Dr. N.G.P. ARTS AND SCIENCE COLLEGE

(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore)
Approved by Government of Tamil Nadu & Accredited by NAAC with A++ Grade (3rd Cycle - 3.64 CGPA)
Dr. N.G.P. -Kalapatti Road, Coimbatore – 641048, Tamil Nadu, India
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Regulations 2025-26 for Post graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc Microbiology Degree

(For the students admitted during the academic year 2025-26)

Programme : Microbiology

ELIGIBILITY:

A pass in any one of the following Degree Course of B.Sc. Microbiology / Biotechnology / Biology / Botany / Zoology /Plant Science/ Animal Sciences / Biochemistry / Bioinformatics / Environmental Science / Food and Nutrition/ Clinical Lab Technology of any University in Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, Course to such conditions as may be prescribed thereto are permitted to appear and qualify for the **M.Sc., Microbiology Examination** of this College after a course study of two academic years.

PROGRAMME OBJECTIVES:

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation to:

1. Present intense knowledge in areas of organization and functioning of microorganisms.
2. Familiarize with the operations of bio instruments and related techniques.
3. Enable students to understand the applications of microbiology in healthcare, agriculture, food technology and environmental protection.
4. Provide opportunities to develop skills and participate in Research Projects.

Programme Outcomes

On the successful completion of the programme, the following are the expected outcomes.

PO Number	PO Statement
PO1	To impart knowledge of various branches of Microbiology and to understand the role of microorganisms in human welfare and sustainable development.
PO2	To acquire skills in the techniques used to observe and study the nature of microorganisms and the techniques, skills, and modern tools necessary for biological practice.
PO3	To appreciate the complexities of microbiological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc.
PO4	To inculcate broad education necessary to understand the impact of microbiological solutions in a global and societal context; an ability to function in multi-disciplinary teams; To develop the ability to identify, formulate, and solve biological problems and to design and conduct experiments, as well as to analyze and interpret data.
PO5	To create awareness of contemporary issue and to appreciate the applications of Microbiology to become an entrepreneur.

CURRICULUM

M.SC. MICROBIOLOGY

A.Y – 2025-26

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
25MBP1CA	Core - I	Fundamentals of Microbiology	4	-	-	4	48	3	25	75	100	4
25MBP1CB	Core - II	Microbial Physiology and Bacterial Diversity	4	-	-	4	48	3	25	75	100	4
25MBP1CC	Core - III	Mycology, Phycology and Lichenology	4	-	-	4	48	3	25	75	100	4
25MBP1CD	Core - IV	Comprehensive Biology	3	1	-	4	48	3	25	75	100	3
25MBP1CE	Core - V	Bio Analytical Techniques	3	1	-	4	48	3	25	75	100	3
25MBP1CP	Core Practical - I	Basic Techniques in Microbiology	-	-	6	6	72	9	40	60	100	3
25MBP1DA	DSE - I	Microbial Technology	3	1	-	4	48	3	25	75	100	3
25BCP1DA		Cancer Biology, Diagnosis and Therapy										
25BTP1DA		Applied Biotechnology										
Total			**21**	**3**	**6**	**30**	**360**				**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Second Semester												
25MBP2CA	Core - VI	Microbial Genetics	4	-	-	4	48	3	25	75	100	4
25MBP2CB	Core - VII	Immunology and Immunotechniques	4	-	-	4	48	3	25	75	100	4
25MBP2CC	Core - VIII	Virology	4	-	-	4	48	3	25	75	100	4
25MBP2CD	Core - IX	Medical Bacteriology	3	1	-	4	48	3	25	75	100	3
25MBP2CE	Core - X	Recombinant DNA Technology	3	1	-	4	48	3	25	75	100	3
25MBP2CP	Core Practical -II	Immunology and Molecular Techniques	-	-	6	6	72	9	40	60	100	3
25MBP2DA	DSE - II	Bionanotechnology	3	1	-	4	48	3	25	75	100	3
25BCP2DA		Biochemistry of Toxicology										
25BTP2DA		Forensic Biotechnology										
Total			**21**	**3**	**6**	**30**	**360**	-	-		**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Third Semester												
25MBP3CA	Core - XI	Environmental and Agricultural Microbiology	4	-	-	4	48	3	25	75	100	4
25MBP3CB	Core - XII	Medical Mycology and Parasitology	4	-	-	4	48	3	25	75	100	4
25MBP3CC	Core - XIII	Pharmaceutical Microbiology and Quality Assurance	4	-	-	4	48	3	25	75	100	4
25MBP3CD	Core - XIV	Food Microbiology and Food Quality Control	4	-	-	4	48	3	25	75	100	4
25MBP3CE	Core - XV	Research Methodology and Biostatistics	3	1	-	4	48	3	25	75	100	3
25MBP3CP	Core Practical - III	Applied Microbiological Techniques	-	-	6	6	72	9	40	60	100	3
25MBP3CT	IT	Internship	-	-	-			-	40	60	100	2
25MBP3DA	DSE - III	Medical Laboratory Techniques	3	1	-	4	48	3	25	75	100	3
25BCP3DA		Free Radicals and Antioxidant System										
25BTP3DA		Molecular Therapeutics										
		Total	**22**	**2**	**6**	**30**	**360**	-	-	-	**800**	**27**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Fourth Semester												
25MBP4CA	Core - XVI	Fermentation Technology	4	1	-	5	60	3	25	75	100	3
25MBP4CB	Core - XVII	Bioethics, Biosafety and IPR	4	1	-	5	60	3	25	75	100	3
25MBP4CV	Core - XVIII	Project and Viva - voce	-	-	16	16	192	-	80	120	200	8
25MBP4DA	DSE - IV	Molecular Diagnostics and Bioinformatics	3	1	-	4	48	3	25	75	100	3
25BCP4DA		Neurobiology										
25BTP4DA		Stem Cell Technology										
Total			**11**	**3**	**16**	**30**	**360**				**500**	**17**
		***Grand Total**									**2700**	**92**

