONS

Units	CLOs	K- Level	Section A		Section B		Section C Essay
			Short Answers		Paragraph (Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K2	2	K1 & K1	2	1 K2	1 K1
2	CLO 2	Up to K2	2	K1 & K1	2	1 K2	1 K1
3	CLO 3	Up to K2	2	K1 & K1	2	1 K2	1 K1
4	CLO 4	Up to K2	2	K1 & K1	2	1 K2	1 K1
5	CLO 5	Up to K2	2	K1 & K1	2	1 K2	1 K1
No. of Questions to be asked			10			10	5
No. of Questions to be answered			5			5	3
Marks for each question			2			7	10
Total Marks for each section			10			35	30

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Section D (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	-	60	46.15	100
K2	-	70	-	-	70	53.85	
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
Total Marks	10	35	50	-	130	100.00	100

Department of Zoology

Revised Curriculum

(Choice Based Credit system with Outcome Based Education)

Academic Year 2020-2021 onwards

III and IV Semesters (B.Sc. Zoology)

Certificate Courses



THE MADURA COLLEGE (AUTONOMOUS), MADURAI-11
DEPARTMENT OF ZOOLOGY

B.Sc. Zoology (with Botany and Chemistry ancillary)
Programme structure for B.Sc. Zoology (2020 -2021 onwards)

Semester	Course	Sub. Code	Subject	Hrs	Credits	Int.	Ext	Total
Semester I	Lang I	20U1T/H/SLA1	Tamil/Hindi/Sanskrit-I	6	3	25	75	100
	Eng I	20U1NEN1	English-I	6	3	25	75	100
	MCT1	20U1ZMC1	Invertebrata-I	3	3	25	75	100
	MCT2	20U1ZMC2	Invertebrata-II	3	3	25	75	100
	MCP1	20U1ZMP1	Major Practical-I	3	2	40	60	100
	AT1/1	20U1CAC1	Ancillary Chemistry-I	4	4	25	75	100
	AP1	20U1CAP1	Ancillary Chemistry Practical-I	2	1	40	60	100
	VE&PE	20U1VE&PE	Value Education & Professional Ethics	3	3	25	75	100
				30	22			
Semester II	Lang II	20U2T/H/SLA2	Tamil/Hindi/Sanskrit-II	6	3	25	75	100
	Eng II	20U2 NEN2	English-II	6	3	25	75	100
	MCT3	20U2ZMC3	Chordata-I	3	3	25	75	100
	MCT4	20U2ZMC4	Chordata-II	3	3	25	75	100
	MCP1	20U2ZMP2	Major Practical-II	3	2	40	60	100
	AT1/2	20U2CAC1	Ancillary Chemistry –II	4	4	25	75	100
	AP1	20U2CAP2	Ancillary Chemistry Practical-II	2	1	40	60	100
	E&GS	20U2E&GS	Equity & Gender Studies	3	3	25	75	100
				-	1			
				30	23			
Semester III	Lan III	20U3T/H/SLA3	Tamil/Hindi/Sanskrit-III	6	3	25	75	100
	Eng III	20U3 NEN3	English-III	6	3	25	75	100
	MCT5	20U3ZMC5	Cell Biology & Biochemistry	5	5	25	75	100
	MCP2	20U3ZMP3	Major Practical-III	3	2	40	60	100
	SBE1	20U3ZSM1	Applied Entomology	2	2	25	75	100
	AT2/3	20U3BAC1	Ancillary Botany-I	4	4	25	75	100
	AP2	20U3BAP1	Ancillary Botany Practical-I	2	1	40	60	100
	NME1	20U3NM1	Non-Major Elective	2	2	25	75	100
				30	22			

Semester IV	Lan IV	20U4T/H/SLA4	Tamil/Hindi/Sanskrit-IV	6	3	25	75	100
	Eng IV	20U4 NEN4	English-IV	6	3	25	75	100
	MCT6	20U4ZMC6	Developmental Biology	5	5	25	75	100
	MCP2	20U4ZMP4	Major Practical-IV	3	2	40	60	100
	SBE2	20U4ZSM2	Medical Zoology	2	2	25	75	100
	AT2/4	20U4 BAC2	Ancillary Botany –II	4	4	25	75	100
	AP2	20U4 BAP2	Ancillary Botany Practical-II	2	1	40	60	100
	NME2	20U4NM2	Non-Major Elective	2	2	25	75	100
				30	22			
Semester V	MCT7	20U5ZMC7	Genetics	5	5	25	75	100
	MCT8	20U5ZMC8	Animal Physiology	5	5	25	75	100
	MCT9	20U5ZMC9	Evolution	5	5	25	75	100
	MCP3	20U5ZMP5	Major Practical-V	3	2	40	60	100
	MCP4	20U5ZMP6	Major Practical-VI	3	2	40	60	100
	SBE3	20U5ZSM3	Ornamental fish culture	2	2	25	75	100
	MET1	20U5ZME1	Biodiversity & Conservation Biology	4	3	25	75	100
	MET2	20U5ZME2	Forensic Science	3	2	25	75	100
				30	26			
Semester VI	MCT10	20U6ZMC10	Microbiology & Immunology	5	5	25	75	100
	MCT11	20U6ZMC11	Biotechnology	5	5	25	75	100
	MCT12	20U6ZMC12	Ecology	5	5	25	75	100
	MCP3	20U6ZMP7	Major Practical-VII	3	2	40	60	100
	MCP4	20U6ZMP8	Major Practical-VIII	3	2	40	60	100
	SBE4	20U6ZSM4	Vermiculture	2	2	25	75	100
	MET3	20U6ZME3	Biophysics, Biostatistics & Bioinformatics	4	3	25	75	100
	MET4	20U6ZME4	Animal Farming	3	2	25	75	100
				30	26			
Total No. of Hrs& Credits				180	141			

Ancillary Zoology Courses for B.Sc. Chemistry

	Sub. Code	Subject	Hrs	Credits	Int.	Ext.	Total
Semester I	20U1ZAC1	Fundamentals of Invertebrates & Chordates	4	4	25	75	100
	20U1ZAP1	Zoology Ancillary Practical-I	2	1	40	60	100
Semester II	20U2ZAC2	Applied Zoology	4	4	25	75	100
	20U2ZAP2	Zoology Ancillary Practical-II	2	1	40	60	100

Ancillary Zoology Courses for B.Sc. Botany

	Sub. Code	Subject	Hrs	Credits	Int.	Ext.	Total
Semester III	20U3ZAC1	Essentials of Invertebrates & Chordates	4	4	25	75	100
	20U3ZAP1	Zoology Ancillary Practical	2	1	40	60	100
Semester IV	20U4ZAC2	Human Physiology, Microbiology & Immunology	4	4	25	75	100
	20U4ZAP2	Zoology Ancillary Practical	2	1	40	60	100

NME Zoology Courses for B.Sc. & B.Com

	Sub. Code	Subject	Hrs	Credits	Int.	Ext.	Total
Semester III	20U3ZNM1	Essentials of Zoology	2	2	25	75	100
Semester IV	20U4ZNM2	Economic Zoology	2	2	25	75	100



THE MADURA COLLEGE (AUTONOMOUS), MADURAI-11
DEPARTMENT OF ZOOLOGY
B.Sc. Zoology (with Botany and Chemistry ancillary)

Semester	Sub. Code	Subject	Hrs	Credits	Int.	Ext.	Total
III	20U3ZMC5	Cell Biology & Biochemistry	5	5	25	75	100
	20U3ZMP3	Major Practical-III	3	2	40	60	100
	20U3ZSM1	Applied Entomology	2	2	25	75	100
IV	20U4ZMC6	Developmental Biology	5	5	25	75	100
	20U4ZMP4	Major Practical-IV	3	2	40	60	100
	20U4ZSM2	Medical Zoology	2	2	25	75	100

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Core	20U3ZMC5	Cell Biology & Biochemistry	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the cell theory, types of cells and techniques used in cell biology
2. To describe ultrastructure and functions of the cell organelles.
3. To appraise the cell cycle and biochemistry of metabolism in cells.
4. To understand the types and role of RNA and protein synthesis.
5. To give an idea about enzymes and their role in cell metabolism.

Unit	Description	Hours	K-level	CLO
I	Introductory Cytology Cell theory - Prokaryotic and Eukaryotic cells. Cytological techniques: Fixation- Sectioning & Staining. Principle & uses of compound microscope, confocal microscope and electron microscope. Cell Junctions - Ultrastructure and functions of plasma membrane.	15	Up to K2	1
II	Cell Organelles Nucleus & Nucleolus. DNA structure and function - DNA Replication - Chromatin - Nucleosome. Chromosomes: - Structure, types, Giant chromosomes. Ultrastructure and functions of Endoplasmic reticulum & Golgi body.	15	Up to K3	2

III	Biochemistry& Cell cycle Ultrastructure and functions of Lysosomes, Centrosomes, Mitochondria. Glycolysis and Krebs cycle. Electron transport chain and formation of ATP. Cell cycle - Mitosis, Meiosis & interphase its regulation. Apoptosis & Cancer.	15	Up to K3	3
IV	Protein Synthesis Types & role of RNA- Structure of t-RNA. Ultra structure, function and types of ribosome. Properties of Genetic code - Detailed study of Protein synthesis – Polysome – differences in eukaryotes – Short outline of post transcriptional modifications.	15	Up to K4	4
V	Enzymes & Metabolism Structure and Classification of Carbohydrates, Protein and lipids. Enzymes: mechanism of action – classification and factors influencing enzyme action – Enzyme Inhibition. Glycogenesis – Glycogenolysis, Gluconeogenesis and HMP shunt. Deamination & Transamination. Beta oxidation of fats.	15	Up to K4	5

Books for Study

1. Arumugam, N. 2020. *Cell Biology & Molecular Biology*, Saras Publications, Nagercoil.
2. Arumugam, N. 2014. *Cell Biology*, Saras Publications, Nagercoil.
3. Fatima, D., Narayanan, LM., Meyyan, RP., Nallasingam, K., Prasanna Kumar, S. & Arumugam, N. 2014. *Biochemistry*, Saras Publications, Nagercoil.
4. Verma, PS. & Aggarwal, VK. 2015. *Cell Biology (Cytology, Biomolecules and Molecular Biology)*, S. Chand Publishers, New Delhi.

Books for References

1. De Robertis, EDP. & De Robertis, EMF. 2010. *Cell and Molecular Biology*, Lippincott Williams & Wilkins.
2. Gupta, PK. 2018. *Cell Biology*, Rastogi Publications, Meerut.
3. Jain, JL., Jain, N. & Jain, S. 2016. *Fundamentals of Biochemistry*, S. Chand Publications, New Delhi.
4. Pawar, CB. 2019. *Cell Biology*, Himalaya Publications.
5. Ramadevi, K. 2016. *Ambika Shanmugam's Fundamentals of Biochemistry for Medical Students*, Wolters Kluwer India Pvt Ltd.
6. David L. Nelson & Michael M. Cox, 2017. *Lehninger Principles of Biochemistry*, Macmillan.

