



PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P1RMC1

COURSE TITLE : Microbial Taxonomy

QN.NO : 9101

TIME : 3 Hours

MAX.MARKS :75

Unit I

Evolution of life on earth, history and diversity of microorganism. Principles of Classification of Taxonomy of Eubacteria(Bacteria and Archaea): Major characteristics used in taxonomy: Cultural, Morphological, Biochemical, Physiological, Genetic and Molecular Characteristics; Numerical Taxonomy (Taxometrics) and Chemotaxonomy. Assessing Microbial Phylogeny: Chronometers. Phylogenetic trees, r-RNA, DNA and proteins as indicators of phylogeny.

Unit II

Ultra structure of Prokaryotic and Eukaryotic cells, *E.coli*, *Bacillus subtilis*, *Saccharomyces cerevisiae*, *Aspergillus sps*, *Nostoc*, *Chlorella*. Structure and functions of Bacterial cell wall, Gram positive, Gram negative, Mycoplasma, Archaeabacterial cell wall, slime layer, capsule, pili, flagella- ultrastructure, other inclusions bodies. Structure and signification and bacterial endospores. Endospores formation in *Bacillus*.

Unit III

Classification (up to class level), Structure and life cycle of Fungi. Ascomycetes (*Aspergillus*), Deuteromycetes (*Candida*), Zygomycetes (*Mucor*), Basidiomycetes (*Agaricus*).

Unit IV

Structure and classification of Algal cells – reproduction and chacteristics, Chlorophyta (*Chlorella*) Chrysophyta (*Diatoms*), Rhodophyta (*Gracillaria*), *Spirulina*, BGA.

Unit V

Classification of Viruses. Bacteriophage – general characteristics, morphology, classification, reproduction and nomenclature. Structure and architecture of viruses animal(Pox, Adeno, Influenza), Plant (TMV,CMV), Mycophage and Cyanophage.

Text Book (s):

1. Pelczar Jr. M.J. Chan. E.C.S and Kreig. N.R (2006). "Microbiology"- 5th Edition Mc Graw Hill Inc. New York.
2. David, B.D., Delbecco,. R., Eisen, H.N and Ginsburg, H.S (1990) "Microbiology" 5th Edition. Harper & Row, New York.

Reference Book(s) :

1. Lansing M. Prescott., John. P. Harley., Donald A, Klein, (2005)"Microbiology"-Mc Graw Hill Inc. New York.
2. Robert F.Boyd., (1991)"General Microbiology" 2nd Edition., Times MIRROR/Moshy College Publishing Virginia.



THE MADURA COLLEGE (Autonomous), MADURAI – 625 011
(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)
RE-ACCREDITED (3rd Cycle) WITH “A” GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P1RMC2

COURSE TITLE : Biochemistry

QN.NO : 9102

TIME : 3 Hours

MAX.MARKS :75

Unit I Bioenergetics

Entropy, enthalpy, free energy, ATP – its role in metabolism, other energy rich compounds, oxidation- reduction reactions. Definition, classification and properties of enzymes. Mechanism of enzyme action- Lock and key mechanism, induced fit theory. Factors affecting enzyme activity: pH, temperature and substrate concentration. Michaelis- Menton equation. Enzyme inhibition: competitive, uncompetitive and non competitive. Biological functions of enzymes.

Unit II Carbohydrates

Definition and classification of Carbohydrates, linear and ring forms (Haworth formula) for Monosaccharides for Glucose and Fructose. Disaccharides – Sucrose and Lactose. Physical properties- mutarotation and Kiliani-Fischer synthesis. Chemical properties – Oxidation, reduction, osazone formation. Polysaccharide; Starch and Cellulose- occurrence, structure, physical and chemical properties.

Unit III Aminoacid

Definition and Classification of aminoacids, common properties of aminoacids, amphoteric nature, isoelectric point, isoelectric pH and zwitter ion. Proteins: Classification, physical properties and structure of protein- primary, secondary, tertiary and quaternary.

Unit IV Lipid

Definition, classification, physical, chemical and biological functions- simple lipids, tertiary compound lipids, derived lipids: steroids. Saturated fatty acids: Butyric and Stearic acid. Unsaturated fatty acids: linoleic and palmitic acid. Biosynthesis, β -oxidation of fatty acid.

Unit V Nucleic acid

Definition, nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions. Structure of tRNA, mRNA and rRNA-occurrence, chemistry and its biological functions. Differences between DNA and RNA properties: cot curve and cot value, T_m , hypo and hyper chromicity.

Text Book (s):

1. Robert K. Murray, Daryl K. Grammer, (1990) -Harper's Biochemistry- McGraw Hill, Lange Medical Books. 25th edition.
2. J.L. Jain, Sanjay Jain, Nitin Jain, (2004)- Biochemistry-S. Chand & Co., Ltd.

Reference Book(s):

1. Lehninger (1970). Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
2. David, B.D., Delbecq., R., Eisen, H.N and Ginsburg, H.S (1990) "Microbiology" 5th Edition. Harper & Row, New York.



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RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P1RMC3

COURSE TITLE : Cell and Molecular biology

QN.NO : 9103

TIME : 3 Hours

MAX.MARKS :75

Unit I

Composition of cells – Cell membrane ,Nucleus, Nucleolus, Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Mitochondria, Chloroplast, Peroxisomes, Microtubules. Cell cycle-G1,G2,S and M phase. Meiotic cell division.

Unit II

Different forms of DNA-A, B and Z , Supercoiling of DNA ,DNA synthesis-DNA polymerase I,II and III, topoisomerase I and II. Properties of DNA. DNA replication – mechanism of DNA replication-types of DNA replication-conservative, semiconservative and dispersive-Q mode, D model, rolling circle model, Bi and uni directional , Enzymology of DNA replication.

Unit III

Transcription in prokaryotes-RNA polymerase structure-promoters-initiation, elongation, and termination. Transcription in eukaryotes-RNA polymerase-promoters-enhancers and silencers. Post transcriptional modifications.

Unit IV

Structure of t RNA, r RNA, m RNA-protein synthesis- initiation, elongation and termination. Protein folding, Post modifications .Genetic code, Wobble hypothesis.

Unit V

Mutation: Spontaneous and Induced types of mutation-physical mutagens and chemical mutagens. Light dependent and dark repair mechanism. Molecular Mechanisms: Site Directed Mutagenesis- Methods of directed mutagenesis.

Text Book (s):

1. Old, R.S. and Primrose, S.B. (1995) Principles of Gene manipulation. An introduction to Genetic Engineering. 5th Edition. Blackwell Scientific Publication, London.
2. Click. B.R. and-Pasternat J.J. (1994)Molecular Biotechnology. ASM press. Washington DC.

Reference Book(s):

- 1.Benjamin Lewin (1997) Genes VI, Oxford University Press.
- 2.David, B.D., Delbecco,. R., Eisen, H.N and Ginsburg, H.S (1990) "Microbiology" 5th Edition. Harper & Row, New York.

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PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P2RMC4

COURSE TITLE : Microbial Physiology

QN.NO : 9106

TIME : 3 Hours

MAX.MARKS :75

Unit I Microbial Nutrition

The common Nutrient requirements and sources of Carbon, Hydrogen/Energy, Oxygen. Major Nutritional types of Microbes- requirements of Carbon, Hydrogen/Electrons, Energy, Oxygen, Nitrogen, Phosphorus and Sulfur. The flow of carbon and energy. Phosphorylation-types, structure and significance of ATP.