EXTRA CREDITS COURSES

Self study paper offered by the Department of Microbiology

S. No.	Semester	Course Code	Course Title
1.	III	25MBPSSA	Good Manufacturing Practices
2.		25MBPSSB	Introduction to Human Anatomy

Semester – I

CORE: FUNDAMENTALS OF MICROBIOLOGY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	25MBP1CA	FUNDAMENTALS OF MICROBIOLOGY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • History of Microorganisms • Basic techniques in Microbiology • Characteristics of algae, fungi, protozoa and viruses.
Prerequisite	Knowledge on general characteristics and classification of microorganisms.

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the theories to understand the importance of microorganisms.	K2
CO2	Apply the principles of sterilization and disinfection. Make use of the types of Media.	K3
CO3	Compare and contrast the principles of Microscopy	K2
CO4	Compare and understand the characteristics of algae, fungi and protozoa.	K3
CO5	Compare and understand the characteristics of viruses.	K3

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓				
CO2	✓	✓	✓	✓	✓
CO3		✓		✓	✓
CO4	✓	✓			
CO5	✓	✓			

25MBP1CA - FUNDAMENTALS OF MICROBIOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**History of Microbiology:** The Historic foundations and development of Microbiology - Spontaneous generation- Germ theory of diseases – Cell theory – Contributions of Antony van Leuwenhoek – Joseph Lister – Robert Koch – Louis Pasteur – Edward Jenner – John Tyndall – Sergei N. Winogradsky – Salmon A. Waksman – Alexander Flemming - Paul Erlich – Fannie Hessie – Elie Metchnikoff, Lederberg and Zinder, Lwoff, Arber and Smith, Temin and Baltimore - Scope of microbiology.	10	Text book 1
II	**Sterilization and culturing methods:** Sterilization and disinfection - Physical and chemical methods. Culturing of Bacteria – Isolation, purification and Cultivation of different types of Microorganisms -Aerobes and Anaerobes - Culture maintenance and Preservation - Culture Collection centres -ATCC, MTCC and NFMC.	10	Text book 2
III	**Microscopy and Staining:** Principles of Microscopy- Light microscope, Inverted microscope, Electron microscope – TEM and SEM, Polarization microscope, Confocal, Perfocal, Atomic force microscope. Stains and staining principles: Simple, Gram, Negative, Capsule, Spore, Flagellar and Acid fast staining.	10	Text book 1
IV	**Prokaryotes:** Characteristics of Prokaryotic cells – Basic cell types: Prokaryotic cells – Size, shape andArrangement – Overview of structure – Cell membrane. Internal membrane structure – Cytoplasm- Nucleoid – Inclusions - chlorosomes – carboxysomes - magnetosomes - phycobilisomes -Endospores. External structure – Cell Wall - Flagella and its function – Glycocalyx – Slime layer.	9	Text book 2
V	**Protozoa, Viruses, Fungi and Algae:** General Characteristics of Protozoa. Structure and Reproduction of Paramecium sp. General Properties of Viruses. Cultivation of Plant and Animal Viruses. Characterization and Enumeration of Viruses-Plant Viruses- CaMV and RNA containing Plant Viruses- TMV. General characteristics of algae- Structure and reproduction of Chalmydomonas sp. General characteristics of fungiStructure and reproduction of *Aspergillus niger.*	9	Text book 2
	Total	**48**	

Text Book	1.	Black J G, 2015, Microbiology, 9th Edition, John Wiley and Sons, New Jersey, United States
	2.	Joanne Wiley, Linda Sherwood, Christopher J and Woolverton, 2020, Prescott's Microbiology, 11th Edition, McGraw Hill Company, New York, United States.
Reference Books	1.	Micheal T Madigan, 2018, Brock Biology of Microorganisms, 14th Edition, Pearson Education, New Delhi
	2.	Jeffrey C Pommerville, 2010, Alcamo's Fundamentals of Microbiology, 9th Edition, Jones and Bartlett Publishers, Massachusetts, United States
	3.	Salle A J, 2014, Fundamental Principles of Bacteriology, 7th Edition, Tata Mc Hill Publishing Company Ltd., New Delhi
	4.	Michael Pelczar, 2021, Microbiology, 5th Edition, Tata Mc Hill Publishing Company Ltd., New Delhi.