Web resources

<https://www.shomusbiology.com/cell-biology.html>
<https://biolympiads.com/notes-of-molecular-biology-of-the-cell-by-alberts/>
<https://www.biologyjunction.com/cell++notes+bi.htm>

Rationale for Nature of the course

This course will enable the students to comprehend the knowledge on concepts of cell theory, ultrastructure and types of cells, advanced techniques used in cell biology, role of cell organelles, phases of cell cycle, biochemistry of metabolism in cells, types and role of RNA, protein synthesis, enzymes and their role in cell metabolism.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquired knowledge on the working principles of advanced instruments used in cytology will help the students for developing their skills in cytological techniques, which further paves the way for their employability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designers:

1. Dr. B. Latha
2. Dr. C. Selvakumar

Lecture Schedule (Total hours: 75)

Unit	Description	Staff Name	Hrs	Mode
I	Cell theory – Prokaryotic & Eukaryotic cells		3	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Cytological techniques: Fixation– Sectioning & Staining		3	
	Principle & uses of compound microscope, confocal microscope and electron microscope		4	
	Cell Junctions		2	
	Ultrastructure and functions of plasma membrane		3	
			15	
II	Nucleus & Nucleolus		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	DNA structure and function		2	
	DNA Replication, Chromatin, Nucleosome.		3	
	Structure & types of Chromosomes		2	
	Giant chromosomes		2	
	Ultrastructure and functions of Endoplasmic reticulum & Golgi body		4	
			15	
III	Ultrastructure and functions of Lysosomes, centrosomes, Mitochondria		4	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Glycolysis & Krebs cycle		4	
	Electron transport chain and formation of ATP		2	
	Cell cycle -Mitosis, Meiosis & Interphase its regulation		3	
	Apoptosis & Cancer		2	
			15	

IV	Types & role of RNA, Structure of t-RNA		3	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Ultra structure, function and types of ribosome		3	
	Properties of Genetic code		3	
	Detailed study of Protein synthesis		3	
	Polysome – differences in eukaryotes		2	
	Short outline of post transcriptional modifications		1	
			15	
V	Structure and Classification of Carbohydrates, Protein & Lipids		4	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Enzymes: mechanism of action, classification and factors influencing enzyme action - Enzyme Inhibition.		4	
	Glycogenesis –Glycogenolysis, Gluconeogenesis and HMP shunt		3	
	Deamination & Transamination		2	
	Beta oxidation of fats		2	
			15	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Describe the cell theory, widely used cytological techniques and ultrastructure & functions of plasma membrane.	Up to K2
CLO-2	Discuss the ultrastructure and functions of cell organelles.	Up to K3
CLO-3	Examine the stages of cell cycle and metabolic cycles in mitochondria	Up to K3
CLO-4	Investigate the mechanism of protein synthesis.	Up to K4
CLO-5	Analyze the role of cellular components and enzymes in cell metabolism	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1	1	2		2		2	
CLO-2	2	2	3				2	
CLO-3	1	1	2				2	
CLO-4	2	1	3			2	2	
CLO-5	3	2	3	2	2	3	3	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	1	1	2	2	3
CLO-2	2	1	2	1	2
CLO-3	2	1	2	1	2
CLO-4	2	2	1	2	2
CLO-5	1	1	3	2	3

3- Advance application; 2- Intermediate level; 1- Basic level

BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Question s	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K 2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)	
2	CLO 2	Up to K 3	2	K1& K2	2	K2	2 (K3&K3)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 3	Up to K 3	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
2	CLO 4	Up to K 4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

BLUE PRINT FOR EXTERNAL

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	2	10	--	17	14.16	42%
K2	5	8	10	10	33	27.5	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Core	20U3ZSM1	Applied Entomology	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented			Entrepreneurship oriented	✓

Course Objectives

By the end of the course, students will be able:

1. To understand the economic and medical importance of insects.
2. To create awareness among the students about the applied aspects of Zoology.
3. To gain knowledge on various techniques employed in rearing of economically important insects.
4. To apply efficiently and execute the methodology for field practice.
5. To restate the role of insects in Forensic investigation.

Unit	Description	Hours	K-level	CLO
I	Sericulture Types of silk worm, Life history of mulberry silk worm <i>Bombyx mori</i> , Mountage, Diseases of silk worm: pebrine, muscardine and flacherie.	6	Up to K2	1
II	Moriculture Cultivation of mulberry plant, Methods of harvesting and preservation. Role of Central Silk Board in Sericulture.	6	Up to K3	2
III	Apiculture Different species of honey bees, Life history of bees, Newton's bee hive, Uses of honey.	6	Up to K3	3
IV	Lac culture Lac insect classification, Life history of lac insects, Cultivation of lac, Harvesting and processing of lac, Composition and uses of lac.	6	Up to K4	4
V	Forensic Entomology Insects of forensic importance, Corpse feeders, Maggots, Life cycle analysis, Role of insects in crime investigation.	6	Up to K4	5

Books for Study

1. Tomer, BS. 2011. *Economic Zoology*, Emkay publications, Delhi.
2. Arumugam, N., Murugan, S., Johnson Rajeshwar, J. & Ramprabha, R. 2005. *Applied Zoology*, Saras publication, Nagercoil.
3. Johnson, M. & Kesary, M. 2008. *Sericulture* IVth Edition, N.M.C. College, Marthandam.
4. Ganga, G. & Sulochanachetty, J. 2000. *An Introduction to Sericulture*, Oxford & IBH Publishing Company Pvt. Ltd. New Delhi.

Books for References

1. Ravindranathan, KR. 2005. *A text book of economic zoology*, Dominant publishers and distributors, New Delhi.
2. Vasantharaj David, B. & Kumaraswamy, T. 1996. *Elements of Economic Entomology*, Popular book depot, Chennai.
3. Venkatanarasaiah, P. 2013. *Sericulture*, APH Publishing Corporation, New Delhi.

Web Resources

http://agritech.tnau.ac.in/farm_enterprises/fe_apiculture_home.html

http://agritech.tnau.ac.in/sericulture/seri_index.html

Rationale for Nature of the course

This course represents an attractive means of combining state-of-the-art transition on various techniques employed in rearing of economically important insects. It also highlights the use of insects in forensic investigations.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquired knowledge on applied entomology will helps the students to develop their entrepreneurial skills that enable the students to become a successful entrepreneur. The knowledge on forensic entomology will help them to get through their employability in forensic department.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course designers:

Dr. S. Dinakaran

Dr. R. Eswaran

LESSON PLAN (Total hours: 30)

Unit	Description	Staff Name	Hrs	Mode
I	Types of silkworm		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Life history of mulberry silk worm <i>Bombyx mori</i>		1	
	Mountage		1	
	Diseases of silkworm (Pebrine, Muscardine & Flacherie)		3	
			6	
II	Cultivation of mulberry plant		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Methods of harvesting		1	
	Methods of preservation		1	
	Role of Central Silk Board in Sericulture		2	
			6	
III	Different species of honey bees		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Life history of bees		1	
	Newton's bee hive		2	
	Uses of honey		1	
			6	
IV	Lac insect classification		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Life history of lac insects		1	
	Cultivation of lac		1	
	Harvesting and processing of lac		1	
	Composition and uses of lac		2	
			6	
V	Insects of forensic importance		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Corpse feeders		1	
	Maggots		1	
	Life cycle analysis		1	
	Role of insects in crime investigation		1	
			6	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Describe the life cycle silkworm, honey bee and lac insects	Up to K2
CLO-2	Outline the rearing techniques of economically important insects.	Up to K3
CLO-3	Examine the rearing and cultivation methods for mulberry	Up to K3
CLO-4	Analyse the uses of products derived from the culture of insects	Up to K4
CLO-5	Investigate the role of insects in Forensic investigation	Up to K4

Mapping with Programme Specific Outcomes of Chemistry

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	2	2	1		2	2		1
CLO-2	2		3	1	2	3	2	1
CLO-3	2	1	1	3	1	3	1	
CLO-4	2		2	1		1	1	
CLO-5	2	1	2	2	3	3	2	2

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	1	1	1	1	2
CLO-2	2	2	1	1	3
CLO-3	2	2	1	1	3
CLO-4	2	3	1	1	3
CLO-5	2	3	1	2	2

3- Advance application; 2- Intermediate level; 1- Basic level

BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Question s	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)	
2	CLO 2	Up to K3	2	K1& K2	2	K2	2 (K3&K3)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 3	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
2	CLO 4	Up to K4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

BLUE PRINT FOR EXTERNAL

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	2	10	--	17	14.16	42%
K2	5	8	10	10	33	27.5	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Core	20U3ZMP3	Major Practical – III	2	3	40	60	100

Nature of Course			
Knowledge and skill			Employability oriented
Skill oriented	✓		Entrepreneurship oriented

Course Objectives

By the end of the course, students will be able:

1. To understand the techniques of cell biology and biochemistry.
2. To operate the instruments using in cell biology and biochemistry experiments.
3. To estimate and qualitative analysis of the macromolecules.

	Experiments
1.	Operational methods and uses of microscope, camera lucida, stage and ocular micrometers.
2.	Observation and measurement of cell.
3.	Preparation of cells and tissues: Squamous epithelium, Striated, Smooth and Cardiac Muscle.
4.	Cell division - Mitosis - Root tips, Meiosis - Grass hopper testis.
5.	Cell Counts - Total count RBC & WBC of Human, Differential Count.
6.	Estimation of carbohydrate, proteins and lipids.
7.	Qualitative analysis of carbohydrates, protein and lipids.
	Spotters
	pH meter, Centrifuge, Spectrophotometer, Paper Chromatography, Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis, DNA & RNA.

Books for References

1. David L. Nelson & Michael M. Cox, 2017. *Lehninger Principles of Biochemistry*, Macmillan.
2. De Robertis, EDP. & De Robertis, EMF. 2010. *Cell and Molecular Biology*, Lippincott Williams & Wilkins.
3. Gupta, PK. 2018. *Cell Biology*, Rastogi Publications, Meerut.
4. Jain, JL., Jain, N. & Jain, S. 2016. *Fundamentals of Biochemistry*, S. Chand Publications, New Delhi.
5. Pawar, CB. 2019. *Cell Biology*, Himalaya Publications.
6. Ramadevi, K. 2016. *Ambika Shanmugam's Fundamentals of Biochemistry for Medical Students*, Wolters Kluwer India Pvt Ltd.

Web Resources

<https://www.youtube.com/watch?v=5-ur7bWqlDQ>
https://www.youtube.com/watch?v=7AWu4Qb_Emk
<https://www.youtube.com/watch?v=tsG2e9gPOqw>
<https://www.youtube.com/watch?v=QacQmS3aaTI>

Rationale for Nature of the course

The students can develop their skills in operating microscopes, camera lucid and micrometers. They could develop their skills to study cell division, cell counts, preparation of cells and tissues, estimation and qualitative analysis of macromolecules and techniques used in biochemistry can be learned.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

Acquiring of skills on operating advanced instruments in the field of cytology and biochemistry, and knowledge on qualitative and quantitative estimation of macromolecules will ensure their career in higher studies, research institutes and industries.

Pedagogy

PPT, group discussion, interaction, tutorial and virtual labs.

Course designers

Dr. B. Latha
Dr. P. Sivakumar

LESSON PLAN (Total hours: 45)

Cycle	Description	Staff Name	Hrs	Mode
Experiments				
1	Operational methods and uses of microscopes		3	Live demo with instruments
2	Operational methods and uses of camera lucida, stage and ocular micrometers		3	Live demo with instruments
3	Observation and measurement of cell		3	Procedure with slides
4	Preparation of cells and tissues: Squamous epithelium, Striated, Smooth and Cardiac Muscle		3	Live demo
5	Mitosis - Root tips,		3	Live demonstration
6	Meiosis - Grass hopper testis		3	Live demonstration
7	Cell Counts - Total count RBC & WBC of Human, Differential Count.		3	Live demonstration
8	Estimation of carbohydrate, proteins and lipids.		3	Live demonstration
9	Qualitative analysis of carbohydrates, protein and lipids		3	Live demonstration
Spotters				
10	pH meter, Centrifuge		3	Live demo with instruments
11	Spectrophotometer, Paper Chromatography		3	Live demo with instruments
12	Agarose Gel Electrophoresis Polyacrylamide Gel Electrophoresis		3	Live demo with instruments
13	DNA and RNA.		3	Comments with Image
14	Internal Practical Test		3	
15	Summative Practical Examination			

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Recall the operational methods and uses of microscopes, camera lucida, stage and ocular micrometers.	Up to K2
CLO-2	Understand the cytological and biochemical techniques.	Up to K3
CLO-3	Apply the knowledge to	Up to K3
CLO-4	Analyse the preparation of cells and tissues, cell division and cell counts.	Up to K4
CLO-5	Examine the quantitative and qualitative analysis of carbohydrate, proteins and lipids.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1	1	2		2		2	
CLO-2	1	2	3				2	
CLO-3	1	1	3				2	
CLO-4	1	1	3				2	
CLO-5	1	2	3	2	2		3	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	1	2	2	2	2
CLO-2	2	2	1	2	2
CLO-3	1	2	2	2	1
CLO-4	1	2	1	2	2
CLO-5	2	2	1	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

Semester III: Mapping of Courses with Programme Specific Outcomes

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
Cell biology & Biochemistry	2	1	2				2	
Applied Entomology	2	1	2		1	3	3	
Major Practical-III	1	1	1				2	

3- Advance application; 2- Intermediate level; 1- Basic level

Semester III: Mapping of Course Outcomes with Programme Specific Outcomes

		PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
Cell biology & Biochemistry	CO-1	1		3	1	1			
	CO-2	1	1	3					
	CO-3	1	1	2					
	CO-4	1		3	2				
	CO-5	1		2					
Applied Entomology	CO-1	2	1		2		2		
	CO-2	1			1		2	3	
	CO-3	2					3		
	CO-4	1				2	2	3	
	CO-5	1	1	3		1		2	

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Core	20U4ZMC6	Developmental Biology	5	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To make an awareness about the theories, concepts and basics of Developmental Biology.
2. To provide an idea about sex cells, fertilization, cleavage, differentiation and development of organs.
3. To make an awareness of the induction, organizers and development of extra embryonic structures.
4. To provide adequate explanation about the late embryonic developments and post embryonic development and aging.
5. To give an idea about teratogenesis, *in vitro* fertilization, stem cells and amniocentesis.