Unit II Metabolism

An overview of Metabolism ATP Production, Anabolism, Catabolism, Phosphorylation, Amphibolic pathway and Anaplerotic pathway. Photosynthesis: Diversity, properties of photosynthetic prokaryotic organisms- Cyanobacteria, Green (sulphur and non- sulphur) Bacteria. Purple (sulphur and non-sulphur) Bacteria. Oxygenic and Anoxygenic photosynthesis. Light reactions: pigment system, carboxysomes, Bacteriochlorophyll. Carboxysomes. light reaction of Cyanobacteria (cyclic and noncyclic). Cyclic light reaction of purple, green and Helicobacteria. Dark reaction: Definition, C₃ cycle of Cyanobacteria. Reductive TCA cycle.

Unit III Catabolism

substrates, significance in Metabolism, Aerobic fermentation and Anaerobic. a) The breakdown of glucose to pyruvate. Glycolytic pathway, pentose phosphate pathway and ED pathway with examples of microbes. b) significance of pyruvic acid- TCA cycle, ETP system. Fermentation-Alcoholic-Lactic acid fermentation-Homolactic and Heterolactic and Mixed acid fermentation of Enterobacteriaceae with examples. Anaerobic Respiration with examples.

Unit IV The organization of anabolism

Amphibolic nature of TCA cycle, production of biosynthetic products. Glyoxylate cycle, Gluconeogenesis-significance. Metabolism of N₂ fixation, classification of Diazotrophs, Nitrogenase- types, structure and functions. Mechanism of N₂ fixation- role of Ferredoxins, Flavodoxins, Electro proteins and Electron transfer. Role of ATP, over all reactions with NH₃ formation.

Unit V Biosynthetic pathway of aminoacids

Glycine, valine, Isoleucine, Phenylalanine. Biosynthetic pathway of Purine and Pyrimidine. Biosynthetic pathway of Bacterial cell wall synthesis.

Text Book (s):

1. Sale, A.J (1992) "Fundamentals Principles of Bacteriology", 7th Edition. McGraw Hill Publishing Co. Ltd., New York.
2. Dubey, R.C. and Maheswari, D.K. (2005) A Text book of microbiology. S. Chand & Company Ltd. New Delhi.

Reference Book(s):

1. Dall, D.O and Rao, K.K (1995) "Photosynthesis" –Cambridge University press.
2. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (1986). "General Microbiology" -Mac Milan Education Ltd. London



PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P2RMC5

COURSE TITLE : Microbial Genetics

QN.NO : 9107

TIME : 3 Hours

MAX.MARKS :75

Unit I

History of microbial genetics-Mutations and genetic analysis-terms used in genetics-useful phenotypes in bacterial and phage genetics-Experiment of Luria and Delbruck. Newcombe- Isolation of Auxotrophic mutants-positive and negative selection of mutants. Complementation-Allelism and cis/trans tests.

Unit II

Bacterial conjugation: F+, F- Hfr strains. Genetic mapping with Hfr crosses. F- prime factors. Complementation test using F-prime factors-conjugation in *Streptomyces* and role of Pheromones in plasmid transfer in *Enterococcus faecalis*. Transformation : Definition – competence-mechanism of DNA uptake in *E.coli*. *Bacillus sps*, and *Haemophilus sps*. Plasmid-transformation competence induction. Recombination and its mechanisms.

Unit III

Phage biology : virulent and temperate bacteriophages (T7,T4,Lambda, P1) phage crosses,recombination and complementation tests with phages.T4 RII locus mapping. Generalized transduction with P1. Mapping of bacterial markers. Co-transduction. Gene expression during lambda lytic cycle and lysogeny- specialized transduction.

Unit IV

Transposable genetic elements- identification of transposition – IS elements, composite transposons, Tn3, Tn5, Tn9, Tn10 and μ phage-mechanism of transposition. Transposable elements in eukaryotes- maize, AC and DS elements,Spm, dspm. Retro transposons. Population genetics.

Unit V

Regulation of gene expression- negative regulation (*lac* and *gal* operon). Positive regulation (*L-ara* operon) regulation bu attenuation of *trp* operon. Role of RNA molecules in gene regulations. Some regulatory mechanisms in *E.coli*- catabolite regulation. t-RNA and r –RNA regulation(stringent control).

Text Book (s):

1. Lodish, H. Baltimore Daerk . A. Zipsury, S.L. Marsudaisa. P. Darnel. J. (1995) Molecular cell biology.
2. Gardner- Simon Snustad. (2008). Principles of genetics, 8th Edition. John Wiley & sons. Inc. New York.

Reference Book(s):

1. Maloy, S.R. Cronan Jr. J.E, Freifelder D (1994), Microbial genetics. Jones and Barlett publishers.
2. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

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PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P2RMC6

COURSE TITLE : Medical Microbiology

QN.NO : 9108

TIME : 3 Hours

MAX.MARKS :75

Unit I

Components of immunity-Innate immunity, Acquired immunity. Humoral immunity, Cell mediated immunity. Types of antigens- Haptens, Adjuvants: Immunoglobulins- structure and functions: classification and biological activities; Antigenic determinants on immunoglobulins- Iso, Allo and Idiotypic, Monoclonal antibodies. The Complement components, function, complement, activation-(i) Classical, (ii) Alternate and (iii) Lectin pathways (characteristics and functions) Hypersensitivity: definition, types, examples.

Unit II

Transplantation immunology-Types of grafts, allograft rejection. Tumour immunology, tumour antigens. Immune response to tumours. Autoimmunity- concepts of autoimmunity, autoimmune disorders. MHC- types, structure, restriction, HLA typing.

Unit III

Pathogenesis, lab diagnosis, prevention & control of bacterial diseases caused by *E.coli*, *Salmonella*, *Shigella*, *Vibrio*, *Staphylococcus*, *Streptococcus*, *Mycobacterium*. Pathogenesis, clinical features & diagnosis of mycoses. Superficial mycoses- black and white piedra, Cutaneous – *Trichophyton* and *Tinea*. Subcutaneous – *Sporothrix* and *Mycetoma*. Systemic mycoses- Histoplasmosis, Coccidioidosis. Opportunistic mycosis – Aspergillosis, Candidiasis.

Unit IV

Pathogenesis, clinical features & diagnosis of diseases caused by Viruses & Protozoans . Viruses – Influenza, Herpes, Hepatitis, SARS & HIV. Protozoa – Entamoeba, Plasmodium, Trypanosoma, Leishmania and Giardia.

Unit V

General characters of antiseptics, disinfectants, antibiotics – beta lactum , aminoglycoside, polyglycoside, polycyclic alkenes.Mechanism of action. Antibiotic sensitivity test. Minimum inhibitory concentration. Drug resistance. Antiviral and Antiparasitic drugs.

Text Book (s):

1. Roitt, I.M (1998) Essential Immunology Blackwell Scientific Publishers.
2. Kuby, J. (1994) Immunology, 2nd edition, W.H. Freeman and Company. New York.
3. Leffel, Donnenberg, A: and Rose, W.(1997).Hand book of Human Immunology Boca Raton Fla: C.R.C Press.
4. Abbas, A.K. Lichtman, A.M. and Pober, J.S. (1997) Cellular and Molecular immunology 3rd edition Philadelphia : W.B. Saunders
5. Ananthanarayanan R. and Jayaram Panicker C.K. (1994). Text book of Microbiology. Orient Longman.

Reference Book(s):

1. Baron, E.J. and Tenover F.C. (1995). Scientific Company. Diagnostic Microbiology. Blackwell Scientific Company.
2. Salle, A.J. (1992). Fundamental Principles of Bacteriology. 7th Edition, Mc. Graw Hill Publishing Co. Ltd., New York.

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PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P3RMC7

COURSE TITLE : Applied Microbiology

QN.NO : 9111

TIME : 3 Hours

MAX.MARKS :75

Unit I

Microbiology of milk, Dairy and Food: Microbiology of milk dairy industries – Microbiology of milk – milk products – production of yoghurt, cheese and rennin. Biotechnology of dairy products (plasmid concept in buttermilk starter culture and gene manipulation. Fermented foods – fermented vegetables, sauerkraut and kimchi, fermented meals, fermented fish, soy sauce, Preservation of food – physical and chemical methods – mode of food borne disease Bacterial – *Clostridium perfringens*. Botulism- Mycotoxins- Aflatoxins - protozoa - *Entamoeba histolytica*.