Journal and Magazines	https://agrimoon.com/wp-content/uploads/Fundamentals-of-Microbiology.pdf
E-Resource and Websites	https://www.basu.org.in/wp-content/uploads/2020/03/Fundamentals-of-Microbiology-1.pdf

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/ Employability

Semester – I

CORE: MICROBIAL PHYSIOLOGY AND BACTERIAL DIVERSITY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	25MBP1CB	MICROBIAL PHYSIOLOGY AND BACTERIAL DIVERSITY	Core	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The physiological, biochemical and metabolic properties of Microorganisms. • The respiratory and nutritional pathways of microorganisms. • The significance of Bacterial diversity.
Prerequisite	Basic characteristic features and diversification among microorganisms

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	To discuss the nutritional classification of microorganisms based on carbon, energy and electron sources.	K3
CO2	To comprehend nomenclature, classification, kinetics and types of enzymes with an emphasis on nature of enzyme Inhibitions.	K4
CO3	To confer the significance of different pathways of carbohydrate metabolism.	K3
CO4	To acquire the knowledge on the concepts of biosynthesis of amino acids, nucleotides, fatty acids and cell wall of Gram positive and Gram negative bacteria.	K2
CO5	To outline the diversified classes among bacteria.	K5

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25MBP1CB - MICROBIAL PHYSIOLOGY AND BACTERIAL DIVERSITY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Nutrition and Growth:** Nutritional types of microorganisms - Phototrophs, Autotorphs, Lithotrophs, Organotrophs. Nutritional requirements -Macro, Micro nutrients and trace elements. Membrane transport – passive, facilitated diffusion, active transport (Proton Motive force, PTS, role of permeases), group translocation and ion uptake. Factors affecting Microbial growth – Temperature, pH, Osmosis, Pressure, Oxygen and Radiation. Physiology of Growth – Growth curve. Growth measurements – batch, continuous and synchronous.	10	Text book 1 Reference Book Journals
II	**Enzymes and co-enzymes:** IUBMB classification and nomenclature of enzymes, active site, Lock and key Mechanism and induced fit hypothesis, Enzyme kinetics - negative and positive. Enzyme inhibition: Reversible – Competitive, Non-competitive, uncompetitive and irreversible inhibition - Feedback inhibition. Regulatory and Allosteric enzymes.	9	Text book 1 Reference Book
III	**Energy Production pathways:** EMP pathway - Substrate level Phosporylation - HMP Pathway –Entner Doudroff pathway - Glyoxalate pathway - Krebs cycle. Energy production: Electron transport chain and Oxidative phosporylation, Pasteur Effect, Bioluminescence. Fermentations of Carbohydrates: Acidic: Homolactic, Mixed acid, Butanediol and Propionic acid fermentation. Alcoholic fermentation: Ethanol. β – Oxidation of Fatty acids.	10	Text book 1 Reference Book Journals
IV	**Biosynthesis of Biomolecules:** Biosynthesis of Aspartate, pyruvate, histidine and serine amino acid families - Purine and pyrimidine nucleotides - Denovo and salvage pathway. Biosynthesis of fatty acids and lipids. Biosynthesis of gram positive and gram negative cell wall.	9	Text book 1 Reference Book
V	**Bacterial Diversity:** Introduction to Archaea – Ecology, Cell walls and membranes, Genetics and molecular biology, metabolism. Archaeal taxonomy – Outline characteristics – Crenarchaeota and Euryarchaeota. Methylotrophs – Methanogens. Eubacteria - Photosynthetic bacteria, Cyanobacteria – Spirochaetes - Bacteroidetes. Characteristics of Proteobacteria: Alpha (Rickettsia), Beta (Neisseria), Gamma (Pseudomonas), Delta (Desulfovibrio) and Epsilon (Helicobacter). Low G+C gram positive (Staphylococcus) and High G+C gram positive (Mycobacterium). Case study on Profiling of Microbial Community from different soil.	10	Text book 1 Reference Book Journals
	Total	**48**	

Text Book	1.	Joanne Wiley, Linda Sherwood, Christopher J and Woolverton, 2016, Prescott's Microbiology, 10th Edition, Mc Graw Hill Company.
Reference Books	1.	David White and George D. Hageman, 2000, Microbial Physiology and Biochemistry Laboratory, Oxford University Press, India.
	2.	Moat. A.G, J.W.Foster, 2002. Microbial physiology. 4th edition. John Wiley & sons. Australia.
	3.	Demain A.J. and Solomon INA, 1999. 2nd edition. Manual of Industrial Microbiology and Biotechnology, ASM press.USA.
	4.	Geoffrey Michael Gadd, 2008, Bacterial Physiology and Metabolism, Cambridge University Press, UK.