Unit	Description	Hours	K-level	CLO
I	Gametes & Fertilization Basic concepts of developmental biology. Structure & types of Spermatozoa, Mammalian egg – Egg membranes. Patterns of egg – Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.	15	Up to K2	1
II	Blastulation & Gastrulation Cleavage – Planes & Patterns, Factors controlling cleavage – Fate map & its construction. Blastulation – Morphogenetic movements – Gastrulation of frog & chick.	15	Up to K3	2
III	Organogenesis Development of Brain, Eye and Heart in frog. Development of Nervous system in chick & Foetal membranes in chick. Placentation in Mammals. Development of Pro, Meso & Metanephric kidneys.	15	Up to K3	3
IV	Applied Embryology Organizer concept – Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo.	15	Up to K4	4

V	Embryological Techniques Ostrous, Menstrual cycle and menopause - Pregnancy – trimesters – development. <i>Erythroblastosis foetalis</i> -Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology – Embryo transfer – Amniocentesis.	15	Up to K4	5

Books for Study

1. Arumugam, N. 2014. *A Text Book of Embryology (Developmental Zoology)*, Saras Publication, Nagercoil.
2. Verma, PS. & Agarwal, VK. 1975. *Chordate Embryology*, S. Chand Publishers, New Delhi.

Books for References

1. Balinsky, BI. 1965. *An Introduction to Embryology*, W.B. Saunders and Co, Philadelphia.
2. Berril, NJ. & Kars, G. 1986. *Developmental biology*, McGraw Hills.
3. Gilbert, SF, 2010. *Developmental Biology*, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
4. Majumdar, NN. 1985. *Vetebrate Embryology*, Tata McGraw-Hill, New Delhi.

Web resources

<https://www.youtube.com/watch?v=NrSfav3euuo>
<https://www.youtube.com/watch?v=nXoYAZLgWmo>
<https://www.youtube.com/watch?v=q6E2Y6JeUjQ>

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Rationale for Nature of the course

This course will enable the students to grasp the theories, concepts and basics of Developmental Biology, fertilization, cleavage, differentiation and development of organs, organizers, late embryonic developments and post embryonic development, aging, teratogenesis, *in vitro* fertilization, stem cells and amniocentesis.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of knowledge on basic and advanced concepts of Developmental Biology enriches students' overall understanding of biology, which may boost their research temperament.

Course designers

Dr. B. Latha
Dr. C. Selvakumar

LESSON PLAN (Total hours: 75)

Unit	Description	Staff Name	Hrs	Mode
I	Basic concepts of developmental biology		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Structure & types of Spermatozoa		3	
	Mammalian egg – Egg membranes.		2	
	Patterns of egg		2	
	Spermatogenesis – Oogenesis		2	
	Fertilization– mechanism, theories and significance		3	
	Parthenogenesis		1	
			15	
II	Cleavage – Planes & Patterns		3	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Factors controlling cleavage		2	
	Fate map & its construction		3	
	Blastulation		1	
	Morphogenetic movements		2	
	Gastrulation of frog		2	
	Gastrulation of chick		2	
			15	
III	Development of Brain, Eye and Heart in frog		4	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Development of Nervous system in chick		2	
	Foetal membranes in chick		2	
	Placentation in Mammals		3	
	Development of Pro, Meso & Metanephric kidneys		4	
			15	
IV	Organizer concept –Structure – mechanism of induction and competence.		4	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Nuclear transplantation		2	
	Teratogenesis		2	
	Regeneration: types - events and factors		3	
	Embryonic stem cells & significance		2	
	Methods to culture embryo		2	
			15	
V	Ostrous, Menstrual cycle and menopause		3	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Pregnancy – trimesters – development		2	
	<i>Erythroblastosis foetalis</i> -Twins – types		3	
	Infertility – causes - Test tube baby and Assisted Reproductive Technology		3	
	Embryo transfer		2	
	Amniocentesis		2	
			15	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Understand the basic concepts, structures and types of gametes and fertilization.	Up to K2
CLO-2	Describe the process of cleavage, blastulation and gastrulation.	Up to K3
CLO-3	Apply the knowledge to arrange sequences in developmental processes in order.	Up to K3
CLO-4	Analyse the importance of applied embryology.	Up to K4
CLO-5	Examine the clinical implications of development and the mechanisms that intervene in developmental alterations.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1		2					
CLO-2	2		2		1			
CLO-3	2	2	2	2	2		2	
CLO-4	2		2		2	2		
CLO-5	1		2		2	2	2	2

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	1		1		
CLO-2	1		2		
CLO-3	1		2		
CLO-4	1	2	2	2	1
CLO-5	2	2	1	2	3

3- Advance application; 2- Intermediate level; 1- Basic level

BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K 2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)	
2	CLO 2	Up to K 3	2	K1& K2	2	K2	2 (K3&K3)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 3	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
2	CLO 4	Up to K4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

BLUE PRINT FOR EXTERNAL

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	2	10	--	17	14.16	42%
K2	5	8	10	10	33	27.5	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Core	20U4ZSM2	Medical Zoology	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To relate communicable and non-communicable diseases.
2. To create awareness among the students about the disease causative organisms.
3. To gain knowledge on the transmitting vectors, mode of transmission, symptoms and prophylaxis.
4. To analyse the health problems in human and to rectify the same.
5. To appraise medical importance of vector borne disease, protozoan diseases, Helminthic diseases and Ectoparasites.

Unit	Description	Hours	K-level	CLO
I	Science of diseases Communicable and non-communicable diseases, Vectors: Biological (Mosquito) and Mechanical (Musca) vectors - Endemic, epidemic and pandemic diseases.	6	Up to K2	1
II	Vector borne diseases Dengue, Rabies, Plague and Kala-Azar (Transmitting vectors, mode of transmission, symptoms and prophylaxis).	6	Up to K3	2
III	Protozoan diseases Amoebiasis, Malaria, Pyorrhoea and Trypanosomiasis (Life cycle of causative organism, pathogenesis and prophylaxis).	6	Up to K3	3
IV	Helminthic diseases Fascioliasis, Taeniasis, Ascariasis and Ancylostomiasis (Mode of infection, pathogenesis and prophylaxis).	6	Up to K4	4
V	Ectoparasites Head louse, bed bug, ticks and mites (General characters, Medicinal importance and control measure).	6	Up to K4	5

Books for Study

1. Rathinaswamy, S. K. 1986. *A hand book of medical entomology and elementary parasitology*, Vishwanathan (Printers & Publishers), Pvt. Ltd. Ananda Book Depot, Madras.
2. Park, I.E. & Park K. 2007. *Text Book of Social and Preventive Medicine*, M/s Banarsidas Bhanot publishers, Jabalpur.

Books for References

1. Ghai O.P. & Gupta, P. 1999. *Essential preventive medicine (1")*. Vikas publishing house Pvt Ltd.
2. Kotpal R.L. 2012. *Modern Text Book of Zoology Invertebrates*, Rastogi Publications, Meerut.

Web Resources

https://www.youtube.com/watch?v=CwxeJk_DGIg
<https://www.youtube.com/watch?v=AogfiF7JEJo>
https://www.youtube.com/watch?v=qNs6Jq_K1rU
<https://www.youtube.com/watch?v=zFVmQVq3Zzs>
<https://www.youtube.com/watch?v=JBHkMaYKYAQ>

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Rationale for Nature of the course

This course will enlighten the students about the communicable and non-communicable diseases, causative organisms, transmitting vectors, mode of transmission, symptoms and prophylaxis. This course augments their knowledge on biology of diseases.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of knowledge on medical zoology could inculcate awareness on communicable and non-communicable diseases in the young minds. Moreover, this knowledge will enable the students to get through their employment in health department and pharma industries.

Course designers:

Dr. S. Dinakaran
Dr. L. D. Devasree

LESSON PLAN (Total hours: 30)

Unit	Description	Staff Name	Hrs	Mode
I	Communicable and non-communicable diseases		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Vectors: Biological (Mosquito) and Mechanical (<i>Musca</i>) vectors		2	
	Endemic, epidemic and pandemic diseases		2	
			6	
II	Dengue-Transmitting vectors, mode of transmission, symptoms and prophylaxis		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Rabies-Transmitting vectors, mode of transmission, symptoms and prophylaxis.		1	
	Plaque -Transmitting vectors, mode of transmission, symptoms and prophylaxis		2	
	Kala-azar -Transmitting vectors, mode of transmission, symptoms and prophylaxis		1	
			6	
III	Amoebiasis-Life cycle of causative organism, pathogenesis and prophylaxis		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Malaria-Life cycle of causative organism, pathogenesis and prophylaxis.		1	
	Pyorrhoea-Life cycle of causative organism, pathogenesis and prophylaxis		2	
	Trypanosomiasis (Life cycle of causative organism, pathogenesis and prophylaxis).		1	
			6	
IV	Fascioliasis-Mode of infection, pathogenesis and prophylaxis.		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Taeniasis-Mode of infection, pathogenesis and prophylaxis.		1	
	Ascariasis-Mode of infection, pathogenesis and prophylaxis		2	
	Ancylostomiasis - Mode of infection, pathogenesis and prophylaxis		1	
			6	
V	Head louse - General characters, Medicinal importance and control measure		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Bed bug - General characters, Medicinal importance and control measure		1	
	Ticks - General characters, Medicinal importance and control measure		2	
	Mites - General characters, Medicinal importance and control measure		1	
			6	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Describe communicable and non-communicable diseases	Up to K2
CLO-2	Explain the causative organism of various diseases.	Up to K3
CLO-3	Examine the transmitting vectors, mode of transmission, symptoms and prophylaxis.	Up to K3
CLO-4	Investigate the health problems in human and to rectify the same.	Up to K4
CLO-5	Assess the medical importance of vector borne disease, protozoan diseases, Helminthic diseases and Ectoparasites.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1	2	2	2	2	3	3	2
CLO-2	1	2	3	2	3	3	3	2
CLO-3	1	2	3	2	3	3	2	2
CLO-4	1	2	3	2	3	3	2	2
CLO-5	1	2	3	2	3	3	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	1	3	2
CLO-2	2	3	2	3	2
CLO-3	2	3	3	3	3
CLO-4	2	3	3	3	3
CLO-5	2	3	3	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K 2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)	
2	CLO 2	Up to K 3	2	K1& K2	2	K2	2 (K3&K3)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 3	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
2	CLO 4	Up to K4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

BLUE PRINT FOR EXTERNAL

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	2	10	--	17	14.16	42%
K2	5	8	10	10	33	27.5	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Core	20U4ZMP4	Major Practical – IV	2	3	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the techniques used in Developmental Biology.
2. To understand the different stages of chick embryo and sperm and egg of an organisms.
3. To learn the mounting and sectioning of egg and sperm of an organism.

S. No.	Experiments
1.	Observation of different stages of chick embryo (24 hrs, 48 hrs, 72 hrs and 96 hrs).
2.	Mounting of egg and sperm of chosen animals.
3.	Transverse section of testis and ovary.
4.	Observation of cleavage stages, blastula, gastrula and neurula of frog.
5.	Observation of different stages of development: Invertebrates and Vertebrates (Life Cycle).
6.	Fertilization and early development of Invertebrate & Vertebrates (Polychaetes, Sea urchin, Frog etc.)
	Spotters
	Sperm and ovum of man Placenta of sheep and man Eggs of frog and hen

Books for References

1. Balinsky, BI. 1965. *An Introduction to Embryology*, W.B. Saunders and Co, Philadelphia.
2. Berril, NJ. & Kars, G. 1986. *Developmental biology*, McGraw Hills.
3. Gilbert, SF, 2010. *Developmental Biology*, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
4. Majumdar, NN. 1985. *Vetebrate Embryology*, Tata McGraw-Hill, New Delhi.

Web Resources

<https://organismalbio.biosci.gatech.edu/growth-and-reproduction/animal-development-i/>
<https://www.youtube.com/watch?v=GciJ9X3tJtI>
<https://www.youtube.com/watch?v=vBGumRAWaa0>
<https://organismalbio.biosci.gatech.edu/growth-and-reproduction/animal-development-ii/>

Pedagogy

PPT, group discussion, interaction, tutorial and virtual labs.

