DEPARTMENT OF MICROBIOLOGY				*CLASS: I M.Sc. Microbiology*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
I	Major Elective - 1	21P1RME1	Bioinstrumentation	4	5	25	75	100

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

Course Objectives

1. To learn theoretical background and practical skills in microscopy
2. To impart knowledge on principles and applications of various instruments used in biology
3. To understand the working mechanism and to characterize biomolecules using spectroscopic techniques
4. To enable the students to explore the methods for separation of biomolecules
5. To emphasize the importance of radioisotopes in biology and its proficient handling

Course Learning Outcomes

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

1. Demonstrate the working mechanism and usage of different microscopes
2. Describe the principle and applications of various instruments used in biology
3. Apprise spectroscopic data for laboratory and project work
4. Separate and determine different components present in biological samples using appropriate separation techniques
5. Categorize, determine the dose limits and safety aspects for various radioisotopes

Unit	Description	Hours	K-level	CLO
I	**Unit-I Microscopy** Principle, working mechanism and applications of light microscope – bright field, dark field, phase contrast and fluorescence. Electron microscopy - transmission electron microscope (TEM) and scanning electron microscope (SEM), energy dispersive x-ray analysis (EDX), scanning tunneling microscopy (STM), atomic force microscopy (AFM), confocal microscopy. Cytophotometry, flow cytometry and micrometry. Sample preparation for microscopy.	15 hrs	Up to K2	1

II	**Unit-II Basic laboratory instruments** Principle, working mechanism and applications of laminar air flow, incubator, hot air oven, autoclave, Quebec colony counter, sonicator and lyophilizer. Centrifugation and types - clinical, differential, density gradient and ultra centrifugation. Sedimentation velocity, sedimentation coefficient, relative centrifugal force (RCF) and revolutions per minute (RPM).	15 hrs	Up to K3	2
III	**Unit-III Spectroscopy** Principle, working mechanism and applications of colorimeter, spectrophotometer- visible, ultraviolet, Fourier transform infrared spectroscopy (FTIR), flame photometer, Raman and atomic absorption spectrophotometer (AAS), fluorescence spectroscopy, X-ray diffraction (XRD), nuclear magnetic resonance (NMR) and electron spin resonance (ESR) spectroscopy.	15 hrs	Up to K3	3
IV	**Unit-IV Separation techniques** Chromatography- Principle, working mechanism and applications of gel filtration, ion exchange, affinity chromatography, gas chromatography (GC) and high performance liquid chromatography (HPLC), gas chromatography–mass spectrometry (GC-MS), liquid chromatography–mass spectrometry (LC–MS). Electrophoresis- Principle, working mechanism (isoelectric focusing, isotachophoresis) and applications of agarose gel electrophoresis, SDS-PAGE, native PAGE, counter current electrophoresis, immune electrophoresis, pulse field gel electrophoresis (PFGE), denaturing gradient gel electrophoresis (DGGE).Gel documentation, fluorescence activated cell sorting (FACS).	15 hrs	Up to K4	4
V	**Unit-V Radioisotopic techniques** Radioactive isotopes - radioactive decay and half life period, effect of radiation on biological system, use of radioisotopes in biology, radioactive labelling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- muller and scintillation counters, autoradiography and its applications. Radiation dosimetry and safety aspects of radio isotopic techniques.	15 hrs	Up to K4	5
		Total 75 Hours		

Books for Study:

1. Jeyaraman, J. (1985). Laboratory Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.
2. Roy, R.N. (1996). A Textbook of Biophysics. New Central Book Agency (P) Ltd., Calcutta.
3. Veerakumari, L. (2009). Bioinstrumentation. MJP Publishers, Chennai.
4. Plummer, D.T. (1998). An Introduction to Practical Biochemistry. 3rd Edition. Tata McGraw Hill, New Delhi.

Books for Reference:

1. Alonso, A. and Arrondo, J.L.R. (2006). Advanced Techniques in Biophysics. Springer, UK.
2. Boyer, R.F. (1993). Modern Experimental Biochemistry. 2nd Edition. Benjamin-Cummings Publishing Company, California.
3. Chatwal, G.R., Anand, S.K. and Sham, K. (2005). Instrumental Methods of Chemical Analysis. Himalaya Publishing House, New Delhi.
4. Ghatak, K.L. (2011).Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi
5. Palanichamy, S. and Shanmugavelu, M. (2011). Principles of Biophysics, 2nd Edition. Palani Paramount Publications, Palani.
6. Palanivel, P. (2000). Laboratory Manual for Analytical Biochemistry & Separation Techniques. 4th Edition. School of Biotechnology, Madurai Kamaraj University, Madurai.
7. Sandhu, G.S. (1990). Research Techniques in Biological Sciences. Anmol Publications, New Delhi.
8. Sawhney, S.K. and Singh, R. (2000). Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.