Journal and Magazines	https://www.frontiersin.org/journals/microbiology/sections/microbial-physiology-and-metabolism https://journals.plos.org/plosone/
E-Resource and Websites	https://onlinecourses.swayam2.ac.in/cec21_bt17/preview

Learning Methods	Chalk and Talk/ PPT / Seminar/ Assignment

Focus of the Course	Skill Development/Employability

Semester – I

CORE: MYCOLOGY, PHYCOLOGY AND LICHENOLOGY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	25MBP1CC	MYCOLOGY, PHYCOLOGY AND LICHENOLOGY	CORE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • To acquire knowledge of the diversity of Fungi, Algae, and Lichens • To gain knowledge on the structural organization and reproduction • To obtain knowledge on the importance of Fungi, Algae, and Lichens
Prerequisite	Knowledge on types and characteristics of microorganisms

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	To introduce diversity, classification and characteristics and acquire knowledge on economic quality of fungi	K4
CO2	To understand the organization and reproduction process of fungi	K3
CO3	To introduce classification, characteristics, and economic quality of algae	K4
CO4	To understand the organization, reproduction, cultivation and various roles of algae in the environment	K4
CO5	To grasp the basic characteristics, classification and economic importance of lichens	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓		✓

25MBP1CC - MYCOLOGY, PHYCOLOGY AND LICHENOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Classification and Characteristics of Fungi:** Classification of fungi (Alexopoulos and Mims, 1979). Recent trends in classification of fungi. General characters of major classes: Mastigomycotina, Schizomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Phylogeny and interrelationships of major groups of fungi. Economic importance of fungi.	10	Text book 1
II	**Organization and Reproductions of Fungi:** Thallus organization - reproduction, life cycle types, parasexual cycles, reduction in sexuality in fungi - physiological races in fungi - spore dispersal mechanisms and fungal genetics, study of fossil fungi.	10	Text book 2 Reference Book
III	**Classification And Characteristics of Algae:** Classification of algae (Fritsch, 1945). Salient features of major classes: Chlorophyta, Cyanophyta, Charophyta, Xanthophyta, Phaeophyta and Rhodophyta. Ultrastructure of prokaryotic and eukaryotic algal cells and their components. Economic importance of algae.	8	Text book 1 Reference Book E-book chapters
IV	**Ecology, Cultivation and Life Cycle Patterns of Algae:** Ecology of algae - algae as pollution indicators, algal blooms, algicides - culture and cultivation of fresh water and marine algae - Knop's solution and Chu-10 medium (1972). Origin and evolution of sex in algae, phylogeny and interrelationships of algae. Lifecycle patterns in algae. Study of fossil algae.	10	Text book 1 Reference Book E books
V	**Classification and characteristics of Lichens:** Classification of Lichens (Hale, 1969). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens, and Deuterolichens. Lichens as indicators of pollution. Economic importance of Lichens. Case Study- Algal diversity and algal bloom in water bodies of your native city or state.	10	Text book 2 Reference Book Journals
	Total	**48**	

Text Book	1.	Michael Madigan, 2015, Brock Biology of Microorganisms, 14th Edition, Pearson Publishers, New Delhi
	2.	Vashishta BR, Sinha AK, Singh VP, 2010, Botany for Degree students Algae, 1st Edition, S Chand &Company Ltd. India
Reference Books	1.	Alexopoulos CJ, Mims CW, Blackwell M, 2002, Introductory Mycology, 4th Edition, Wiley India Pvt. Ltd, India
	2.	Moore D, Robson GD, Anthony P, Trinci J, 2011, 21st Century Guidebook to Fungi, Cambridge University Press, United Kingdom
	3.	Thomas H. Nash, 2008, Lichen Biology, 2nd Edition Cambridge University Press, India
	4.	Ernst Athearn Bessey, 2020, Morphology and taxonomy of fungi, 1st Edition, Alpha Edition Publishers, India

Journal and Magazines	archive.bio.ed.ac.uk/jdeacon/microbes/fungalwe.html
E-Resource and Websites	https://gclambathach.in/lms/Algae.pdf https://gclambathach.in/lms/Algae.pdf

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/Employability/Social Awareness and Environment

Semester – I

CORE: COMPREHENSIVE BIOLOGY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	25MBP1CD	COMPREHENSIVE BIOLOGY	CORE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The structure and function of biomolecules • The basic concepts of developmental biology and cell signalling • The evolution of living cells.
Prerequisite	Knowledge on fundamentals of cell biology.

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the importance of biological molecules.	K3
CO2	Cognize the basic concepts of developmental biology.	K3
CO3	Critically understand the idea on how a cell responds to external stimulus.	K3
CO4	Understand the inheritance of chromosomes.	K3
CO5	Cognize the formation and evolution pattern exhibited till date by living organisms over different time frames.	K3

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	

25MBP1CD - COMPREHENSIVE BIOLOGY
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	Structure of atoms, molecules and chemical bonds: Composition, structure and function of bio-molecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc.). Principles of biophysical chemistry (pH, buffer, thermodynamics, colligative properties). Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).	10	Text book 1
II	Basic concepts of developmental biology: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; fertilization and early development.	10	Text book 2
III	Cell Signaling: Cell signaling - Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.	10	Text book 1
IV	Inheritance biology: Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.	9	Text book 2
V	Evolution: Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch. Case Study 1: Is there a scenario, where, within the earth, there are locations mimicking the ancient timelines with regards to temperatures (when the globe was formed from the sun due to explosion). If so, are we still witnessing abiotic synthesis even today?	9	Text book 2
	Total	**48**	