Rationale for Nature of the course

The students will acquire skills on studying the different stages of embryo, cleavage stages, different stages of development of an organism and the techniques used in developmental biology.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

Students could learn the skills in studying different stages developing embryo, mounting and sectioning of egg and sperm. It would help their overall understanding on true affinities existing between animals that enriches their research career.

Course designers:

Dr. B. Latha

Dr. P. Sivakumar

LESSON PLAN (Total hours: 45)

Cycle	Description	Staff Name	Hrs	Mode
Experiments				
1	Observation of different stages of chick embryo (24 hrs and 48 hrs)		3	Procedure with slides
2	Observation of different stages of chick embryo (72 hrs and 96 hrs)		3	Procedure with slides
3	Mounting of egg of chosen animals		3	Mounting
4	Mounting of sperm of chosen animals		3	Mounting
5	Transverse section of testis		3	Sectioning
6	Transverse section of ovary		3	Sectioning
7	Observation of cleavage stages, blastula, gastrula and neurula of frog.		3	Procedure with slides
8	Observation of different stages of development: Invertebrates (Life Cycle).		3	Procedure with slides
9	Observation of different stages of development: Vertebrates (Life Cycle).		3	Procedure with slides
10	Fertilization and early development of Invertebrate & Vertebrates (Polychaetes, Sea urchin, Frog etc.)		3	Explanation with images
Spotters				
11	Sperm and ovum of man		3	Explanation with slide
12	Placenta of sheep and man		3	Explanation with slide
13	Eggs of frog and hen		3	Explanation with slide
14	Internal Practical Test		3	
15	Summative Practical Examination			

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Understand the different stages of chick embryo.	Up to K2
CLO-2	Describe the process of cleavage, blastulation and gastrulation.	Up to K3
CLO-3	Apply the knowledge to mount the egg and sperm of chosen animals and transverse section of testis and ovary	Up to K3
CLO-4	Analyse the cleavage stages, blastula, gastrula and neurula of frog.	Up to K4
CLO-5	Examine the fertilization and developmental stages of Invertebrate & Vertebrates.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1	1	1	1			1	
CLO-2	1	2	3	3			3	
CLO-3	1	3	3	3			3	
CLO-4	1	3	3	3			3	
CLO-5	1	2	2	1	2	2	2	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2		2	
CLO-2	2	2		2	
CLO-3	2	2	1	3	2
CLO-4	2	2	2	2	1
CLO-5	2	2		3	3

3- Advance application; 2- Intermediate level; 1- Basic level

Semester IV: Mapping of Courses with Programme Specific Outcomes

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
Developmental Biology	2	1	2				2	
Medical Zoology	2	1	2		1	3	3	
Major Practical-1V	1	1	1				2	

3- Advance application; 2- Intermediate level; 1- Basic level

Semester IV: Mapping of Course Outcomes with Programme Specific Outcomes

		PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
Developmental Biology	CO-1	1		3	1	1			
	CO-2	1	1	3					
	CO-3	1	1	2					
	CO-4	1		3	2				
	CO-5	1		2					
Medical Zoology	CO-1	2	1	1		3			1
	CO-2	2	3	2	1	3			1
	CO-3	1	2	1	1	2			2
	CO-4	1				3			2
	CO-5	2	2	2		3			1

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Allied	20U3ZAC1	Essentials of Invertebrates & Chordates	4	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To describe the general characters and outline classification of Invertebrate and Chordate.
2. To identify the animals and recognize their distinguishing features.
3. To appraise the specific features of animal and their life cycle.
4. To understand the morphology and adaptations of animals in the context of evolution.
5. To learn how different body designs solve biological problems related to physiological and environmental challenges.

Unit	Description	Hours	K-level	CLO
I	Classification, Protista & Porifera Systems of classification and nomenclature, Levels of organization, Types of symmetry. General characters and outline classification of invertebrates (up to phylum) with examples. Life cycle of <i>Plasmodium</i> , Canal system in sponges, Corals and coral reefs.	12	Up to K2	1
II	Platyhelminthes, Annelida & Arthropoda Parasitic adaptation in helminthic worms, Metamerism in Annelida, Metamorphosis in insects, Mouth parts in insects, Affinities of Peripatus.	12	Up to K3	2
III	Mollusca, Echinodermata & Chordata Torsion in Mollusca, Economic importance of Mollusca, Water vascular system in starfish. General characters and outline classification of Chordates (up to class) with examples.	12	Up to K3	3
IV	Prochordates & Fishes General characters and classification of Urochordates, Cephalochordates and Hemichordates (up to class) with examples, Parental care in fishes, Migration of fishes.	12	Up to K4	4
V	Amphibia, Reptilia, Birds & Mammals Neoteny in Amphibians, Poisonous snakes of south India (Cobra and krait), Identification of poisonous and non poisonous snakes, Flight adaptations in birds, Egg laying and pouched mammals, Adaptive radiation in mammals.	12	Up to K4	5

Books for Study

1. Nair NC, Leelavathy S, Soundara Pandian N, Murugan T and Arumugam N, 2017. *A Text Book of Invertebrates*, Saras Publication, Nagercoil.
2. Thangamani A, Prasannakumar, S, Narayanan L.M and Arumugam N, 2017. *A Text Book of Chordates*, Saras Publication, Nagercoil.
3. Nair N.C, Thangamani A, Leelavathy S, Prasanakumar S, Soundrapandian N, Murugan T, Narayanan L.M and Arumugam N, 2017. *Animal diversity (Invertebrata & Chordata)*, Saras Publication, Nagarcoil.
4. Kotpal R.L, 2017. *Modern Text Book of Zoology: Invertebrate*, Rastogi Publications, Meerut.
5. Kotpal R.L, 2017. *Modern text book of Zoology: Vertebrates*, Rastogi Publications, Meerut.

Books for References

1. Barnes R.D. 2006. *Invertebrate Zoology* (1982) VIIth Edition, Holt Saunders International Edition.
2. Ekambaranatha Ayyar and Ananthakrishnan T.N, 1992. *Manual of Zoology Vol – I, Part I & II*, S.Viswanathan Pvt. Ltd. Chennai.
3. Kotpal R.L, Agarwal S.K and Khetarpal R.P, 1990. *Invertebrates*, Rastogi Publications, Meerut.
4. Anderson D.T, 2001. *Invertebrate Zoology*, Oxford University Press, New Delhi.
5. Verma P.S, 2010. *Chordate Zoology*, S Chand Publishers, New Delhi.

Web resources

<https://www.nwf.org/Educational-Resources/Wildlife-Guide/Invertebrates>
<https://biologydictionary.net/invertebrate/>
<https://basicbiology.net/animal/invertebrates>
<https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-121>
<https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-122>
<https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-123>

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Rationale for Nature of the course

This course will enable the students to comprehend the general characters and outline classification of Invertebrates and Chordates. It augments the students' knowledge on morphology and adaptations of animals to meet challenges in their living environment.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of knowledge on body designs of Invertebrates & Chordates, their role to solve physiological and environmental challenges, could enrich the students' knowledge on biology in an evolutionary perspective. It could pave the way for their holistic understanding on biology.

Course designers:

Dr. R. Eswaran
Dr. L. D. Devasree

LESSON PLAN (Total hours: 60)

Unit	Description	Staff Name	Hrs	Mode
I	Systems of classification & nomenclature		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Levels of organization		1	
	Types of symmetry		1	
	General characters of Invertebrates		1	
	Classification of Invertebrates (up to phylum) with examples		2	
	Life cycle of <i>Plasmodium</i>		2	
	Canal system in sponges		2	
	Corals and coral reefs		2	
			12	
II	Parasitic adaptation in helminthic worms		3	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Metamerism in Annelida		2	
	Metamorphosis in insects		2	
	Mouth parts in insects		3	
	Affinities of Peripatus		2	
			12	
III	Torsion in Mollusca		3	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Economic importance of Mollusca		3	
	Water vascular system in starfish		2	
	General characters of Chordates		2	
	Classification of Chordates (up to class) with examples		2	
			12	
IV	General characters and classification of Urochordates (up to class) with examples		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	General characters of and classification Cephalochordates (up to class) with examples		2	
	General characters and classification of Hemichordates (up to class) with examples		2	
	Parental care in fishes		3	
	Migration of fishes		3	
			12	
V	Neoteny in Amphibians		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Poisonous snakes of south India (Cobra and krait)		2	
	Identification of poisonous and non poisonous snakes		2	
	Flight adaptations in birds		2	
	Egg laying and pouched mammals		2	
	Adaptive radiation in mammals		2	
			12	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Understand the systems of classification and nomenclature for animals.	Up to K2
CLO-2	Predict the adaptations of animals with their mode of life.	Up to K3
CLO-3	Apply the knowledge to identify evolutionary relationship among Invertebrates and Chordates.	Up to K3
CLO-4	Investigate the relations between unique behaviours of animals with their habitat.	Up to K4
CLO-5	Examine the role of Invertebrate and Chordates in biological communities and ecological interactions.	Up to K4

Mapping with Programme Specific Outcomes of Botany

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CO-1	2	2	1	1				
CO-2	2	2	3	1				2
CO-3	1	2	1	2				
CO-4	2	1	3	3				1
CO-5	2	2	2	1	2		3	2

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CO-1	2	2	1	2	2
CO-2	2	2	2	3	
CO-3	3	3	2	2	2
CO-4	1	3	2	3	3
CO-5	2	2	3	3	2

3- Advance application; 2- Intermediate level; 1- Basic level

BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K 2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)	
2	CLO 2	Up to K 3	2	K1& K2	2	K2	2 (K3&K3)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 3	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
2	CLO 4	Up to K4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

BLUE PRINT FOR EXTERNAL

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	2	10	--	17	14.16	42%
K2	5	8	10	10	33	27.5	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Allied	20U3ZAP1	Zoology Ancillary Practical – I	1	2	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the dissection and mounting techniques.
2. To understand the different organisms of Invertebrates and Chordates.

S.No.	Dissection
1.	Digestive system of Cockroach
2.	Reproductive system of Cockroach
3.	Fifth cranial nerve
	Mountings
4.	Earth worm: Body Setae
5.	Cockroach: Mouth parts and Salivary glands
6.	House fly: Mouth parts
7.	Honey Bee: Mouth parts
	Spotters
	<i>Trypanosoma, Obelia, Ephyra, Taenia, Ascaris, Leech, Trochophore larva, Nauplius, Albulia, Star fish, Amphioxus, Axolotl larva, Poisonous snakes of south India, Feather of bird.</i>

(Note: Mounting and dissections are to be done by using live specimen or virtual method or slides and preserved specimens from archives).

Books for References

1. Jayasurya, Nair N.C, Soundarapandian N, Arumugem N, Leelavathy S and Murugan T, 2013. *Practical Zoology Vol. 1 Invertebrata*, Saras publication, Nagercoil.
2. Jayasurya, Thangamani A, Arumugam N, Prasanakumar S and Narayanan L.M, 2013. *Practical Zoology Vol. 2 Chordata*, Saras publication, Nagercoil.
3. Sinha J, Chatterjee A.K and Chattopadhyay P, 2011. *Advanced Practical Zoology*, Books and Allied (P) Ltd., Kolkata.

Web Resources

<https://www.youtube.com/watch?v=mWpWUZKo3Wo>
<https://www.youtube.com/watch?v=wF7ew2w24as>
<https://www.youtube.com/watch?v=4WKdnPqj9N0>
https://www.youtube.com/watch?v=aFd7tq_fyBY

Pedagogy

PPT, group discussion, interaction, tutorial and virtual labs.

Rationale for Nature of the course

The course will help to enrich the basic and advanced skills of students on dissection and mounting techniques. It provides opportunity to learn diversity of Invertebrates and Chordates in a hands-on training.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of skills in dissection and mounting will be very helpful for their experimental work in their project work, higher studies and research career.