Unit II

Soil microflora, Vermicompost production ,Development of Bacterial and Cyanobacterial biofertilizers - production of biofertilizers, inoculums preparation and mass scale production. Role of mycorrhizae in organic farming. Microbial insecticides-*Bacillus thuringiensis* - insecticidal toxin of *Bt*. Mode of action- various strains of *Bt* and their toxins. Toxin clone isolation and procedure for sub cloning of *Bt*. Toxicity and binding specificity of Cry proteins.Procedure for the development of genetically engineered *Pseudomonas fluorescens*- Baculo virus as biocontrol agent- mode of action –genetic engineering for improved biocontrol.

Unit III

Fermentation of microbial products: SCP, Alcoholic fermentation, Beer and Wine production- Antibiotics-Penicillin, Streptomycin: Organic acid-Citric acid, Acetic acid: Amino acid- Glutamic acid, L-lysine: Vitamins-B12 and Riboflavin: Hormone- Gibberellic acid: Biogas- Methane: Enzyme production- Protease, Cellulase and Lipase. Mushroom cultivation.

Unit IV

Role of microbes in biogeochemical cycle- nitrogen, sulphur, phosphate solubilizing organisms. Microbial degradation. Organic pollutants, Pesticides, hydrocarbon, Xenobiotic. Biodegradation-the meta effect of biodegradation. Microbial interaction with metal pollutants- Biomagnification, metal toxicity on microbes. Microbial metal resistance and detoxification, enhanced recovery of metals-Bioleaching with reference to Copper, Uranium. Enhanced recovery of petroleum. Biofiltration, Bioaugmentation and Phytoremediation.

Unit V

Production of Insulin. Bacterial production of growth hormone(hGH), Interleukins and Interferons-Stimulatory hormone. Drugs related with AIDS treatment. Vaccine-subunit vaccine *Herpes simplex* and *Tuberculosis*, attenuated vaccines- *Chloera* and *Salmonella*- Vector vaccines-Vaccine against Hepatitis B virus.

Text Book(s):

1. Rangasami G & Bagyaraj D.J.(1993) Agricultural Microbiology 2/e, Prentice-Hall publications.
2. Atlas, R. & Richard, B. (1987). Microbial ecology 2/e, Benjamin-Cummings publications, 1987.
3. Patel A.H(1996) Industrial microbiology Macmillan India limited.

Reference Book(s):

1. Prescott L.M, Harley J.P. & Klein D.A.,(2010). Microbiology, 6/e, McGraw Hill Publishers, 204. Madigan
2. M.T., Martinko J.M. & Brock P.J.(1997). Biology of Microorganisms 8/e, Prentice-Hall Inc.

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PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P3RMC8

COURSE TITLE : Bioinformatics & Biostatistics

QN.NO : 9112

TIME : 3 Hours

MAX.MARKS :75

Unit I

Computer : Basic components – brief account on processor. Input and output devices. Memory and storage: software -types-applications: operating systems; internet, WAN, LAN. Network software. [WWW.SRS\(NCBI,EBB net, Entrez\)](http://WWW.SRS(NCBI,EBB net, Entrez)). Introduction to Bioinformatics-basic concepts-DNA and protein sequence, structure and functions and interrelationship-Genome projects-*E.coli* and Human -Role of bioinformatics

Unit II

Databases –Importance – Types –Classification –Sequence format –Database record :DBMS –Nucleicacid sequence databases (Gene Bank,DDBJ, GSTB) . Protein sequence database-Primary,PIR ,Swiss-Prot ,TrEMBL, NRL-30. Structure database-RCSB,MSD: Structure, classification- SCOP,CATH: Secondary databases –PROSITE .PRINT – Composite databases –NDB, CSD, BMRD.Bibliography databases – Pubmet. Virtual library . Medline. Sequence alignment pairwise sequence and multiple alignment. Homology tools BLAST ,FASTA and phylogenetic analysis using CLUSTAL W .PHYLIP. Molecular visualizing tools –ROSMOL.Swiss PDP viewer. Drug design- molecular tagging – Gene finding using Genscan. WebGene Gene Wise.

Unit III

Nature and scope of statistical methods and their limitations- Compilation classification and tabulation of statistical – data. Event and sets – Samples space –Concept of probability – Addition and multiplication theorem on probability –Conditional probability and independence of events.

Unit IV

Standard distributions- Binomial poisson and normal distributions – standard distributions –to test based on normal – t,chi- square and R-non parametric test run median, Sign, Mann,Whitney and Wilcox signed rank test

Unit V

Coefficient of Correlation – scattered diagram – regression lines. Principles of scientific experiment Randomization replication and local control Analysis of Variance – One way and Two way classifications.

Text Book (s):

1. S. Palanisamy and M. Manoharan, (2002). Statistical methods for Biologists. Palani Paramount Publication, Anna Nagar, Palani, T. N.
2. S.C. Gupta and K. Kapoor, (2002). Fundamentals of Applied Statistics. 3rd Edition. Sultan Sons Educational Publisher, N.D.
3. N. Gurumani, (2002). An introduction to Biostatistics. MJP Publishers, Chennai.

Reference Book(s):

1. Ghosh,Z.and Mallick,V.(2008). Bioinformatics-principles and applications Oxford university press.
2. P.R. Vittal, and V. Malini, (2002). Statistical and Numerical Methods. Margham Publications, Chennai.



PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P3RNM1

COURSE TITLE : Microbial World

QN.NO : 9115

TIME : 3 Hours

MAX.MARKS :75

Unit I

Introduction – types, structure and properties. Brief account on microscopic algae, fungi, bacteria, protozoan and viruses.

Unit II

History of Microbiology – Anton Van LeEuwenhock – spontaneous generation of organisms, contribution by Redi, Spallanzani, Liebig, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Flemming in the field of Microbiology.

Unit III

Role of Microbes in the Environment – superbugs, Biogeochemical cycle, Biogas, Biofertilizer, Biological control, Bioremediation.

Unit IV

Beneficial aspects of Microbes- any four important uses with specific examples from Algae, Fungi and Bacteria.

Unit V

Harmful aspects of Microbes – any four harmful effects of Fungi, Bacteria and viruses with specific examples.

Text Book (s):

1. Anathanarayan, R & Paniker, C.K. (2000). A text book of Microbiology, Orient Longman, New Delhi.
2. Dubey, R.C. (2004), Basic Microbiology, S. Chand Publication, New Delhi.

Reference Book(s):

1. Christon J. et al, (2002), Manual of Environmental Microbiology, 2nd Edition, ASM Press, New Delhi.
2. Atlas, R.A. (1995), Principles of Microbiology, Mosby Publications, USA.

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PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P4RMC9

COURSE TITLE : Microbial Biotechnology

QN.NO : 9116

TIME : 3 Hours

MAX.MARKS :75

Unit I

Introduction – Definition – interdisciplinary approach-scope and importance –Biotechnology in India- organization and activities.Recombinant DNA technology-Restriction endonuclease-types, nomenclature, recognition sequences. Cleavage patterns. Modification of cut ends. Steps in gene cloning.isolation of desire gene clone.CDNA library, genomic library.

Unit II

Plasmids – basic biology, types, classification and properties of cloning vectors. The origin, restriction map of pBR322, pUC18, Ti plasmids. Lambda phage, M13, Cosmids, Phasmids.

Unit III

Gene transfer in Animal cells-DNA mediated transformation.viral transduction.expression systems for animal cells, role of stem cells. Production and importance of monoclonal antibodies.