Text Book	1.	Dr. A. P. Singh & Kumar Pushkar, 2021, Upkar CSIR-UGC NET/JRF/SET Life Sciences, 1st Edition, Upkar Prakashan publishers, India.
	2.	Quaisher J. Hossain, Prashant Kumar, Ashish Nagesh, 2018, UGC CSIR NET / SLET (JRF & LS) Life Sciences, 4th Edition, Arihang Publications
Reference Books	1.	Pranav Kumar & Usha Mina, 2020, Pathfinder Academy: CSIR-JRF-NET Life Sciences Book Combo Set with Ecology, 1st Edition, Pathfinder Publication.
	2.	De Robertis, E. D. P, 2017, Cell and Molecular Biology, 8th Edition, Lea & Febiger, New York.
	3.	Van De Graaff, R. Ward Rhees, Sidney L. Palmer, 2013, Schaum's Outline of Human Anatomy and Physiology, 4th Edition, Mcgraw-Hill Companies, New York.
	4.	Michael Pelczar, 2021, Microbiology, 5th Edition, Tata Mc Hill Publishing Company Ltd., New Delhi.

Journal and Magazines	https://www.thebiomics.com/notes/csir/unit-11
E-Resource and Websites	Previous Year NET Life Sciences Question Paper | EasyBiologyClass

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/ Employability/ Innovations

Semester – I

CORE: BIO ANALYTICAL TECHNIQUES

Semester	Course Code	Course Name	Category	L	T	p	Credits
1	25MBP1CE	BIO ANALYTICAL TECHNIQUES	Core	36	12	-	3

Preamble	This course has been designed for students to learn and understand • To comprehend the principle and instrumentation of diverse instruments for • Microbiology • To procure knowledge on the working methods of different instruments • To appreciate its application in diverse fields
Prerequisite	Knowledge on bioinstrumentation

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	To understand the principles, instrumentation with an emphasis on applications of Analytical centrifuge.	K3
CO2	To become equipped with the operational principle and working methods of spectral instruments	K2
CO3	To procure knowledge on the principles and techniques of various types of electrophoresis	K3
CO4	To acquaint the concept of radioactivity and its types of decay	K3
CO5	Application of knowledge for the characterization of Biomolecules	K2

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25MBP1CE - BIO ANALYTICAL TECHNIQUES

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Centrifugation and Chromatography:** Centrifugation: Principles and types - Low speed, High speed and Ultra centrifuge. Applications of Analytical Ultra Centrifugation – Determination of Molecular weight and purity of macromolecules. Chromatography: Instrumentation, detection methods and Applications of TLC, Column, Gas, Ion Exchange, HPLC, Gel Filtration, GCMS and LCMS.	10	Text book Reference Book Journals
II	**Colorimetry and Spectrometry:** Colorimetry: Principles, Instrumentation, Application and Analysis – Qualitative and Quantitative. Spectrophotometry: Principles, Instrumentation and Applications of UV, Visible, IR, NMR, FTIR, Atomic absorption, Mass Spectroscopy and MALDI – TOF, Spectrofluorometry and Flame Photometry	9	Text book Reference Book
III	**Electrophoresis:** Principles and Instrumentation - Separation of Nucleic acids – Agarose Gel Electrophoresis, Electrophoresis of RNA, Capillary Electrophoresis and Microchip Electrophoresis. Separation of Proteins – SDS – PAGE, Native Gel, Gradient Gel, Iso Electric Focusing, 2D Page, Cellulose Acetate Electrophoresis, Western Blotting - Detection, Estimation and Recovery of Proteins in gel.	10	Text book Reference Book
IV	**Radiometry:** Introduction - Detection and Measurement of Radioactivity –Detection based on gas ionization - Autoradiography and its applications – Scintillation Counting - Safety Aspects – Biosensors and its applications (DNA and Immunosensors).	9	Text book Reference Book
V	**Quantification Methods for Biomolecules:** Quantitative determination of Macromolecules: Carbohydrates (DNSA and Anthrone method), Lipids (Gravimetric), Protein (Lowry and Bradford method). Determination of Molecular weight of protein (MS and SDS-PAGE) and DNA (Agarose gel). Estimation of Microbial pigments: Chlorophylls and Carotenoids. Case study - Collect the various plant leaves from our college campes and analyze their compounds using chromatography techniques.	10	Text book Reference Book Journals
	Total	**48**	

Text Book	1.	L Veerakumari, 2011, Bioinstrumentation, First Edition, MJB Publishers.
Reference Books	1.	Keith Wilson and John Walker, 2010, Principles and Techniques of. Biochemistry and Molecular Biology, Seventh edition, Cambridge University Press
	2.	Plummer .T David, 2004, An Introduction to Practical Biochemistry, Third Edition, TMH Publishers
	3.	Rodney Boyer, 2000, Modern Experimental Biochemistry, Third Edition, Pearson education Publishers
	4.	Swahney S K and Singh R, 2014, Introductory Practical Biochemistry, Narosa Publishing House