Course designers:

Dr. L. D. Devasree

Dr. R. Eswaran

LESSON PLAN (Total hours: 30)

Cycle	Description	Staff Name	Hrs	Mode
Dissection				
1	Digestive system of Cockroach		2	Procedure with illustration
2	Reproductive system of Cockroach		2	Procedure with illustration
3	V th Cranial nerve of frog		2	Procedure with illustration
Mountings				
4	Body setae of Earthworm		2	Mounting
5	Mouth parts of Cockroach		2	Mounting
6	Mouth parts of Housefly		2	Mounting
7	Mouth parts of Honey bee		2	Mounting
Spotters				
8	<i>Trypanosoma, Obelia, Ephyra,</i>		2	Specimen & Image
9	<i>Taenia, Ascaris, Leech</i>		2	Specimen & Image
10	Trochophore larva, Nauplius,		2	Specimen & Image
11	<i>Albunia, Star fish</i>		2	Specimen & Image
12	Amphioxus, Axolotl larva		2	Specimen & Image
13	Poisonous snakes of south India, Feather of bird		2	Specimen & Image
14	Internal Practical Test		2	
15	Summative Practical Examination		2	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Describe the diversity of Invertebrates and Chordates.	Up to K2
CLO-2	Explain the structure and functions of the organism.	Up to K3
CLO-3	Classify and identify the Invertebrate and Chordate fauna based on their unique characters.	Up to K3
CLO-4	Examine the organs/systems and their role in Invertebrate and Chordates.	Up to K4
CLO-5	Inspect the role of Invertebrates and Chordates in biological communities and ecological interactions.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	2	2	3	3	3	3	3	2
CLO-2	2	3	3	3	2	2	2	2
CLO-3	2	3	3	3	3	3	3	2
CLO-4	2	2	3	3	2	3	2	2
CLO-5	2	3	3	3	3	3	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	2	2	3
CLO-2	2	2	2	3	2
CLO-3	2	3	2	3	2
CLO-4	2	3	2	3	2
CLO-5	3	3	2	3	2

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Allied	20U4ZAC2	Human Physiology, Microbiology & Immunology	4	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the structures and basic facts of human physiology.
2. To explain cellular basis of physiological functions in animals.
3. To examine the basic concept of microbiology and various culture techniques and its handling.
4. To compare and create awareness about the various microbial diseases and the causative organisms.
5. To prioritize and inspect the cellular components involved in the immunity and the mechanism, types and concepts regarding immune response.

Unit	Description	Hours	K-level	CL O
I	Digestion, Respiration and Nerves Digestive system of Man: Structure of alimentary canal, digestive glands (secretion and its functions only). Respiratory system of Man: Structure of lungs, O ₂ and CO ₂ transport. Nervous system of Man: Structure of neuron, conduction of nerve impulse through myelinated and non- myelinated nerve.	12	Up to K2	1
II	Excretion and Reproduction Excretory system of Man: Structure of kidney, nephrons and formation of urine. Reproductive system of man: Structure of male and female reproductive system. Menstrual cycle, Oestrogen, Androgen, Prolactin, Relaxin and Birth control methods.	12	Up to K3	2
III	Microbiology Five kingdom concept. Sterilization and disinfection, Autoclave, Laminar air flow and Hot air oven. Culture medium (Solid & Liquid) and its composition, types of culture medium. Bacterial growth, growth rate, growth curve. Preservation and pasteurization of milk.	12	Up to K3	3
IV	Microbial Diseases Cholera, Tuberculosis, Botulism, Rabies and AIDS – causative organism, pathogenecity, mode of transmission, symptoms and their preventive measures.	12	Up to K4	4
V	Immunology Types of immunity – natural and acquired (active and passive). Lymphoid organs – primary and secondary lymphocytes. Stem, T and B cells, Macrophages. Antigen-antibody reaction (Precipitation and Agglutination). Immunoglobulin – Structure and functions.	12	Up to K4	5

Books for Study

1. Arumugam N, Mani A, Narayanan LM, Fatima D, Selvaraj AM, &, 2015. *Immunology and Microbiology*, Saras Publication, Nagercoil.
2. Arumugam N. & Mariakuttikan A, 2014. *Animal Physiology*, Saras Publications, Nagercoil.
3. Verma PS, Tyagi BS, & Agarwal VK. 2010. *Animal Physiology*, S. Chand Publishers, New Delhi.
4. Dubey RC. & Maheswari DK, 2013. *A Textbook of Microbiology*, S. Chand Publishers, New Delhi.
5. Ramesh SR, 2017. *Immunology*, McGraw Hill Education India Private Limited.

Books for References

1. Abul K Abbas, Andrew H. Lichtman, & Shiv Pillai, 2019. *Basic Immunology*, Elsevier.
2. Jain AK, 2017. *Textbook of Physiology*, Avichal Publishing Company.
3. Pelczar MJ, Chan EC, Pelczar MF. 1981. *Elements of Microbiology*. McGraw-Hill International Book Company.
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2017. *Roitt's Essential immunology*, Wiley-Blackwell.
5. Ryan KJ & Ray CG, (Editors), 2004. *Sherris Medical Microbiology*. McGraw-Hill Education.
6. Willey J, Sherwood L. & Christopher J. Woolverton, 2017. *Prescott's Microbiology*, McGraw Hill.

Web resources

<https://www.youtube.com/watch?v=S1hdq8ugaQY>
<https://www.youtube.com/watch?v=PLFq-1h4870>
<https://www.youtube.com/watch?v=44B0ms3XPKU>
<https://www.youtube.com/watch?v=W1fw2qQ9Syo>
<https://www.youtube.com/watch?v=7UU1lhFnDVQ>
<https://www.youtube.com/watch?v=aPWO71UIvCI>

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Rationale for Nature of the course

This course will enable the students to comprehend the basics of human physiology and microbiology. The students can also learn about the various culture techniques and its handling, microbial diseases, the causative organism and cellular components involved in the immunity and the mechanism, types and concepts regarding immune response.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of basic knowledge on human physiology, microbiology and immunology could help the students to understand the structure, functions and mechanism of their own body. The knowledge and skills acquired could be a complement for the students to get through their employability in health and pharma industries.

Course designers:

Dr. L. D. Devasree
Dr. R. Eswaran

LESSON PLAN (Total hours: 60)

Unit	Description	Staff Name	Hrs	Mode
I	Structure of alimentary canal,		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Digestive glands (secretion and functions only)		3	
	Structure of lungs		2	
	O ₂ and CO ₂ transport		2	
	Structure of neuron		2	
	conduction of nerve impulse through myelinated and non- myelinated nerve		2	
			12	
II	Structure of kidney		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Nephrons and formation of urine		2	
	Structure of male and female reproductive system		2	
	Menstrual cycle		2	
	Oestrogen, Androgen, Prolactin, Relaxin and		2	
	Birth control methods		2	
			12	
III	Five kingdom concept		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Sterilization and disinfection		2	
	Autoclave		1	
	Laminar air flow and Hot air oven		2	
	Culture medium (Solid & Liquid) and its composition, types of culture medium		3	
	Bacterial growth, growth rate, growth curve		2	
	Preservation and pasteurization of milk		1	
			12	
IV	Cholera, Tuberculosis, Botulism – causative organism, pathogenecity, mode of transmission, symptoms and their preventive measures.		6	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Rabies and AIDS – causative organism, pathogenecity, mode of transmission, symptoms and their preventive measures.		6	
			12	
V	Types of immunity – natural and acquired (active and passive)		4	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Lymphoid organs – primary and secondary lymphocytes		2	
	Stem, T and B cells, Macrophages		3	
	Antigen-antibody reaction (Precipitation and Agglutination)		1	
	Immunoglobulin – Structure and functions.		2	
			12	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statement	Knowledge level
CLO-1	Describe the structure and functions of specific organs in human.	Up to K2
CLO-2	Explain the structure and functions of human physiological systems.	Up to K3
CLO-3	Classify the types of culture medium, sterilization, handling, identification and assessing growth characters of microorganisms.	Up to K3
CLO-4	Compare and contrast various microbial diseases, the causative organisms, symptoms and their preventive measures.	Up to K4
CLO-5	Inspect the types of immunity and cellular components involved in immune response.	Up to K4

Mapping with Programme Specific Outcomes of Botany

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1				3			3	2
CLO-2				3			3	2
CLO-3				3	2	2	3	3
CLO-4				3			3	3
CLO-5				3			3	2

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	3	2	3	2
CLO-2	2	2	2	2	3
CLO-3	2	3	1	3	3
CLO-4	2	3	2	3	2
CLO-5	2	3	2	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K 2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)	
2	CLO 2	Up to K 3	2	K1& K2	2	K2	2 (K3&K3)	2(K2/K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 3	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K3)	
2	CLO 4	Up to K4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

BLUE PRINT FOR EXTERNAL

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	2	10	--	17	14.16	42%
K2	5	8	10	10	33	27.5	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Allied	20U4ZAP2	Zoology Ancillary Practical – II	1	2	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the techniques of physiology, immunology and microbiology.
2. To understand the physiological instruments, microbiological techniques and immunological molecules.

S.No.	Experiments
1.	Estimation of oxygen consumption of fish with reference to body weight
2.	Estimation of oxygen consumption of fish with reference to temperature
3.	Estimation of O ₂ in water sample
4.	Estimation of CO ₂ in water sample
5.	Lymphoid organs in Chick (Demo)
6.	Blood grouping - Man.
7.	Simple staining
8.	Gram's staining
9.	Hanging drop method.
	Spotters
	Sphygmomanometer, Kymograph, Autoclav, Bacterial growth curve, Double immunodiffusion, Antibody structure, Gene cloning, DPT vaccines.

Books for References

1. Abul K Abbas, Andrew H. Lichtman, & Shiv Pillai, 2019. *Basic Immunology*, Elsevier.
2. Jain AK, 2017. *Textbook of Physiology*, Avichal Publishing Company.
3. Pelczar MJ, Chan EC, Pelczar MF. 1981. *Elements of Microbiology*. McGraw-Hill International Book Company.
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2017. *Roitt's Essential immunology*, Wiley-Blackwell.
5. Ryan KJ & Ray CG, (Editors), 2004. *Sherrie Medical Microbiology*. McGraw-Hill Education.

6. Willey J, Sherwood L. & Christopher J. Woolverton, 2017. *Prescott's Microbiology*, McGraw Hill.

Web Resources

<http://www.iworx.com/documents/LabExercises/O2Consumption-AerobicResp.pdf>
<https://www.youtube.com/watch?v=ftrl5ZoeNQ>
<https://www.msmanuals.com/professional/multimedia/lab-tests/v44088168>
<https://www.youtube.com/watch?v=FKdzbgHaQQM>
<https://www.youtube.com/watch?v=PLhbRulwNV0>
<http://nbtc.naco.gov.in/assets/resources/training/5.pdf>

Pedagogy

PPT, group discussion, interaction, tutorial and virtual labs.

Rationale for Nature of the course

The course will supplement the laboratory skills of students on animal physiology, immunology, microbiology and human blood grouping.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of practical hands on training skills on the experiments in the field of animal physiology, microbiology, and immunology could help the students to improve their career in higher studies and research.

Course designers:

Dr. R. Eswaran
Dr. L. D. Devasree

LESSON PLAN (Total hours: 30)

Cycle	Description	Staff Name	Hrs	Mode
Experiments				
1	Estimation of oxygen consumption of fish with reference to body weight.		2	Procedure with Experiment
2	Estimation of oxygen consumption of fish with reference to temperature		2	Procedure with Experiment
3	Estimation of O ₂ in water sample		2	Procedure with Experiment
4	Estimation of CO ₂ in water sample		2	Procedure with Experiment
5	Lymphoid organs in Chick (Demo)		2	Procedure with illustration
6	Blood grouping – Man		2	Procedure with Experiment
7	Simple staining		2	Procedure with Experiment
8	Gram staining		2	Procedure with Experiment
9	Hanging drop method		2	Procedure with Experiment
Spotters				
10	Sphygmomanometer, Kymograph		2	Instrument with comments
11	Autoclave, Bacterial growth curve		2	Instrument with comments
12	Double immunodiffusion, Antibody structure		2	Illustration with comments
13	Gene cloning, DPT vaccines		2	Illustration with comments
14	Internal Practical Test			
15	Summative Practical Examination			

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Understand the basic facts of animal physiology.	Up to K2
CLO-2	Describe the structure and functions of the immune system.	Up to K3
CLO-3	Apply the knowledge to identify and assess the microorganisms.	Up to K3
CLO-4	Analyse the human blood groups and their functions and significance.	Up to K4
CLO-5	Examine the role of immune system and cellular and molecular basis of immune response.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1		1	1	1	1		1	1	1
CLO-2		1	3	3			2	1	2
CLO-3		2	3	2			3	2	2
CLO-4		1	3	3			3	3	2
CLO-5		2	2	2	2		2	2	2

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	1	2	1
CLO-2	2	2	2	1	2
CLO-3	2	2	1	3	2
CLO-4	3	2	2	2	1
CLO-5	3	2	3	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: II UG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Non Major Elective	20U3ZNM1	Essentials of Zoology	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the concept and systematic classification of animal kingdom.
2. To recognize the general characters and outline classification of Invertebrate and Chordate.
3. To analyze the structure and functions of nucleic acids.
4. To create an awareness about the various microbial diseases and the causative organisms.
5. To gain knowledge on blood and their components, groups and clotting mechanism.