Gene transfer in plant cell-Agrobacterium mediated transformation. Role of ti plasmid and cDNA in the field of vectors. Transfer of gene into plant cells with references to TGMV, *Arabidopsis*, *Nicotiana* and *Antirrhinum*.

Unit IV

Applications of recombinant DNA technology for the human welfare-Marshling rDNA to fight against AIDS,DNA based diagnosis of genetic diseases,human gene therapy with reference to HPRT,ADA,PNP,GC,PKU, β -globulin. Role of skin fibroblast in gene therapy.DNA fingerprinting and forensic studies. Concepts of stem cell therapy.

Unit V

Transgenic animals- introduction,objectives,vectors,transfection methods.brief account on transgenic mice-sheep, pigs, cattle and fish.

Transgenic plants- introduction, role of promoter,reportor and terminator genes. Antisense RNA mechanism. Production of transgenic tomato. brief account on the importance of Bt - Bt cotton, Bt brinjal- herbicide resistant,drought resistance plant productions.

Text Book(s):

1. Ratledge C & Kristiansen B.(2008). Basic Biotechnology 3/e, Cambridge University Press.
2. Darnell J. Lodish H. & Baltimore D.(2006). Molecular Cell Biology, Scientific American Books Inc., Iowa.
3. Glick B.R. & Pasternak, J.J., (2006).Molecular Biotechnology- Principles and Applications of Recombinant DNA technology, ASM press, Washington.
4. Mitra S., (2001)Genetic Engineering, Macmillan, India Limited, New Delhi.

Reference Book(s):

1. Winnacker E.L.(1987) From Genes to Clones: Introduction to Gene Technology, VCH Publications, Germany.
2. Winnacker E.L.(1987). From Genes to Clones: Introduction to Gene Technology, VCH Publications, Germany.



PROGRAMME : M.Sc., Microbiology

COURSE CODE : 17P4RMC10

COURSE TITLE : Genomic and Proteomics

QN.NO : 9117

TIME : 3 Hours

MAX.MARKS :75

Unit I

Genome of prokaryotes and eukaryotes-structure and organization of prokaryotic genome and eukaryotic genome- eukaryotic organelle genomes. Repetitive DNA content. Mapping genomes : genetic mapping – RAPD, RFLPs, SSLPs, SNPs detection of SNPs using DNA chip and microarrays. DNA chip and microarrays, physical mapping, restriction mapping. FISH, STS mapping (Radiation hybrid , flow cytometry).

Unit II

PCR technology – gene amplification. PCR primer designing and optimization site directed mutagenesis. DNA foot printing and finger printing. Methods of DNA sequencing .Sangers and Maxam gilbert methods. Automated DNA sequencing with fluorescent labeled ddNTPS. Thermal cycle sequencer, assembly of contigs-DNA sequencer-shotgun approaches.

Unit III

Clone contig approach by chromosome walking and whole genome – shotgun approach. Gene identification, location and computer analysis gene function . molecular phylogenetics – DNA based phylogenetic tree-Tree construction and application of molecular phylogenetics. Transcriptome analysis- Northern blot. RT-PCR . RACE: S1 nuclease mapping. SAGE DNA chips.

Unit IV

Proteomics classification 1 D –SDSPAGE a 2D –SDS PAGE.Detection and quantitation of proteins in gels, pros and cons of various staining methods. Basics of mass spectrometry. MALDITOF and ES1 and their application in proteomics.

Unit V

Tandem MS/MS spectrometry. Peptide sequencing by tandem mass spectrometry. Affinity purification of protein.TAP tag. Gel based proteome profiling

Text Book(s):

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Reference Book(s):

1. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.(1996). IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.
2. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.



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 RE-ACCREDITED (3rd Cycle) WITH “A” GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology

COURSE CODE : 21P1RMC1

COURSE TITLE : Microbial Taxonomy

QN.NO : 13001

TIME : 3 Hours

MAX.MARKS :75

Course Objectives

1. To recollect history, classification and diversity of microbes
2. To differentiate various groups of bacteria
3. To outline the unique features and reproduction of fungi
4. To understand the classification and significance of algae
5. To gain knowledge about classification and general characteristics of viruses

Course Learning Outcomes

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

1. Classify the microorganisms
2. Compare and contrast prokaryotes and eukaryotes
3. Interpret the characteristics and significance of fungi
4. Compare algal and cyanobacterial members
5. Explain the classification and nomenclature of viruses

Unit	Description	Hours	K-level	CLO
I	Unit I – Classification and diversity of microorganisms History, diversity of microorganisms and contributions of Indian scientists in the field of microbial classification. Systems of classification - Binomial Nomenclature, Whittaker’s five kingdom and Carl Woese’s three kingdom classification systems and their utility. Principles of taxonomical classification of Eubacteria (Bacteria and Archaea). Major characteristics used in taxonomy - cultural, morphological, biochemical, physiological, genetic and molecular characteristics. Numerical Taxonomy (Taxometrics) and Chemotaxonomy. Assessing microbial phylogeny – chronometers, phylogenetic trees, r-RNA, DNA and proteins as indicators of phylogeny.	15Hrs	Up to K2	1
II	Unit II – Taxonomy of bacteria Bergey’s system of classification of bacteria. Nomenclature of bacteria. Structure and functions of Bacterial cellwall (Gram positive and Gram negative), slime layer, capsule, pili, flagella and other inclusions bodies. Ultra structure of bacteria- <i>Streptococcus</i> sp., <i>Corynebacterium</i> sp., <i>Pseudomonas</i> sp. Characteristics and types of Archaeabacteria. Unique features of Mycoplasma. Structure, formation and significance of bacterial endospores (<i>Bacillus</i>).	15Hrs	Up to K3	2
III	Unit III - Taxonomy of fungi Classification of fungi (Alexopoulos and Mims). General characteristics of fungi - habitat, distribution, nutritional requirements, ultra structure of thallus, cell wall structure, asexual reproduction, sexual reproduction and significance. Life cycles - Ascomycetes (<i>Aspergillus</i>), Deuteromycetes (<i>Candida</i>), Zygomycetes (<i>Mucor</i>) and Basidiomycetes (<i>Agaricus</i>). Endophytes.	15Hrs	Up to K3	3

IV	Unit IV - Taxonomy of algae Classification of algae by Fritsch. General characteristics of algae – occurrence and thallus organization. Ultra structure, pigments, flagella, food reserves and vegetative, asexual reproduction, sexual reproduction and significance - Chlorophyta (<i>Ulothrix</i>), Chrysophyta (<i>Diatoms</i>), Rhodophyta (<i>Gracillaria</i>) and Cyanophyta (<i>Spirulina</i> , <i>Nostoc</i> , <i>Oscillatoria</i> , <i>Synechococcus</i> , <i>Chroococcus</i>).	15Hrs	Up to K4	4
V	Unit V - Taxonomy of viruses Classification of Viruses - Structure-based classification, International Committee on Taxonomy of Viruses (ICTV) and Baltimore classification. Definition and concept of viroids, virusoids, satellite viruses and Prions. General characteristics, nomenclature, morphology and reproduction - Bacteriophage (T4 and Lambda), Animal viruses (Polio, SARS and Corona), Plant viruses (TMV and CMV), Mycophage and Cyanophage.	15Hrs	Up to K4	5

Total 75 Hours

Books for study:

1. Pelczar, Jr. M.J., Chan, E.C.S. and Kreig, N.R. (2006). Microbiology. 5th Edition. McGraw Hill Inc., New York.
2. Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Micro-organisms. 14th Edition. Parker J. Prentice Hall International, Inc., New Jersey.