Journal and Magazines	http://www.omicsonline.org/analytical-bioanalytical-techniques.php
E-Resource and Websites	https://www.aminotes.com/2017/09/bioanalytical-techniques-study-material.html

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/Employability/Entrepreneurship

25MBP1CP	CORE PRACTICAL: BASIC TECHNIQUES IN MICROBIOLOGY	SEMESTER I

Total Credits: 3
Total Instructions Hours: 72 h

S.No	Contents
1	Bacterial Staining techniques - Gram, Acid-fast, Spore, Capsule and Negative Staining.
2	Morphological observation of Fungi –LPCB Mount.
3	Micrometry – Measurement of Microorganisms.
4	Motility determination- Hanging drop and soft agar inoculation.
5	Enumeration of Microorganisms from soil: Bacteria, Fungi and Actinomycetes.
6	Determination of Bacterial generation time - Direct microscopic method and turbidity method
7	Effect of various intrinsic factors on the growth of bacterium – pH, Temperature
8	IMViC test, Hydrogen sulphide test, Oxidase test, Calalase test, Urease test
9	Preferential utilization of sugar - Carbohydrate fermentation & TSI; Polymer degradation – Starch, Casein
10	Quantitative determination of Sugar by DNSA method and Protein by Lowry et al method
11	Separation techniques: Chromatography- TLC and Column.
12	Microscopic observation of Algae and Lichen thallus

Note: Out of 12–10 Mandatory

References

1 *James Cappuccino, Natalie Sherman,* 2013, **Microbiology: A Laboratory Manual**, *10th Edition, Pearson Publishers*

2 *Aneja. K.R,* 2012. **Experiments in Microbiology**, *Plant Pathology and Biotechnology, 2nd edition. New age publisher*

3 *Rajan S. Selvi Christry.R, Experimental Procedures in Lifesciences, CBS Publishers & Distributors Pvt Ltd*

4 *Kannan, N,* 1997, **Laboratory Manual of General Microbiology**, *1st Edition, Panima Publishing house*

Semester – I

DSE I: MICROBIAL TECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	p	Credits
I	25MBP1DA	MICROBIAL TECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The production of Sustainable products using Microorganisms. • The importance of Microorganisms in Pharmaceutical sector. • How to explore the ideas in commercial level
Prerequisite	Knowledge on microbial products and their mass production

Course Outcomes (Cos)

CO Number	Course Outcomes (Cos) Statement	Bloom's Taxonomy Knowledge Level
CO1	Inculcate about microbial products and its scale up production through establishing a small scale industry	K2
CO2	Exemplify the ideas about the production and uses of Biofuel and Biofertilizer.	K3
CO3	Demonstrate the commercial production of Biopolymers using Microorganisms.	K4
CO4	Understand the way of cells and enzymes were immobilized for industrial uses.	K3
CO5	Explore the pharmaceutical products and possibilities of converting it to a commercial product.	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2	✓	✓		✓	✓
CO3	✓		✓	✓	✓
CO4	✓		✓		✓
CO5	✓	✓		✓	✓

25MBP1DA: DSE- MICROBIAL TECHNOLOGY
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Single Cell Protein and its Economic Aspects:** Bacterial, Yeast, Fungal and Algal Proteins –Brewer's and Baker's yeast – Food and Fodder yeast – Mushroom (Agaricus, Oyster) and Products from Higher fungi (*Ganoderma lucidum*).	9	Text book Reference Book Journals
II	**Production of Biofuel & Biofertilizer:** Production, Methods and Uses of Bioethanol (*S. cerevisiae*) – Biodiesel (*Chlorella*) – Biohydrogen (*Chlamydomonas*) – Biogas (Methanobacteria). Biofertilizer - N_2 fixing, Phosphate Solubilizing, Phosphate Mobilizing, Plant Growth Promoting Rhizobacteria - Mass production and Applications.	9	Text book Reference Book
III	**Biopolymer production:** Production and Uses of Polyhydroxybutyrate (PHB) – Xanthan – Alginate – Cellulose –Cyanophycin – Levan - Melanin - Welan - Succinoglucan- Curdlan- Chitosan -Polyhydroxyalkanoates - Hyaluronic acid.	9	Text book Reference Book
IV	**Immobilization of Cells & Enzymes:** Cells – Surface attachment of cells – Entrapment - Hydrogel method, Preformed support materials – Containment behind a barrier: Microencapsulation, Immobilization using membranes – Self aggregation of cells –Methods for Enzyme immobilization – Carrier binding method, Intermolecular cross linking – Applications of Immobilized cells and Enzymes.	10	Text book Reference Book
V	**Microbial products with pharmaceutical importance**: Vaccines – Steps of Manufacturing – Growing the microbes and separation – Preparation of Live and killed vaccine – Preparation of Toxoid and uses – BCG Vaccine – Cholera vaccine – Rabies vaccine – Diptheria toxoid. Pharmaceutical industry - certification & accreditation required. Bioentreprenurship opportunities and Funding sources - Government funds, Venture capital, NGOs, Crowd funding and Incubation centers. Antimicrobial compounds from soil microbes -Case study	11	Text book Reference Book Journals
	Total	**48**	