Unit	Description	Hours	K-level	CLO
I	Classification Concept of five kingdom classification of life. Systems of classification & nomenclature - Levels of organization - Types of symmetry.	6	Up to K2	1
II	Invertebrates & Chordates General characters and classification of Invertebrates (up to phylum) with example. General characters and classification of Chordates (up to class) with example.	6	Up to K2	2
III	Nucleic acids Nucleic acids. DNA structure – Watson and Crick model. Significance of DNA. RNA –structure, types of RNA –mRNA, tRNA and rRNA	6	Up to K2	3
IV	Microbial Diseases Communicable Diseases: AIDS, Rabbits – causative agent, mode of transmission, symptoms and treatment. Non-communicable Diseases: Cholera, Typhoid- causative agent, mode of transmission, symptoms.	6	Up to K2	4
V	Immunology Components of blood, blood groups- ABO blood grouping, Rh factor, blood pressure, blood clotting-mechanism.	6	Up to K2	5

Books for Study

1. Arumugam, N. 2020. *Cell Biology & Molecular Biology*, Saras Publications, Nagercoil.
2. Arumugam N, Mani A, Narayanan LM, Fatima D, Selvaraj AM, &, 2015. *Immunology and Microbiology*, Saras Publication, Nagercoil.
3. Nair N.C, Thangamani A, Leelavathy S, Prasanakumar S, Soundrapandian N, Murugan T, Narayanan L.M and Arumugam N, 2017. *Animal diversity (Invertebrata & Chordata)*, Saras Publication, Nagarcoil.
4. Dubey RC. & Maheswari DK, 2013. *A Textbook of Microbiology*, S. Chand Publishers, New Delhi.

Books for References

1. Abul K Abbas, Andrew H. Lichtman, & Shiv Pillai, 2019. *Basic Immunology*, Elsevier.
2. Barnes R.D. 2006. *Invertebrate Zoology* (1982) VIIth Edition, Holt Saunders International Edition.
3. De Robertis, EDP. & De Robertis, EMF. 2010. *Cell and Molecular Biology*, Lippincott Williams & Wilkins.
4. Pelczar MJ, Chan EC, Pelczar MF. 1981. *Elements of Microbiology*. McGraw-Hill International Book Company.
5. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2017. *Roitt's Essential immunology*, Wiley-Blackwell.
6. Ryan KJ & Ray CG, (Editors), 2004. *Sherris Medical Microbiology*. McGraw-Hill Education.
7. Willey J, Sherwood L. & Christopher J. Woolverton, 2017. *Prescott's Microbiology*, McGraw Hill.

Web resources

<https://www.youtube.com/watch?v=hiQCCN5oisw>
<https://www.youtube.com/watch?v=jAnch9ET-gg>
<https://www.youtube.com/watch?v=MA-ouz1LtpM>
<https://www.youtube.com/watch?v=ZVvjXuSmyZQ>
<https://www.youtube.com/watch?v=H6w-BRSgfMg>

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Rationale for Nature of the course

This course will enable the students to comprehend the principles of classification and general characters of Invertebrate and Chordate, structure and functions of nucleic acids, microbial diseases and the causative organisms and components of blood and blood groups.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquiring of basic knowledge on diversity of animals, nucleic acids, microbial pathogens, and immunology could enable the students to understand the science in a holistic perspective. It could be helpful for the students in developing their multidisciplinary skills.

Course designers:

Dr. L. D. Devasree
Dr. C. Selvakumar

LESSON PLAN (Total hours: 30)

Unit	Description	Staff Name	Hrs	Mode
I	Concept of five kingdom classification of life		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Systems of classification & nomenclature		2	
	Levels of organization		1	
	Types of symmetry		1	
			6	
II	General characters of Invertebrate with examples		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Classification of Invertebrate (up to phylum) with examples		2	
	General characters and classification of Chordata (up to class) with examples		2	
			6	
III	Nucleic acids		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	DNA structure – Watson and Crick model, Significance of DNA.		2	
	RNA –structure, types of RNA –mRNA, tRNA and rRNA		2	
			6	
IV	AIDS & Rabbits – causative agent, mode of transmission, symptoms and treatment		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Cholera – causative agent, mode of transmission, symptoms		2	
	Typhoid – causative agent, mode of transmission, symptoms		2	
			6	
V	Components of blood		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Blood groups – ABO blood grouping, Rh factor		2	
	Blood pressure, blood clotting mechanism		2	
			6	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Describe the concept and systematic classification of animal kingdom.	Up to K2
CLO-2	Explain the characters and outline classification of Invertebrate and Chordates.	Up to K2
CLO-3	Examine the structure and role of nucleic acids.	Up to K2
CLO-4	Compare and contrast various microbial diseases and the causative organisms, symptoms and their preventive measures.	Up to K2
CLO-5	Inspect the blood components, blood groups and clotting mechanism.	Up to K2

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	2	1	2					
CLO-2	2	3	1					
CLO-3	1		3					
CLO-4	1				3		2	
CLO-5	1		3				2	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	1	3	2
CLO-2	2	2	1	2	1
CLO-3	2	3	2	2	2
CLO-4	2	3	2	3	2
CLO-5	3	3	2	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

Learning Outcome Based Education & Assessment (LOBE)
Blue Print –(CIA-I & II)
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO x	Up to K2	1	K1	1	K2/K2	1	K1
CLO y	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

Distribution of Section-wise Marks with K Levels (CIA I & II)

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

Learning Outcome Based Education & Assessment (LOBE)
Blue Print
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

DEPARTMENT OF ZOOLOGY				CLASS: II UG				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Non Major Elective	20U4ZNM2	Economic Zoology	2	2	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented			Entrepreneurship oriented	✓

Course Objectives

By the end of the course, students will be able:

1. To understand the economic importance of animals.
2. To create awareness among the students about the applied aspects of Zoology.
3. To gain knowledge on various techniques employed in different culture systems.
4. To apply efficiently and execute the methodology for field practice.
5. To motivate the students for the self employment.

Unit	Description	Hours	K-level	CLO
I	Apiculture Organization of bee colony – Queen, Drone and Worker. Rearing of bee colony – Newton's bee hive. Problems in Apiculture – Natural enemies.	6	Up to K2	1
II	Sericulture Life cycle of Mulberry silkworm <i>Bombyx mori</i> . Rearing of silkworm – Appliances.	6	Up to K2	2
III	Pisciculture Cultivable fishes (fin fishes and shell fishes), Polyculture of carps, Economic importance of fishes.	6	Up to K2	3
IV	Pearl Oyster farming & Poultry Types of pearl, culture methods of pearls. Poultry: Breeds of poultry, Types of poultry house and Poultry diseases and control.	6	Up to K2	4
V	Dairy farming Economically important cattle, Nutritive value of milk, Livestock diseases: Mastitis, Foot and mouth diseases and Rinder pest.	6	Up to K2	5

Books for Study

1. Tomer B.S, 2011. *Economic Zoology*, Emkay publications, Delhi.
2. Arumugam N, Murugan S, Johnson Rajeshwar J and Ramprabha R, 2005. *Applied Zoology*, Saras publication, Nagercoil.
3. Johnson M and Kesary M, 2008. *Sericulture* IVth Edition, N.M.C. College, Marthandam.
4. Ganga G and Sulochanachetty J, 2000. *An Introduction to Sericulture*, Oxford & IBH Publishing Company Pvt. Ltd. New Delhi.
5. Arumugam N, 2000. *Aquaculture*, Saras publication, Nagercoil.

Books for References

1. Ravindranathan K.R, 2005. *A text book of Economic Zoology*, Dominant publishers and distributors, New Delhi.
2. Vasantharaj David B and Kumaraswamy T, 1996. *Elements of Economic Entomology*, Popular book depot, Chennai.
3. Venkatanarasaiah P, 2013. *Sericulture*, APH Publishing Corporation, New Delhi.

Web Resources

http://agritech.tnau.ac.in/farm_enterprises/fe_apiculture_home.html
http://agritech.tnau.ac.in/sericulture/seri_index.html
http://www.agritech.tnau.ac.in/expert_system/poultry/index.html
http://agritech.tnau.ac.in/animal_husbandry/animhus_cattle%20_index_page.html
http://agritech.tnau.ac.in/fishery/fish_index.html

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Rationale for Nature of the course

This course represents an attractive means of combining state-of-the-art transition on various methodologies, field practice employed in rearing of economically important animals.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquired knowledge and skill of Economic Zoology will helps the students to augment their entrepreneurial skills that enable the students to become a successful entrepreneur.

Course designers:

Dr. C. Selvakumar
Dr. P. Sivakumar

LESSON PLAN (Total hours: 30)

Unit	Description	Staff Name	Hrs	Mode
I	Organization of bee colony		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Rearing of bee colony		1	
	Newton's bee hive		1	
	Problems in Apiculture		1	
	Natural enemies		1	
			6	
II	Life cycle of silkworm		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Rearing of silkworm		2	
	Rearing appliances		2	
			6	
III	Cultivable fishes (fin fishes)		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Cultivable fishes (Shell fishes)		1	
	Polyculture of carps		2	
	Economic importance of fishes		2	
			6	
IV	Types of pearl		1	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Culture methods of pearl		1	
	Breeds of poultry		2	
	Types of poultry house		1	
	Poultry diseases and control		1	
			6	
V	Economically important cattle		2	Lecture, Chalk and Talk, Interaction, PPT & Group Discussion
	Nutritive value of milk		1	
	Livestock disease (Mastitis)		1	
	Livestock disease (Foot & mouth diseases)		1	
	Livestock diseases (Rinder pest)		1	
			6	

Course Learning Outcomes:

On successful completion of the course, the student will able to:

CLOs	CLO Statements	Knowledge level
CLO-1	Understand the insect and animal types, rearing techniques and it uses.	Up to K2
CLO-2	Describe the economically important of animals.	Up to K2
CLO-3	Apply the knowledge to execute the methodology for field practice.	Up to K2
CLO-4	Analyse the problem in culture practices and to rectify the same.	Up to K2
CLO-5	Infer the biological importance of Apiculture, Sericulture, Poultry farming, Dairy farming, Pisciculture, Edible oyster and Perl oyster culture.	Up to K2

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	2		1			2		
CLO-2	2		1			2		
CLO-3	2		2			2	2	
CLO-4	2	1	2	1		2		
CLO-5	2					1		

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	2	3	3
CLO-2	1	2	2	3	2
CLO-3	2	2	2	3	3
CLO-4	2	3	2	3	3
CLO-5	2	3	2	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – (CIA-I & II)
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

CLOs	K- Level	Section A		Section B		Section C	
		Short Answers		(Either/or Choice)		(Open Choice)	
		No. of Questions	K- Level	No. of Questions	K- Level	No. of Questions	K- Level
CLO x	Up to K2	1	K1	1	K2/K2	1	K1
CLO y	Up to K2	2	K1	1	K2/K2	2	K1
No. of Questions to be asked		3		2		3	
No. of Questions to be answered		3		2		2	
Marks for each question		2		7		10	
Total Marks for each section		6		14		20	

Distribution of Section-wise Marks with K Levels (CIA I & II)

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
K1	6	-	30	36	56.25	100
K2	-	28	-	28	43.75	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	6	14	30	64	100.00	100%

Learning Outcome Based Education & Assessment (LOBE)
Blue Print
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Section-Wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Add-on course	20U3ZAD1	Health Education	2	50	50	100	III

Course Objectives

1. To understand the concepts of health.
2. To discuss the balanced diet and nutritional deficiency diseases.
3. To analyze the problems of infertility, combating methods and birth control measures.
4. To appraise the communicable and non communicable diseases.
5. To create awareness on health, nutrition and environment.