Books for reference:

1. Prescott, L.M., Harley, J.P. and Klein, D.A. (2005). Microbiology. McGraw Hill Inc., New York.
2. Boyd, R.F. (1991). General Microbiology. 2nd Edition. Times Mirror/Moshy College Publishing, Virginia.
3. Atlas, R.M. (1997). Principles of Microbiology. 2nd Edition. W.M.T.Brown Publishers, Iowa.
4. Black, J.G. (2008). Microbiology: Principles and Explorations. 7th Edition. Prentice Hall, US.
5. Srivastava, S. and Srivastava, P.S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.
6. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. (2005). General Microbiology. 5th Edition. McMillan, London.
7. Tortora, G.J., Funke, B.R. and Case, C.L. (2008). Microbiology: An Introduction. 9th Edition. Pearson Education, London.
8. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill Higher Education, New York.

Web resources:

1. <https://microbenotes.com/classification-of-bacteria/>
2. https://www.brainkart.com/article/Ultrastructure-of-a-Bacterial-cell_32841/
3. <https://www.toppr.com/guides/biology/biological-classification/kingdom-fungi/>
4. <https://www.toppr.com/guides/biology/plant-kingdom/algae/>
5. <https://www.sciencedirect.com/topics/immunology-and-microbiology/virus-classification>
6. <https://www.youtube.com/watch?v=8IJRzcPC9wg>

Rationale for nature of the course

Microbial Taxonomy deals with three important disciplines like classification, nomenclature and identification of microbes thus enabling to explore microbes and their taxonomical position in microbial world. A universal language of classification system can be understood.

Activities having direct bearing on skill development/ employability/entrepreneurship

- Identify and prepare phylogenetic tree
- Understand the similarities and differences among microbes
- Explore the economic importance of microbes

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 Outcomes	Knowledge Level
CLO1	Classify the microorganisms	Up to K2
CLO2	Compare and contrast prokaryotes and eukaryotes	Up to K3
CLO3	Interpret the characteristics and significance of fungi	Up to K3
CLO4	Compare algal and cyanobacterial members	Up to K4
CLO5	Explain the classification and nomenclature of viruses	Up to K4

Mapping of Course Learning Outcomes with Programme Specific Outcomes

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

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

Mapping of Course Outcome with Programme Outcomes

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

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 Classification and diversity of microorganisms	a) History, diversity of microorganisms and contributions of Indian scientists in field of Microbial classification.		3	Chalk and Talk
	b) Systems of classification Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.		4	
	c) Principles of taxonomical classification of Eubacteria (Bacteria and Archaea). Major characteristics used in taxonomy: cultural, morphological, biochemical, physiological, genetic and molecular characteristics; Numerical Taxonomy (Taxometrics) and Chemotaxonomy.		5	
	d) Assessing Microbial Phylogeny- chronometers. phylogenetic trees, r-RNA, DNA and proteins as indicators of phylogeny.		3	
II Taxonomy of bacteria	a) Bergey's system of classification of bacteria. Nomenclature of bacteria.		4	Chalk and Talk
	b) Structure and functions of Bacterial cell wall (Gram positive, Gram negative),		3	
	c) Slime layer, capsule, pili, flagella and other inclusions bodies. Ultra structure of bacteria- <i>Streptococcus</i> sp. <i>Corynebacterium</i> sp. and <i>Pseudomonas</i> sp.		2	
	d) Characteristics and types of Archaeabacteria. Unique features of Mycoplasma		4	
	e) Structure, formation and significance of bacterial endospores (<i>Bacillus</i>).		2	
III Taxonomy of fungi	a) Classification of fungi (Alexopoulos and Mims).		3	Chalk and Talk
	b) General characteristics of fungi - habitat, distribution, nutritional requirements, ultra- structure of thallus, cell wall structure, asexual reproduction, sexual reproduction and significance.		5	
	c) Life cycles - Ascomycetes (<i>Aspergillus</i>), Deuteromycetes (<i>Candida</i>)		4	
	d) Zygomycetes (<i>Mucor</i>), Basidiomycetes (<i>Agaricus</i>). Endophytes.		3	
IV Taxonomy of algae	a) Classification of algae by Fritsch.		3	Chalk &Talk, PPT
	b) General characteristics of algae – occurrence and thallus organization.		3	
	c) Ultra-structure, pigments, flagella, food reserves vegetative, asexual and sexual reproduction and significance - Chlorophyta (<i>Ulothrix</i>), Chrysophyta (<i>Diatoms</i>)		3	
	d) Ultra-structure, pigments, flagella, food reserves		3	

	vegetative, asexual and sexual reproduction and significance - Rhodophyta (<i>Gracillaria</i>) and Cyanophyta - <i>Spirulina, Nostoc</i>			
	e) Ultra-structure, pigments, flagella, food reserves vegetative, asexual and sexual reproduction and significance - <i>Oscillatoria, Synechococcus, Chroococcus</i> .		3	
V Taxonomy of viruses	a) Classification of Viruses - Structure-based classification, International Committee on Taxonomy of Viruses (ICTV) and Baltimore classification.		4	Chalk &Talk, PPT
	b) Definition and concept of viroids, virusoids, satellite viruses and Prions		2	
	c) General characteristics, nomenclature, morphology and reproduction – Bacteriophage (T4 and Lambda),		2	
	d) Animal viruses (Polio, SARS and Corona)		3	
	e) Plant viruses (TMV, CMV), Mycophage and Cyanophage.		4	

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011
(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)
RE-ACCREDITED (3rd Cycle) WITH “A” GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology

COURSE CODE : 21P1RMC2

COURSE TITLE : Biochemistry

QN.NO : 13002

TIME : 3 Hours

MAX.MARKS :75

Course Objectives

1. To know the bioenergetics and high energy compounds
2. To recognize different types of carbohydrates and their properties
3. To gain information about the properties and classification of amino acids and enzymes.
4. To familiarize with the properties and functions of lipids.
5. To differentiate between DNA and RNA.

Course Learning Outcomes

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

1. Explain the bioenergetics process and functions of enzymes.
2. Outline the classification and properties of carbohydrates.
3. Determine the structure and properties of amino acid and enzyme.
4. Classify the types and functions of Lipids.
5. Analyze the quantity of Nucleic acid.

Unit	Description	Hours	K- level	CLO
I	Unit - I Bioenergetics Concept of free energy, standard free energy, determination of Gibb's free energy (ΔG) for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials and free energy change (derivations and numericals included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG . Energy change.	15Hrs	Up to K2	1
II	Unit- II Carbohydrates Definition and classification of carbohydrates, linear and ring forms (Haworth formula). Physical properties-mutarotation and kilianicynohydrin synthesis. Chemical properties – Oxidation, reduction, osazone formation. Monosaccharides- glucose and fructose. Disaccharides – sucrose and lactose. Oligosaccharides. Polysaccharide - starch, cellulose and hemicellulose, pectin.	15Hrs	Up to K3	2
III	Unit- III Proteins and Enzymes Structure, classification, physical and chemical properties of aminoacids - amphoteric nature, isoelectric point, isoelectric pH and zwitter ion. Proteins - classification, physical and chemical properties and structural organization of proteins- primary, secondary, tertiary and quaternary. Enzyme - general characteristics and IUB enzyme classification. Mechanism of enzyme action. Enzyme kinetics -Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burkeplot and Haldane-Briggs relationship.	15Hrs	Up to K3	3
IV	Unit- IV Lipids Definition, classification, biological functions, physical, and chemical properties. Simple lipids - triglycerides, steryl esters, and wax esters. Compound lipids – phospholipids, glycolipids. lipoproteins. Derived lipids - steroids, sterols and terpenes. Saturated fatty acids - butyric and stearic acid. Unsaturated fatty acids - linoleic and palmitic acid. Biosynthesis of lipids–	15Hrs	Up to K4	4

V	Unit- V Nucleic acids Definition, structure of purines and pyrimidines. Nucleosides and nucleotides. Different forms of DNA. Double helical model of DNA (Watson and Crick), properties - cot curve and cot value, T _m , hypo and hyper chromicity and its biological significance. Structure, occurrence and biological functions of RNA -tRNA, mRNA and rRNA. Differences between DNA and RNA. Quantification of Nucleic Acid.	15Hrs	Up to K4	5
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Total 75 Hours

Books for Study

1. Murray, R.K. and Grammer, D.K. (1990). Harper's Biochemistry. 25th Edition, McGraw Hill Publication, New York.
2. Satyanarayana, U. and Chakrapani, U. (2017). Biochemistry. 5th Edition. Books & Allied Ltd. Kolkata.
3. Jain, J.L., Jain, S. and Jain, N. (2016). Biochemistry. 7th edition, S. Chand & Co., Ltd. New Delhi.
4. David, B.D., Delbecco, R., Eisen, H.N. and Ginsburg, H.S. (1990). Microbiology. 5th Edition. Harper & Row. New York.