Text Book	1.	Patel A H, 2012, Industrial Microbiology, 2nd Edition, Trinity Press, New Delhi
Reference Books	1.	El-Mansi E M T, Bryce C F A, Dahhou B, Sanchez S, Demain A L and Allman A R, 2012, Fermentation Microbiology and Biotechnology, 3rd Edition, CRC Press, USA
	2.	Bernard R Glick, Jack J Pasternek and Cheryl L Patten, 2010, Molecular Biotechnology -Principles and Applications of Recombianant DNA, 4th Edition, ASM Publishers, USA]
	3.	Nidhi Goel, 2013, Pharmaceutical Microbiology, 1st Edition, Narosa Publishing House, New Delhi.
	4.	Puvanakrishnan R, Sivasubramanian S and Hemalatha T, 2012, Microbial Technology -Concepts and Applications, 1st Edition, MJP Publishers, New Delhi

Journal and Magazines	https://link.springer.com/ https://aem.asm.org/
E-Resource and Websites	https://www.microbialbiotechnology.com/ https://www.asmscience.org/content

Learning Methods	Chalk and Talk/ Seminar/ Assignment

Focus of the Course	Skill Development/Employability/Entrepreneurial Development/Innovations/Intellectual Property Rights

Semester – I DSE I: CANCER BIOLOGY, DIAGNOSIS AND THERAPY							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	**25BCP1DA**	**CANCER BIOLOGY,DIAGNOSIS AND THERAPY**	**DSE**	**36**	**12**	**-**	**3**

Preamble	This course has been designed for students to learn and understand • Molecular basis of cancer, mutations causing cancer, and repair mechanisms • The basic principles of cancer development and available therapeutic options • The different diagnostic and treatment methods for cancer.
Prerequisite	Basic Knowledge on Cell Biology

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Compare and contrast benign and malignant tumors and the morphological characteristics of cancer cells.	K4
CO2	Justify the molecular basis of cancer. Distinguish interdisciplinary areas in cancer biology.	K5
CO3	Evaluate the molecular mechanism of oncogenesis, tumor biology and the role of cell cycle in cancer	K5
CO4	Validate the role of tumor suppressor genes and apoptosis. Explain about epigenetics.	K5
CO5	Summarize on the choice of diagnosis and therapy available for cancer patients.	K6

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BCP1DA | CANCER BIOLOGY, DIAGNOSIS AND THERAPY

Syllabus

Unit	Content	Hrs	Resources
I	**Introduction** Cancer cell-morphology and growth characteristics. Metastasis and cytoskeleton. Apoptosis. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Differences between benign and malignant tumors.	9	Text Book
II	**Carcinogenesis** Cancer epidemiology and endocrinology. Cancer causing agents-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Para-neoplastic syndromes. Mutation-definition, significance, rates and frequency. Mutagenic agents. Molecular basis of mutagenesis: induced and spontaneous mutations, crossing over and segregation. Cancer genetics. Chemical carcinogenesis- genetic and epigenetic carcinogens, pro-carcinogens and co- carcinogens, promoters and initiators, testing for carcinogenecity, Ames test. Aberrant metabolism during cancer development.	9	Reference Book
III	**Tumor Markers and Signal Transduction** Oncogenes - RNA and DNA tumor viruses, retroviruses and viral oncogenes and abrupt activation. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- protooncogenesis, oncoproteins, tumor suppressor genes involved in cancer. Radiation- effect of ionizing radiations on DNA, chromosomal aberrations. Cancer Markers: Genetic basis of cancer, use of tumor markers in detection and monitoring of cancer. Signal transduction in cancer: cell-cell interactions, cell adhesion, invasion and metastasis, VEGF signalling and angiogenesis; role of transcription factors. Growth factors- EGF, TNF-α and TGF-β and growth factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.	10	Reference Book
IV	**Cell Cycle, Cell Death and Cancer** Cell Cycle Regulation cancer: control of the cell cycle - cyclins and CDKs, and tumor suppressor genes p53, p21Rb, BRAC1 and BRAC2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing- epigenetic silencing of tumor - suppressor genes.	10	NPTEL
V	**Cancer Diagnosis and Cancer Therapy, Stem Cells and Cancer** Principles and methods of cancer diagnosis - biochemical, genetic, cytotoxic, cell growth and viability tests. Diagnosis of cancer by histopathology, MRI scans, PET scan, cytogenetics test, kariotype, FISH. Strategies of anticancer drug therapy– chemotherapy, gene	10	You Tube Videos

	therapy, immuno therapy, radiotherapy and surgical therapy. Principles of cancer biomarkers and their applications.		
	Total	**48**	

	Note: Case studies related to the above topics to be discussed (Examined Internal only)

Text book	1.	Mc Kinnell R.G et al, 2012, "The Biological Basis of Cancer", Second edition, Cambridge University Press, London.
	2.	Weinberg R.A, 2014, "The Biology of Cancer", Second edition, Garland Science, New York & London.
Reference Books	1	Vincent T. De Vita M. D et al, 2020, "Principles and Practice of Oncology: Primer of Molecular Biology in Cancer", Third edition, Lippincott Williams and Wilkins, Philadelphia.
	2.	Pelengaris S and Khan M, 2010, "The Molecular Biology of Cancer - A bridge from bench to bed side", Second edition, Wiley Black well, London
	3.	Hesketh R, 2013, "Introduction to Cancer Biology", First edition, Cambridge University Press, London.
	4.	Pezzella F et al, 2019, "Oxford textbook of Cancer Biology", First edition, Oxford University Press, London.