Unit	Description	Hours
I	Concepts of Health Physical Health - Mental Health - Occupational Health - Social Health - Natural History of Diseases - The Disease Agents - Health Planning and Management.	6
II	Nutrition and Health Balanced diet and requirements - Nutritional deficiency diseases - Prevention and Treatment.	6
III	Reproductive Biology Fertility – Problems of male and female Infertility- Combating methods- IVF-GIFT- Test tube babies - Birth control measures.	6
IV	Environment and Health Water pollution - Purification of water - Air pollution and health - Solid waste disposal and control.	6
V	Communicable and Non Communicable Diseases Respiratory infections – Tuberculosis and COVID-19, Intestinal infections – Typhoid and cholera, Arthropod borne infections – Malaria and Dengue, Causative agents - Pathogenecity - Mode of Transmission-Symptoms –Treatment. Cancer, Diabetes, Cardio vascular diseases - Care and control.	6

References

1. Balinsky B.I., 1981. *An Introduction to Embryology*, 5th Ed., Holt –Saunders International, Philadelphia, London
2. Berril N.J., 1980. *Developmental Biology*. Tata McGrawHill Pub. Company Ltd., New Delhi.
3. De Hart. G. B., Sroufe. L.A., and Cooper. R.G., 2000. *Child development – its nature and course*, 4th ed., MC Graw Pub., Boston.
4. Park, K., 2019. *Preventive and Social Medicine*, 25th Ed. M/s Banarsidas Bhanot Publishers, Jaipur.

Web resource

<https://acphd.org/communicable-disease/>
<https://www.medicalnewstoday.com/articles/communicable-diseases>
<https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
<https://www.sciencedirect.com/topics/medicine-and-dentistry/non-communicable-disease>
https://www.health.ny.gov/diseases/communicable/arboviral/fact_sheet.htm#:~:text=These%20infections%20usually%20occur%20during,%2C%20Yellow%20Fever%2C%20and%20Zika.

Course designers: Dr. B. Latha & Dr. C. Selvakumar

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology			
Semester	Course Type	Course Code	Course Title	Contact Hours/week	CIA	Ext	Total
IV	Add-on course	20U4ZAD2	Wildlife Conservation	2	50	50	100

Course Objectives

1. To understand the methods of wildlife sampling.
2. To appraise the role of studies on animal behaviours in wildlife management.
3. To learn the techniques for behaviour field research.
4. To discuss the methods of immobilization of animals and animal damage control.
5. To analyze the wildlife conservation methods.

Unit	Description	Hours
I	Definition and wildlife sampling methods Wildlife management – Definition, scope. Sampling methods for Invertebrates (over view on Pitfall trap, Bait trap, sweep netting, Light trap, suction sampling) - Sampling methods for Vertebrates (cast net & Gill net for fish sampling, Trapping for Amphibians, Noosing for Lizards, Line transects for Birds, and Counting calls, dung, food prints & feeding signs for Mammals.	6
II	Environmental variables & Relevance of behaviours in Wildlife management Environmental variables – wind, rainfall, temperature, Humidity, pH, water turbidity, salinity, soil characteristics. Innate and learned process of behaviours, classification of release signals, behaviours dealing directly with environment, with other species, with conspecifics.	6
III	Techniques for behaviour field research Types of social behaviour, recording behaviour, quantitative methods of sampling behaviour, feeding habits, social structure, social group, sub structure, activity budget, dominance hierarchy and resource competition.	6
IV	Animal damage control and immobilization of animal Techniques of animal damage control – Biological methods, traps, mechanical and electric barrier, repellents. Chemical immobilization of animals –characteristics of Ideal drug, stages of anaesthesia, signs indicating drug action, care and examination of sedated animals.	6
V	Conservation methods <i>in situ conservation</i> - Zoo, aquarium, captive breeding, gene bank. <i>ex situ conservation</i> – National parks, biosphere reserves, sanctuaries. Role of people and Non-governmental organization in Wildlife conservation.	6

Books for Study

1. Sutherland, W.J., 2006, *Ecological census techniques*, Cambridge University Press, New York.
2. Berwick, S.H. and Saharia, V.B. 1995. *Wildlife Research and Management*, Oxford University Press, New Delhi.
3. Pushpangadan, P., Ravi, K and Santhosh, V., 1997. *Conservation and Economic Evaluation of Biodiversity* (Volume II), Oxford & IBH publishing Co. Pvt. Ltd, New Delhi.

Books for References

1. Teague, R.D. 1987. *A manual of Wildlife Conservation*, Natraj Publishers, Dehra Dun.
2. Festa-Bianchet, M, and Apollonio, M (Eds.), 2003. *Animal Behavior and Wildlife Conservation*. Island Press, Washington.
3. Sinclair, A.R.E., Fryxell, J.M. and Caughley, G. 2006. *Wildlife Ecology, Conservation and Management*. Blackwell Publishing, Oxford.
4. Morrison, M.L. and Mathewson, H.A. 2015. *Wildlife Habitat Conservation Concepts, Challenges and Solutions*, John Hopkins University Press, Baltimore.

Course designers:

Dr. S. Dinakaran

Dr. R. Eswaran

Evaluation pattern for Add-on courses

Internal evaluation : 50 % marks

External evaluation : 50 % marks

External examination duration : 2 hours

CIA Components: 50 marks

Components	Allocation	Suggestive Evaluation types (Any one)
I	20%	Periodic Assignment (3 Nos) / mini project / case studies
II	15%	Paper presentation / Group discussion / Criticism of a book / oratorical skill
III	15%	Quiz / Viva-voce (related to the paper) / innovative experiment modelling

Question Paper Pattern for External Examination: 50 Marks

Section	Marks
A- Multiple Choice Questions (10 X 1 mark)	10
B- Descriptive type – consisting of 7 questions out of which 4 to be answered (4 X 10 marks)	40
Total	75

DEPARTMENT OF ZOOLOGY				CLASS: II B.Sc. Zoology			
Semester	Course Type	Course Code	Course Title	Contact Hours/week	CIA	Ext	Total
III & IV	Self study paper		Fish and fish-feed culture		50	50	100

Course Objectives

1. To understand the need and scope of aquaculture.
2. To study the economically important aquarium fishes, culture practices and management.
3. To acquire knowledge about life feed culture, artificial feed formulation and technique on aquaculture practices.
4. To create awareness and motivates students to become entrepreneurs.
5. To encourage students for self-employment.

Unit	Description	Hours
I	Theory Introduction Definition, Objectives of Aquaculture; History of Aquaculture, Aquaculture in India and Different varieties of exotic and indigenous fishes.	6
II	Setting up of an aquarium A freshwater aquarium, Essential Pre-requisites for setting an Aquarium, Aquarium Fishes, Steps in Setting an Aquarium at Home.	6
III	Culture of Aquarium Fishes Breeding of gold fish and live bearers, Common diseases and their control.	6
IV	Live feed Culture of Fishes Culture of Daphnia, Culture of microworms, Culture of Artemia,	6
V	Food and Feeding Feeding habits, Nutritional requirements of fishes, Artificial fish food, Feed preparation, Ingredients for Fish Feed formulation, Feed preparation, Feeding.	6

Reference books

1. Zade, S.B., Khune, C.J., Sitre, S.R., and Tijare, R.V. 2011. *Principles of Aquaculture*, Himalaya Publishing House, Mumbai.
2. Tharadevi, C.S. and Jayashree, K.V. 2009, *Home Aquarium*, Saras Publication.
3. Kamleshwar Pandey and Shukla, J.P. 2012. *Fish and Fisheries*, Rastogi Publication, Meerut.

Course designers:

Dr. L. D. Devasree
Dr. P. Sivakumar

Evaluation pattern for Self-study courses

Assessment components	Marks
Assignments (minimum 2)	25%
Project/innovative experimental design	25%
Paper presentation/ viva voce	25%
Internal test	25%
Total	100%

DEPARTMENT OF ZOOLOGY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Certificate course		Sericulture	2	2	50	50	100

Course Objectives

To understand the economic importance of sericulture.

1. To discuss the cultivation of mulberry plant and culture of silkworm.
2. To acquire the knowledge on various techniques on sericulture practices.
3. To create awareness and motivates students to become entrepreneurs.
4. To encourage students for self-employment.

Unit	Description	Hours
I	Introduction to Sericulture Importance of Sericulture, Sericulture industry in India, Sericulture as cottage industry, Role of Central Silk Board. Moriculture - Optimum conditions for mulberry growth, Planting material - seedling propagation, vegetative propagation- stem cutting, grafting. Harvesting of leaves, Preservation of leaves, Nutritive value of leaves.	9
II	Silkworm Varieties of silkworm, <i>Bombyx mori</i> : Classification, Life cycle of <i>Bombyx mori</i> - Metamorphosis, moulting, Mature worm, Spinning of cocoon, Pupal stage, Adult moth, Silk glands.	9
III	Silkworm Rearing Rearing house, Rearing appliances, Rearing operations, Brushing, maintenance of temperature and humidity, feeding at different stages, mounting- methods, spinning of cocoons, harvesting cocoons, Cocoon reeling- cocoon stifling- sun drying, steam stifling, three pan system of boiling, Reeling appliance- Country charka	9
IV	Silkworm Diseases Causative organism, mode of transmission, symptoms and control measures: Protozoan disease – Pebrine, Viral disease - Flacherie, Bacterial disease- Septicemia, Fungal disease- White Muscardine. Pests- Indian uzifly-structure, damages caused, control- physical, chemical and biological.	9
V	Marketing and Entrepreneurial Opportunities Cocoon marketing- Commercial characteristics of cocoon, marketing centres. Raw silk marketing: Visual tests, Mechanical tests, Marketing in India. Entrepreneurial Opportunities in Sericulture: Pre cocoon sector, Silkworm seed production, By-product utilization, Post cocoon sector and producing hybrid silkworms.	9

Text Book

1. Johnson, M. and Kesary, M. 2008. *Sericulture*, Fourth edition, CSI Press, Marthandam.

Reference Book

1. Shankar, J.P.A. and Reddy, R. 2009. *Sericulture*, Commonwealth Publishers.
2. Ganga, G. and SulochanaChetty, J. 2000. *An Introduction to Sericulture*, Oxford & IBH Publishing Company Pvt. Ltd. New Delhi.
3. Krishnaswami, S., Narasimhanna, M.N., Surayanarayana, S.K., Kumararaj, S. 1973. *Manual on Sericulture - Silkworm rearing*, UN Food and Agriculture Organisation, Rome.
4. Dandin, S.B., Jayant Jayaswal and Giridhar, K. 2010. *Hand Book of Sericulture Technologies*, Central Silk Board, Bangalore.

Course designers

Dr. L. D. Devasree

Dr. R. Eswaran

DEPARTMENT OF ZOOLOGY				CLASS: I B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major	20U1ZMP1	Major Practical – I	2	3	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the dissection and mounting techniques.
2. To understand the different organisms of Invertebrates.

Mountings

Body Setae of Earth worm
Mouth parts of Cockroach
Salivary glands of Cockroach

Dissections

Digestive system of Cockroach
Nervous system of Cockroach
Reproductive system of Cockroach

Spotters:

Amoeba, Euglena, Paramoecium, Trypanosoma, Elphidium, Noctiluca, Spicules, Obelia, Physalia, Porpita, Pennatula, Adamsia, Fungia, Tape worm, Redia larva, Cercaria, Liver fluke, Planaria, Ascaris, Dracunculus, Chaetopterus, Arenicola, Aphrodite, Leech, Sacculina, Albunea, Scolopendra, Limulus, Scorpion, Aplysia, Vaginulus, Pinctada, Octopus, Nautilus, Chiton, Dentalium, Star fish, Bipinnaria larva.

Books for References

1. Jayasurya, Nair N.C, Soundarapandian N, Arumugem N, Leelavathy S and Murugan T, 2013. *Practical Zoology Vol. 1 Invertebrata*, Saras publication, Nagercoil.
2. Sinha J, Chatterjee A.K and Chattopadhyay P, 2011. *Advanced practical zoology*, Books and Allied (P) Ltd., Kolkata.

Web Resources

<https://www.youtube.com/watch?v=wF7ew2w24as>

Pedagogy

PPT, group discussion, interaction, quiz, tutorial and virtual labs.

Rationale

This course provides basic knowledge on diversity of Invertebrates, structure and functions of organisms, identify the unique features and finally their role in biological communities.

Activities having direct bearing on employability / Skill development / Entrepreneurship

The knowledge gained provides the skill to identify Invertebrates, unique structures and its functions, analyse their role in the ecological system.

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge level
CLO-1	Recall the diversity of Invertebrates.	Up to K1
CLO-2	Understand the structure and functions of the organism.	Up to K2
CLO-3	Apply the knowledge to identify the Invertebrates fauna based on their unique characters.	Up to K3
CLO-4	Analyse the organs/systems and their role in Invertebrates.	Up to K4
CLO-5	Examine the role of Invertebrates in biological communities and ecological interactions.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	2	2					1	
CLO-2	1	2	3				3	
CLO-3	1	3	2	1			3	
CLO-4	1	3	3	2			3	
CLO-5	1	2	3	2			3	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2		2	2
CLO-2	2	2	1	2	2
CLO-3	2	3	2	3	2
CLO-4	2	2		2	
CLO-5	2	2	1	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: I B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major	20U1ZMP2	Major Practical – II	2	3	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the dissection and mounting techniques.
2. To understand the different organisms of Chordates.