Books for Reference

1. Voet, D. and Voet, J.G. (2010). Biochemistry. 4th Edition. John Wiley and Sons, New Jersey.
2. Engel, P. (1986). Enzyme Kinetics. 2nd Edition. John Wiley and Sons. Inc., New York.
3. Dixon and Webb. (1979). Enzymes, 3rd Edition. Academic Press, New York.
4. Nelson, D.L. and Cox, M. (2017). Lehninger Principles of Biochemistry, 7th Edition, WH Freeman publisher, USA.

Web Resources

1. <https://www.sciencedirect.com/book/9780123884251/bioenergetics>
2. <https://microbenotes.com/carbohydrates-structure-properties-classification-and-functions/>
3. <https://www.thoughtco.com/amino-acid-373556>
4. <https://microbenotes.com/lipids-properties-structure-classification-and-functions/>
5. <https://biologydictionary.net/nucleic-acid/>

Rationale for Nature of the course

The goal of this course is to understand the basic building blocks of living organisms, introduce the structure and properties of various biomolecules and to emphasize on the association between structure and function of various biomolecules. This course highlights on the concepts involved in the mechanism of enzyme action and to understand the significance of vitamins as vital ingredient of life.

Activities having direct bearing on skill development/ employability/entrepreneurship

To provide knowledge on biomolecules and their significance in the metabolism
 To know about the structure of biomolecules found in cells, to determine their structures.
 To inculcate the formulation of biomolecules such as enzymes, hormones and vitamins in drug designing.

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	Explain the bioenergetics process and functions of enzymes.	Up to K2
CLO2	Outline the classification and properties of carbohydrates.	Up to K3
CLO3	Determine the structure and properties of aminoacid and enzyme.	Up to K3
CLO4	Classify the types and functions of Lipids.	Up to K4
CLO5	Analyze the quantity of Nucleic acid.	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	2	2	2
CLO2	2	2	2	2	3
CLO3	3	2	3	2	3
CLO4	2	2	2	3	2
CLO5	2	3	3	3	2

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

Mapping of Course Outcome with Programme Outcome

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

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 Bioenergetics	a) Concept of free energy, standard free energy, determination of Gibb's free energy(ΔG) for a reaction.		2	Chalk and Talk
	b) Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions.		4	
	c) Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials & free energy change (derivations and numericals included).		5	
	d) High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG . Energy charge.		4	
II Carbohydrates	a) Definition and classification of carbohydrates, linear and ring forms (Haworth formula)		2	Chalk and Talk
	b) Physical properties-mutarotation and kiliani cynohydrin synthesis.		2	
	c) Chemical properties – Oxidation, reduction, osazone formation.		3	
	d) Monosaccharides- glucose and fructose.		3	
	e) Disaccharides – sucrose and lactose, Oligosaccharides.		2	
	f) Polysaccharide - starch, cellulose and hemicellulose, pectin.		3	
III Proteins and Enzymes	a) Structure, classification, physical and chemical properties of aminoacids - amphoteric nature, isoelectric point, isoelectric pH and zwitter ion.		3	Chalk and Talk & PPT
	b) Proteins - classification, physical and chemical properties and structural organization of proteins- primary, secondary, tertiary and quaternary.		3	
	c) Enzyme - general characteristics and IUB enzyme classification.		3	
	d) Mechanism of enzyme action.		2	
	e) Enzyme kinetics -Michaelis - Menton equation and its significance in enzyme kinetic studies.		2	
	f) Lineweaver- Burkeplot and Haldane-Briggs relationship.		2	

IV Lipids	a) Definition, classification, biological functions, physical, and chemical properties.		2	PPT & Chalk and Talk
	b) Simple lipids - triglycerides, steryl esters, and wax esters.		2	
	c) Compound lipids – phospholipids, glycolipids. lipoproteins.		2	
	d) Derived lipids - steroids, sterols and terpenes.		2	
	e) Saturated fatty acids - butyric and stearic acid.		2	
	f) Unsaturated fatty acids - linoleic and palmitic acid.		2	
	g) Biosynthesis of lipids – cholesterol.		1	
	h) Oxidation of fatty acid – α and β .		2	
V Nucleic acid	a) Definition, structure of purines and pyrimidines. Nucleosides and nucleotides.		3	Chalk and Talk & PPT
	b) Different forms of DNA.		2	
	c) Double helical model of DNA (Watson and Crick), properties - cot curve and cot value, T_m , hypo and hyper chromicity and its biological significance.		4	
	d) Structure, occurrence and biological functions of RNA -tRNA, mRNA and rRNA.		3	
	e) Differences between DNA and RNA.		1	
	f) Quantification of Nucleic Acid.		2	
Total			75 Hours	

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011
 (AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)
 RE-ACCREDITED (3rd Cycle) WITH “A” GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology
COURSE TITLE : Microbial Physiology
TIME : 3 Hours

COURSE CODE : 21P1RMC3
QN.NO : 13003
MAX.MARKS :75

<p>Course Objectives</p> <ol style="list-style-type: none"> To understand microbial growth and nutrition To understand the concept of photosynthesis and bioluminescence To know the concept of catabolism and catabolic pathways in microbes To gain knowledge about the microbial anabolic pathways and nitrogen metabolism To know about anaerobic respiration and microbial stress response
<p>Course Learning Outcomes</p> <p><i>On successful completion of the programme, the students will be able to</i></p> <ol style="list-style-type: none"> Outline the concept of microbial growth and nutrition. Define the basic concept of photosynthesis and bioluminescence. Summarize the concept of catabolism and catabolic pathways in microbes Interpret the microbial anabolic pathways and nitrogen metabolism Illustrate anaerobic respiration and microbial stress response