Web Resources:

1. https://microbenotes.com/category/instrumentation/
2. https://www.biologydiscussion.com/biochemistry
3. https://www.youtube.com/watch?v=wxrAELeXlek
4. https://www.youtube.com/watch?v=myolF-h1kKI

Rationale for nature of the course

Basic understanding of contemporary bioinstrumentation is essential for its application in the laboratory. It is useful for handling, analyzing and interpreting various biological samples. Hands-on experience pertaining to biological equipments is mandatory in the field of quality control, testing, diagnosis and research.

Activities having direct bearing on skill development/ employability/entrepreneurship

Imparting knowledge and technical skills to handle and maintain different equipments in clinical and molecular biology laboratories.

Applying the techniques related to quality control in various industrial sectors and research units.

Fabrication of minor equipments, marketing and servicing of laboratory equipments.

Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

Course Learning Outcomes (CLO)

On the completion of the course the student will be able to

CLOs	Course Learning Outcome	Knowledge Level
CLO1	Demonstrate the working mechanism and usage of different microscopes	Up to K2
CLO2	Describe the principle and applications of various instruments used in biology	Up to K3
CLO3	Apprise spectroscopic data for laboratory and project work	Up to K3
CLO4	Separate and determine different components present in biological samples using appropriate separation techniques	Up to K4
CLO5	Categorize and discriminate dosage and safety aspects for various radioisotopes	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 interferences with evidences

Mapping of Course Learning Outcome with Programme Specific Outcome

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

Advance application – 3 Intermediate level – 2 Basic level – 1

Mapping of Course Outcome with Programme Outcome

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

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	K2 & K2	1	K1	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K3	2	K3 & K3	1	K1	2 (K3&K3)	1(K3)
3.	CLO 3	Up to K3	2	K3 & K3	1	K2	2 (K2&K2)	1(K3)
4.	CLO 4	Up to K4	2	K4& K4	1	K2	2 (K4&K4)	1(K4)
5.	CLO 5	Up to K4	2	K1& K1	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 interferences 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**	100.00	**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 interferences with evidences

LESSON PLAN

UNITS	DESCRIPTION	STAFF	HOURS	MODE
I Microscopy	a) Principle, working mechanism and applications of light microscope- bright field and dark field microscope		3	Chalk and Talk, PPT, Quiz
	b) Phase contrast and fluorescence microscope		2	
	c) Electron microscopy- Transmission electron microscope (TEM) and scanning electron microscope (SEM), energy dispersive x-ray analysis (EDX)		3	
	d) Scanning tunneling microscopy (STM), atomic force microscopy (AFM), confocal microscopy		3	
	e) Cytophotometry, flow cytometry		2	
	f) Micrometry, sample preparation for microscopy		2	
II Basic laboratory Instruments	a) Principle, working mechanism and applications of laminar air flow, incubator, hot air oven		4	Chalk and Talk, PPT, Quiz
	b) Autoclave, Quebec colony counter, sonicator and lyophilizer		4	
	c) Centrifugation and types - clinical, differential, density gradient and ultra centrifugation		4	
	d) Sedimentation velocity, sedimentation coefficient, relative centrifugal force (RCF) and revolutions per minute (RPM)		3	
III Spectroscopy	a) Principle, working mechanism and applications of colorimeter, spectrophotometer- visible, ultraviolet, Fourier transform infrared spectroscopy (FTIR)		4	Chalk and Talk, Seminar, Screening of educational videos
	b) Flame photometer, Raman and atomic absorption spectrophotometer (AAS)		4	
	c) Fluorescence spectroscopy, X-ray diffraction (XRD)		4	
	d) Nuclear magnetic resonance (NMR) and electron spin resonance (ESR) spectroscopy		3	
IV Separation	a) Chromatography- Principle, working mechanism and applications of gel filtration,		3	PPT, Seminar,

UNITS	DESCRIPTION	STAFF	HOURS	MODE
Techniques	ion exchange, affinity chromatography			Screening of educational videos
	b) Gas chromatography (GC) and high performance liquid chromatography (HPLC), gas chromatography–mass spectrometry (GC-MS), liquid chromatography–mass spectrometry (LC–MS)		3	
	c) Electrophoresis- Principle, working mechanism (isoelectric focusing and isotachophoresis) and applications of agarose gel electrophoresis, SDS-PAGE, native PAGE		3	
	d) Counter current electrophoresis, immuno-electrophoresis, pulse field gel electrophoresis (PFGE), denaturing gradient gel electrophoresis (DGGE)		4	
	e) Gel documentation and fluorescence activated cell sorting (FACS)		2	
V Radioisotopic techniques	a) Radioactive isotopes - radioactive decay and half life period, effect of radiation on biological system		3	Chalk and talk, PPT, Group discussion
	b) Use of radioisotopes in biology, radioactive labelling, principle and application of tracer techniques		4	
	c) Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- muller and scintillation counters, autoradiography and its applications		5	
	d) Radiation dosimetry and safety aspects of radio isotopic technique		3	
Total			**75 Hours**	

Course designers

1. Dr.P.Kiruthika Lakshmi