Mountings

Placoid scales of Shark
Cycloid scales of fin fish
Brain of frog (Procedure with illustration)

Dissections

Digestive system of fish
Respiratory system of fish
V cranial nerve of Frog (Procedure with illustration)
Metamorphosis in Bufo bufo
Nervous system in Calotes (V & VII cranial nerves)
Pneumatic bones in Pigeon

Observation

Poisonous and non-poisonous snakes
Air sacs in Pigeon

Spotters:

Amphioxus, Balanoglossus, Ascidian, Doliolum, Petromyzon, Narcine, Trygon, Hippocampus, Echeneis, Exocoetes, Cynoglossus, Rhacophorus, Urocyonophylus, Axolotl, Tadpole larva, Draco, Chameleon, Typhlops, Bungarus, Naja, Viper, Enhydryna, Eudynamis, King fisher, Ant eater, Loris and Pteropus.

Books for References

1. Jayasurya, Thangamani A, Arumugam N, Prasanakumar S and Narayanan L.M, 2013. *Practical Zoology Vol. 2 Chordata*, Saras publication, Nagercoil.
2. Sinha J, Chatterjee A.K and Chattopadhyay P, 2011. *Advanced practical zoology*, Books and Allied (P) Ltd., Kolkata.

Web Resources

<https://www.youtube.com/watch?v=xSu7jeOuPDk>
<https://www.youtube.com/watch?v=sCWUZiRaBbA>
<https://www.youtube.com/watch?v=xuSckL-IPhg>
https://www.youtube.com/watch?v=PKK_ExR2SkY

Pedagogy

PPT, group discussion, interaction, quiz, tutorial and virtual labs.

Rationale

This course provides basic knowledge on diversity of Chordates, structure and functions of organisms, identify unique features and finally their role in biological communities.

Activities having direct bearing on employability / Skill development / Entrepreneurship

The knowledge gained provides the skill to identify Chordates, unique structures and its functions, analyse their role in the ecological system.

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge level
CLO-1	Recall the diversity of Chordates.	Up to K2
CLO-2	Understand the structure and functions of the organism.	Up to K3
CLO-3	Apply the knowledge to identify the Chordate fauna based on their unique characters.	Up to K3
CLO-4	Analyse the organs/systems and their role in Chordates.	Up to K4
CLO-5	Examine the role of Chordates in biological communities and ecological interactions.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	2	2					1	
CLO-2	1	2	3				3	
CLO-3	1	3	2	1			3	
CLO-4	1	3	3	2			3	
CLO-5	1	2	3	2			3	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2		2	2
CLO-2	2	2	1	2	2
CLO-3	2	3	2	3	2
CLO-4	2	2		2	
CLO-5	2	2	1	3	3

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: I B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Allied Practical	20U1ZAP1	Zoology Ancillary Practical – I	1	2	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the dissection and mounting techniques.
2. To understand the different organisms of Invertebrates.

Mountings

Earth worm: Body Setae

Cockroach: Mouth parts and Salivary glands

House fly: Mouth parts

Honey Bee: Mouth parts

Dissection

Digestive system of Cockroach

Reproductive system of Cockroach

Spotters

Trypanosoma, Obelia, Ephyra, Taenia, Ascaris, Dracunculus, Leech, Trochophore larva, Appendages of prawn, Nauplius, Albulia, Glochidium, Star fish, Bipinnaria larva.

(Note: Mounting and dissections are to be done by using live specimen or virtual method or slides and preserved specimens from archives).

Books for References

1. Jayasurya, Nair N.C, Soundarapandian N, Arumugem N, Leelavathy S and Murugan T, 2013. *Practical Zoology Vol. 1 Invertebrata*, Saras publication, Nagercoil.
2. Sinha J, Chatterjee A.K and Chattopadhyay P, 2011. *Advanced practical zoology*, Books and Allied (P) Ltd., Kolkata.

Web Resources

<https://www.youtube.com/watch?v=wF7ew2w24as>

Pedagogy

PPT, group discussion, interaction, quiz, tutorial and virtual labs.

Rationale

The basic knowledge and skill on identification of animals, their unique structures, functions and their role in ecological interactions.

Activities having direct bearing on employability / Skill development / Entrepreneurship

The students will be able to understand structural organization of Invertebrates and develop skill in identification of animals in their natural habitat by analysing unique structures and functions.

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge level
CLO-1	Recall the diversity of Invertebrates.	Up to K2
CLO-2	Understand the structure and functions of the organism.	Up to K3
CLO-3	Apply the knowledge to identify the Invertebrate fauna based on their unique characters.	Up to K3
CLO-4	Analyse the organs/systems and their role in Invertebrate.	Up to K4
CLO-5	Examine the role of Invertebrates in biological communities and ecological interactions.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1	1	1	1			1	
CLO-2	1	2	3	3			3	
CLO-3	1	3	3	3			3	
CLO-4	1	3	3	3			3	
CLO-5	1	2	2	1	2	2	2	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2		2	
CLO-2	2	2		2	
CLO-3	2	2	1	3	2
CLO-4	2	2	2	2	1
CLO-5	2	2		3	3

3- Advance application; 2- Intermediate level; 1- Basic level

DEPARTMENT OF ZOOLOGY				CLASS: I B.Sc. Chemistry				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Allied Practical	20U2ZAP2	Zoology Ancillary Practical – II	1	2	40	60	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives

By the end of the course, students will be able:

1. To learn the dissection and mounting techniques.
2. To understand the different organisms of Chordates.

Virtual Dissection

Frog Arterial system
Fifth cranial nerve
Urinogenetal system

Mountings

Brain of Frog (Procedure with illustration)

Spotters

Amphioxus, Placoid scale, Axolotl larva, Frog - Osteology, Poisonous snakes of south India, Feather of bird.

(Note: Mounting and dissections are to be done by using live specimen or virtual method or slides and preserved specimens from archives).

Books for References

1. Jayasurya, Thangamani A, Arumugam N, Prasanakumar S and Narayanan L.M, 2013. *Practical Zoology Vol. 2 Chordata*, Saras publication, Nagercoil.
2. Sinha J, Chatterjee A.K and Chattopadhyay P, 2011. *Advanced practical zoology*, Books and Allied (P) Ltd., Kolkata.

Web Resources

<https://www.youtube.com/watch?v=wF7ew2w24as>

Pedagogy

PPT, group discussion, interaction, quiz, tutorial and virtual labs.

Rationale

The basic knowledge and skill on identification of animals, their unique structures, functions and their role in ecological interactions.

Activities having direct bearing on employability / Skill development / Entrepreneurship

The students will be able to understand structural organization of Chordates and develop skill in identification of animals in their habitat by analysing unique structures and functions.

Course Learning Outcomes:

CLOs	CLO Statement	Knowledge level
CLO-1	Recall the diversity of Chordates.	Up to K1
CLO-2	Understand the structure and functions of the organism.	Up to K2
CLO-3	Apply the knowledge to identify the Chordate fauna based on their unique characters.	Up to K3
CLO-4	Analyse the organs/systems and their role in Chordates.	Up to K4
CLO-5	Examine the role of Chordates in biological communities and ecological interactions.	Up to K4

Mapping with Programme Specific Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8
CLO-1	1	1	1	1			1	
CLO-2	1	2	3	3			3	
CLO-3	1	3	3	3			3	
CLO-4	1	3	3	3			3	
CLO-5	1	2	2	1	2	2	2	

3- Advance application; 2- Intermediate level; 1- Basic level

Mapping with Programme Outcomes

	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2		2	
CLO-2	2	2		2	
CLO-3	2	2	1	3	2
CLO-4	2	2	2	2	1
CLO-5	2	2		3	3

3- Advance application; 2- Intermediate level; 1- Basic level

I UG Ratifications

Course Code	Course Title	Nature of Course	Rationale	Activities having direct bearing on employability / Skill development / Entrepreneurship
20U1ZMC1	Invertebrata-I	Knowledge and skill	This course will enable the students to comprehend the knowledge on systematic classification, identification of animals from Protista to Platyhelminthes by recognizing their distinguishing features, appraise the diversity of animals in phylogenetic context, adaptations of animals to various biological problems and environmental challenges, and develop an appreciation for the role of invertebrates in biological communities.	The acquired knowledge on the systematic classification, distinguishing characters, ecological interaction and conservation problems will develop their skill in identification of animals and their sustainability in their environment which further paves the way for their skill development, higher studies and research work.
20U1ZMC2	Invertebrata-II	Knowledge and Skill oriented	This course will enable the students to comprehend the knowledge on taxonomy, systematic classification from Aschelminthes to Echinodermata, unique characters of the animals, appraise the diversity of animals in phylogenetic context, adaptations of animals to various biological problems and environmental challenges and develop an appreciation for the role of invertebrates in biological communities.	The acquired knowledge on the taxonomy, unique characters and their role in the environment will develop their skill in identification of animals and their sustainability in biological communities which further paves the way for their skill development, higher studies and research work.
20UIZMP1	Major Practical-I	Skill Oriented	This course provides basic knowledge on diversity of Invertebrates and Chordates, structure and functions of organisms, identify unique features and finally their role in biological communities.	The knowledge gained provides the skill to identify Invertebrates and Chordates, unique structures and its functions, analyse their role in the ecological system.

Course Code	Course Title	Nature of Course	Rationale	Activities having direct bearing on employability / Skill development / Entrepreneurship
20U1ZAC1	Fundamentals of Invertebrates & Chordates	Knowledge and skill	This course will enable the students to understand the classification and identification of Invertebrates and Chordates, salient features, distinguishing characters and their life history.	The acquired knowledge on the systematic classification, morphology, adaptations in the context of evolution, interaction with the ecosystem will develop their skill in identification of animals by their unique features, functioning of animal biological system and specific adaptations of animals in different environments.
20U2ZAP1	Zoology Ancillary Practical - I	Skill oriented	The basic knowledge and skill on identification of animals, their unique structures, functions and their role in ecological interactions	The students will be able to understand structural organization of Invertebrates and Chordates and develop skill in identification of animals in their natural habitat by analysing unique structures and functions.
20U2ZMC3	Chordata-I	Knowledge and skill	This course will enable the students to comprehend the knowledge on systematic classification from Prochordata to Pisces, recognize their distinguishing features, appraise the affinities of animals in phylogenetic context, adaptations of animals to various physiological changes in the environment, and develop an appreciation for the role of chordates in biological communities.	The acquired knowledge on the systematic classification, distinguishing characters, ecological interaction and conservation problems will develop their skill in identification of animals and their sustainability in their environment which further paves the way for their skill development, higher studies and research work.
20U2ZMC4	Chordata-II	Knowledge and skill	This course will enable the students to comprehend the knowledge on systematic classification and evolution of higher vertebrates from amphibia to mammals, recognize their	The acquired knowledge on the systematic classification, distinguishing characters, ecological interaction and conservation problems will develop their skill in identification of animals and

Course Code	Course Title	Nature of Course	Rationale	Activities having direct bearing on employability / Skill development / Entrepreneurship
			distinguishing features, appraise the affinities of animals in phylogenetic context, adaptations of animals to various physiological changes in the environment, and develop an appreciation for the role of higher vertebrates in biological communities.	their sustainability in their environment which further paves the way for their skill development, higher studies and research work. The knowledge gained will be applicable to assess EIA.
20U2ZMP2	Major Practical-II	Skill oriented	This course provides basic knowledge on diversity of Invertebrates and Chordates, structure and functions of organisms, identify unique features and finally their role in biological communities	The knowledge gained provides the skill to identify Invertebrates and Chordates, unique structures and its functions, analyse their role in the ecological system.
20U2ZAC2	Applied Zoology	Knowledge and skill	This course will enable the students to understand the economic importance of animals, learn the techniques employed in culture systems and encourage executing for field practices.	The acquired knowledge on economic significance of animals and applied aspects of Zoology will encourage the students to develop skill in various techniques employed in rearing animals and ultimately motivates the students for self employment and entrepreneurship. High productivity will be gained with less investment which will cater the Global needs.
20U2ZAP2	Zoology Ancillary Practical -II	Skill oriented	The basic knowledge and skill on identification of animals, their unique structures, functions and their role in ecological interactions	The students will able to understand structural organization of Invertebrates and Chordates and develop skill in identification of animals in their habitat by analysing unique structures and functions