Unit	Description	Hours	K- level	CLO
I	<p>Unit- I Microbial Growth and Nutrition</p> <p>Growth of Bacteria - phases of growth, batch culture, continuous culture, diauxic growth and synchronous culture - induction of synchrony and growth kinetics. Factors affecting microbial growth. Classification of organisms based on carbon, energy and electron sources. Microbial nutrition – Nutritional requirements and types of bacteria – phototrophs and chemotrophs, autotrophs and heterotrophs, organotrophs and lithotrophs - photoorganotrophs and chemolithotrophs (ammonia, nitrate sulphur, hydrogen, iron oxidizing bacteria). Nutrient transport mechanisms- Passive diffusion, facilitated diffusion, active transport, group translocation and specific transport system.</p>	15 hrs	Up to K2	1
II	<p>Unit- II Bacterial Photosynthesis</p> <p>Bacterial Photosynthesis- general types of microbial photosynthesis - oxygenic and anoxygenic. Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids and phycobilins. Photosynthetic bacteria - green sulphur and purple bacteria. Light reaction in aerobic oxygenic phototrophic bacteria. Light reaction in anaerobic anoxygenic phototrophic bacteria (Green and Purple bacteria). CO₂ fixation – Calvin cycle. Bioluminescence - Process and application.</p>	15 hrs	Up to K3	2
III	<p>Unit –III Metabolism</p> <p>Basic concepts of metabolism, oxidation – reduction reactions, Energy generation by anaerobic metabolism – glycolysis, pentose phosphate pathway, Entner- Doudoroff (ED) pathway, Fermentation - alcoholic and lactic acid fermentation – homolactic, heterolactic and mixed acid fermentation with examples. Energy generation by aerobic metabolism - TCA cycle, glyoxylate pathway and electron transport chain, mechanism of ATP synthesis – chemiosmosis, Pasteur effect.</p>	15 hrs	Up to K3	3
IV	<p>Unit –IV Anabolism and Nitrogen metabolism</p> <p>Glycogenesis, gluconeogenesis and amphibolic nature of TCA</p>	15 hrs	Up to K4	4

	cycle -production of biosynthetic products. Biosynthetic pathway of peptidoglycan. Nitrogen Metabolism- Sources of nitrogen, Nitrogen fixation - non symbiotic and symbiotic nitrogen fixation. Nitrification, denitrification, Nitrate and ammonia assimilation pathways, Nitrogen cycle. Diazotrophs of nitrogen fixation, structure of nitrogenase complex. Regulation of nitrogenase complex by oxygen and combined nitrogen sources. Nif genes and their regulation.			
V	Unit- V Anaerobic respiration and microbial stress response Anaerobic respiration. Nitrogen, sulphur, iron and hydrogen oxidation. Methanogenesis. Microbial stress responses (extremophiles) - osmotic stress and osmoregulation, aerobic to anaerobic transitions, oxidative stress, pH stress and acid tolerance, thermal stress and heat shock response, nutrient stress and starvation stress, stringent response.	15 hrs	Up to K4	5

Total 75 Hours

Books for Study:

1. Moat, A.G. and Foster, J.W. (2009). Microbial Physiology. 4th Edition. John Wiley & Sons, New York.
2. Atlas, R.M. (1997). Principles of Microbiology. 2nd Edition. WCB/McGraw-Hill Co., USA.

Books for Reference:

1. Hall, D.O. and Rao, K.K. (1994). Photosynthesis. 5th Edition. Cambridge University press, UK.
2. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. (1986). General Microbiology. 5th Edition. Macmillan Education Ltd., London.
3. Dubey, R.C. and Maheswari, D.K. (2005). A Text book of microbiology. S. Chand & Company Ltd., New Delhi.
4. Salle, A.J. (1992). Fundamentals Principles of Bacteriology. 7th Edition. McGraw Hill Publishing Co. Ltd., New York.
5. Sundararajan, S. (2003). Microbial Physiology. Anmol Publication, New Delhi.

Web Resources:

1. http://www.chris-anthony.co.uk/pdf_files/presentations/IntroductionWeb.pdf
2. <https://www.youtube.com/watch?v=NYMTeqpr6JI>
3. <https://www.youtube.com/watch?v=ei6Z7orCpPk>

Rationale for nature of the course

Microbial physiology provides information on sources of energy and its utilization by microorganisms. Microorganisms play important role in environment as producers, consumers and decomposers. These are the only group of organisms which takes part in all three important stages of ecosystem. Understanding microbial physiology has greater application in industry, developing medicine and even in agriculture.

Activities having direct bearing on skill development/employability/entrepreneurship:

Microbial physiology has traditionally played a very important role in both fundamental research and in industrial applications of microorganisms.

The classical approach in microbial physiology is to analyze the role of individual components (genes or proteins) in the overall cell function.

It is possible to optimize industrial fermentations through introduction of directed genetic modification - an approach referred to as metabolic engineering.

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

	Course Learning Outcome	Knowledge Level
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CLO1	Outline the concept of microbial growth and nutrition.	Up to K2
CLO2	Define the basic concept of photosynthesis and bioluminescence.	Up to K3
CLO3	Summarize the concept of catabolism and catabolic pathways in microbes	Up to K3
CLO4	Interpret the microbial anabolic pathways and nitrogen metabolism	Up to K4
CLO5	Illustrate anaerobic respiration and microbial stress response	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	1	1	1	1	3
CLO2	1	1	1	2	2
CLO3	1	2	1	1	3
CLO4	2	2	2	1	2
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	1	1	1	1	1
CLO2	1	1	1	1	1
CLO3	1	1	1	1	1
CLO4	1	2	2	2	2
CLO5	2	2	2	2	2

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 Microbial Growth and Nutrition	a) Growth of Bacteria: phases of growth, growth kinetics - batch culture, continuous culture, diauxic growth and synchronous culture - induction of synchrony and growth kinetics		3	Chalk and Talk
	b) Factors affecting microbial growth		3	
	c) Classification of organisms based on carbon, energy and electron sources		3	
	d) Nutrition – nutritional requirements and types of bacteria – phototrophs and chemotrophs, autotrophs and heterotrophs, organotrophs and lithotrophs - photoorganotrophs and chemolithotrophs (ammonia, nitrate sulphur, hydrogen, iron oxidizing bacteria).		3	
	e) Nutrient transport mechanisms- Passive diffusion, Facilitated diffusion, Active transport, Group translocation and Specific transport system.		3	
II Bacterial Photosynthesis	a) Bacterial Photosynthesis- General types of microbial photosynthesis - oxygenic and anoxygenic		2	Chalk and Talk
	b) Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids and phycobilins		2	
	c) Photosynthetic bacteria - green sulphur and purple. Light reaction in aerobic oxygenic phototrophic bacteria		2	
	d) Light reaction in anaerobic an-oxygenic phototrophic bacteria (Green and Purple		3	

	bacteria)			
	e) CO ₂ fixation – Calvin cycle		3	
	f) Bioluminescence - Process and application		3	
III Metabolism	a) Basic concepts of metabolism, Oxidation – reduction reactions		3	Chalk and Talk & PPT
	b) Energy generation by anaerobic metabolism – glycolysis, pentose phosphate pathway, Entner- Doudoroff (ED) pathway		4	
	c) Fermentation-alcoholic-lactic acid fermentation-Homolactic and Heterolactic and Mixed acid fermentation with examples		4	
	d) Energy generation by Aerobic metabolism - TCA cycle, glycoxylate pathway and electron Transport chain, Mechanism of ATP synthesis – Chemiosmosis, Pasteur effect		4	
IV Anabolism and Nitrogen metabolism	a) Glycogenesis, Gluconeogenesis and Amphibolic nature of TCA cycle -production of biosynthetic products		3	PPT & Chalk and Talk
	b) Biosynthetic pathway of peptidoglycan		3	
	c) Nitrogen Metabolism- Sources of nitrogen, Nitrogen fixation: Non symbiotic and symbiotic nitrogen fixation. Nitrification, denitrification, Nitrate and ammonia assimilation pathways		4	
	d) Nitrogen cycle. Diazotrophs of nitrogen fixation, Structure of nitrogenase complex. Regulation of nitrogenase complex by oxygen and combined nitrogen sources. Nif genes and their regulation		5	
V Anaerobic respiration and microbial stress response	a) Anaerobic Respiration. Nitrogen, sulphur, iron and hydrogen oxidation.		3	PPT
	b) Methanogenesis.		2	
	c) Microbial stress responses (extremophiles)- Osmotic stress and osmoregulation, Aerobic to anaerobic transitions, oxidative stress, pH stress and acid tolerance		5	
	d) thermal stress and heat shock response, nutrient stress and starvation stress, stringent response		5	
Total			75 Hours	

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011
 (AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)
 RE-ACCREDITED (3rd Cycle) WITH “A” GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology
COURSE TITLE : Bioinstrumentation
TIME : 3 Hours