Journal and Magazines	https://www.tandfonline.com/toc/kcbt20/current https://journals.lww.com/amjclinicaloncology/pages/default.aspx
E-Resources and Website	https://www.cancer.gov>research>resources; https://nptel.ac.in

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion/Case Study

Focus of the Course	Skill Development/ Employability

Semester - I
DSE I: APPLIED BIOTECHNOLOGY

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	25BTP1DA	APPLIED BIOTECHNOLOGY	DSE	36	12	-	3

Preamble	This course has been designed for students to learn and understand • The applications of biotechnology in plant, animal and Environmental field the basic concept of sequence and series • The applications of biotechnology in health care sector • The products obtained from fermentation and its applications
Prerequisite	Knowledge on Applied Biotechnology

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the fundamental applications of Biotechnology	K2
CO2	Know the basics and fundamentals of biotechnology applications in environment	K2
CO3	Discuss about the disease and disease prevention	K3
CO4	Discuss the applications of Enzymes in various fields	K4
CO5	Discuss the production and application of products obtained from fermentation technology	K2

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2	✓		✓	✓	✓
CO3			✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

25BTP1DA	DSE: APPLIED BIOTECHNOLOGY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Agricultural, Plant Biotechnology and Animal Biotechnology:** Applications of transgenic crop technology: Herbicide resistance (Glyphosate Resistance plants), Pest resistance (Bt Cotton) and Virus Resistance. Enhancement of micro-nutrients (Vitamin A). Delayed Fruit Ripening. Molecular pharming in plants. Transgenic animals (Transgenic mice and Transgenic cattle). Production and recovery of products from animal tissue cultures (Blood clotting factors, Growth hormones, insulin)	10	Text Book - 1
II	**Environmental Biotechnology:** Bioremediation- (Bioaugmentation and Biostimulation). Biodegradation of Xenobiotic componds. Bioleaching. Microbially Enhanced Oil Recovery. Biotechnological methods for hazardous waste management. Bioindicators –Biomarkers –Biosensors – Management of effluent toxicity, heavy metal pollution, thermal and radioactive pollution	08	Reference Book - 2
III	**Health Care Biotechnology:** Disease prevention – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines, DNA vaccines, synthetic vaccines. Disease Diagnosis – Probes, monoclonal antibodies and detection of genetic diseases. Disease treatment – interferons, monoclonal antibodies. Gene therapy, enzyme therapy and replacement. Forensic medicine.	10	Reference Book -3
IV	**Enzyme Biotechnology:** Enzymes used for diagnostic purpose- (acid phosphatase, alanine aminotransferase and alkaline phosphatase). Cardiac Biomarkers. Enzymes used for screening liver and kidney diseases. Enzymes used in food industry, leather industry, wool industry, dairy industry and textile industry.	10	Referece Book – 2 and NPTEL
V	**Fermentation Biotechnology:** Production, harvest, recovery and uses – enzymes, antibiotics (Tetracycline), vitamins (B2), aminoacids (glutamic acid), organic solvents (ethanol); organic acids (lactic acid). Single cell protein (algae), beverages (Wine). Formulation of Biofertilizer (Rhizobium), Biopesticides.	10	You Tube Videos and Reference Book - 4
	Total	**48**	

Text Book	1.	Bernard R Glick and Jack J Pasternak, 2010, "Molecular Biotechnology: Principles and Applications of recombinant DNA", 4th Edition, ASM Press
Reference Books	1.	Marwaha S S & Arora K, 2000, "Food processing: Biotechnological application", Asiatech Publishers INC, New Delhi.
	2.	Palmer T, Bonner PLR, 2014, "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 2nd Edition, Woodhead Publishing Limited, Oxford..
	3.	Owen, Jenni Punt and Sharon A Stranford, 2013, "Kuby Immunology",7th Edition, W.H. Freeman and Company, New York.
	4.	Stanbury PF and Whitaker A, 2007, "Fermentation microbiology and Biotechnology", 2nd Edition, Taylor and Francis.

Journal and Magazines	https://www.macrothink.org/journal/index.php/jab, https://link.springer.com/journal/12010
E-Resources and Website	https://www.keaipublishing.com/en/journals/biotechnology-notes/ https://www.drishtiias.com/to-the-points/paper3/biotechnology-and-its-applications https://nptel.ac.in

Learning Methods	Chalk and Talk/Assignment/Seminar

Focus of the Course	Entrepreneurial Development /Employability