COURSE CODE : 21P1RME1
QN.NO : 13004
MAX.MARKS :75

<p>Course Objectives</p> <ol style="list-style-type: none"> To learn theoretical background and practical skills in microscopy To impart knowledge on principles and applications of various instruments used in biology To understand the working mechanism and to characterize biomolecules using spectroscopic techniques To enable the students to explore the methods for separation of biomolecules To emphasize the importance of radioisotopes in biology and its proficient handling
<p>Course Learning Outcomes <i>On successful completion of the programme, the students will be able to</i></p> <ol style="list-style-type: none"> Demonstrate the working mechanism and usage of different microscopes Describe the principle and applications of various instruments used in biology Apprise spectroscopic data for laboratory and project work Separate and determine different components present in biological samples using appropriate separation techniques 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, isotachopheresis) and	15 hrs	Up to K4	4

	electrophoresis (DGGE).Gel documentation, fluorescence activated cell sorting (FACS).			
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=myoIF-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	Section B	Section C	Section D	Total	% of	Consolidated
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	(No Choice)	(No Choice)	(Either/or)	(Open Choice)	Marks	Marks without choice	
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 Techniques	a) Chromatography- Principle, working mechanism and applications of gel filtration, ion exchange, affinity chromatography		3	PPT, Seminar, 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		3	

UNITS	DESCRIPTION	STAFF	HOURS	MODE
	isotachopheresis) and applications of agarose gel electrophoresis, SDS-PAGE, native PAGE			
	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	

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THE MADURA COLLEGE (Autonomous), MADURAI – 625 011
(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)
RE-ACCREDITED (3rd Cycle) WITH “A” GRADE BY NAAC

PROGRAMME : M.Sc., Microbiology
COURSE TITLE : Microbial World
TIME : 3 Hours

COURSE CODE : 21P1RNM1
QN.NO : 13007
MAX.MARKS :75

Course Objectives <ol style="list-style-type: none">1. To know the structure and nomenclature of microorganisms2. To impart basic knowledge on history of microbiology.3. To identify the uses of environmentally friendly microorganisms4. To know the beneficial aspects of microbes5. To study harmful aspects of microbes
Course Learning Outcome <p><i>On successful completion of the programme, the students will be able to</i></p> <ol style="list-style-type: none">1. Explain the morphological and cultural characteristics of microorganisms2. Understand the contributions of scientists in the field of microbiology3. Summarize the application of microorganisms in bioremediation4. Understand the beneficial aspects of microbes5. Classify the harmful microbial characteristics

Unit	Description	Hours	K Level	CLO
I	Unit I - Basic structure and properties of microorganisms Introduction – types, structure and properties of microorganisms- bacteria, fungi, microscopic algae, protozoan and viruses.	6 hrs	Up to K2	1
II	Unit II - Contribution of scientists in the field of microbiology History of Microbiology – Anton van Leeuwenhock – spontaneous generation of organisms, contributions by Redi, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming in the field of Microbiology.	6 hrs	Up to K2	2
III	Unit III – Interaction of microbes with environment Role and significance of microbes in the environment – superbugs, Biogeochemical cycle, Biogas, Bio-fertilizer, Biological control, Bio-remediation.	6 hrs	Up to K2	3
IV	Unit IV – Significant aspects of microbes Beneficial aspects of microbes- any four important uses and its economical importance with specific examples from Algae, Fungi and Bacteria.	6 hrs	Up to K2	4
V	Unit V – Adverse effects of microbes Harmful aspects of microbes – any four harmful effects of Fungi, Bacteria and viruses with specific examples.	6 hrs	Up to K2	5

Total 30hrs

Books for study:

1. Pelczar, Jr. M.J., Chan, E.C.S. and Kreig, N.R. (2006). Microbiology. 5th Edition. McGraw Hill Inc., New York.
2. Dubey, R.C. (2004). Basic Microbiology, S.Chand Publications, New Delhi.

Reference Books:

1. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A. and Mills, A.L. (2002). Manual of

- Environmental Microbiology, 2nd Edition. ASM Press, New Delhi.
2. Atlas, R.A. (1995). Principles of Microbiology. Mosby Publications, USA.
 3. Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14th Edition. Prentice Hall International Inc., USA.

Web resources

1. <https://microbiologyinfo.com/category/basic-microbiology/>
2. <https://microbiologyinfo.com/category/basic-microbiology/>
3. <https://www.britannica.com/science/microbiology>

Rationale for nature of the course

Microorganisms play a vital role in nutrient cycling, biodegradation, climate changes and in making life-saving drugs and manufacture of biofuels. Bio-treatment of waste has become environmentally friendly alternative to other options. Microbes are also known to cause deadly disease and cause an adverse impact on other living organisms.

Activities having direct bearing on skill development/ employability/entrepreneurship

Determination of the morphological characteristic of microorganisms.

Categories environmental friendly microbes

Microbial adverse effects on other life

Pedagogy

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

Course Learning Outcomes (CLO)

On completion of this course the students will be able to

CLOs	Course Learning Outcome	Knowledge Level
CLO-1	Explain the morphological and cultural characteristics of microorganisms	Up to K2
CLO-2	Understand the contributions of scientists in the field of microbiology	Up to K2
CLO-3	Summarize application of microorganisms in bioremediation	Up to K2
CLO-4	Understand the beneficial aspects of microbes	Up to K2
CLO-5	Classify the harmful microbial characteristics of microbes	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 interferences with evidences

Mapping of Course Learning Outcome with Programme Specific Outcome

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

Advance application – 3,

Intermediate level – 2,

Basic level – 1.

Mapping of Course Outcome with Programme Outcome

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

CLO5	1	1	1	2	1
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Advance application – 3, Intermediate level – 2, Basic level – 1.

LESSON PLAN

Units	Description	Staff	Hours	Mode
I Basic structure and properties of microorganisms	a) Introduction – types, structure and properties of microorganisms		1	Chalk and Talk
	b) Types, structure and properties of bacteria, fungi		2	PPT
	c) Types, structure and properties of microscopic algae, protozoan and viruses.		3	PPT
II Contribution of scientists in the field of microbiology	a) History of Microbiology — spontaneous generation of organisms.		1	Chalk and talk
	b) Contributions by Anton van Leeuwenhock, Redi, in the field of Microbiology.		2	PPT
	c) Spallanzani, Louis Pasteur, Robert Koch in the field of Microbiology.		2	Chalk and Talk
	d) Edward Jenner and Alexander Fleming in the field of Microbiology.		2	Lecture
III Interaction of microbes with environment	a) Role and significance of microbes in the environment – superbugs.		1	PPT
	b) Role and significance of microbes in the environment –biogeochemical cycle.		1	Chalk and Talk
	c) Role and significance of microbes in the environment – biogas, bio-fertilizer.		2	Lecture
	d) Role and significance of microbes in the environment – biological control, bio-remediation.		2	PPT
IV Significant aspects of microbes	a) Beneficial aspects of microbes- any four important uses and its economical importance with specific examples from Algae.		2	Chalk and talk
	b) Beneficial aspects of microbes- any four important uses and its economical importance with specific examples from Fungi.		2	PPT
	c) Beneficial aspects of microbes- any four important uses and its economical importance with specific examples from Bacteria		1	Chalk and Talk
V Adverse effects of microbes	a) Harmful aspects of microbes – any four harmful effects of Fungi with specific examples.		2	PPT
	b) Harmful aspects of microbes – any four harmful effects of Bacteria with specific examples.		2	Lecture
	c) Harmful aspects of microbes – any four harmful effects of viruses with specific examples.		2	Chalk and Talk
Total			30 Hours	

**Learning Outcome Based Education & Assessment (LOBE)
Formative Exam – 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	

- CLO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

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)	Section D (Open Choice)	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%

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)	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

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