

M.Sc., Microbiology (Students admitted from 2017-18 and onwards)

MASTER OF SCIENCE IN MICROBIOLOGY

SYLLABUS: 2017-18 Onwards



Dr. N.G.P ARTS AND SCIENCE COLLEGE (Autonomous)
(Re-Accredited with A Grade by NAAC)
(Affiliated to Bharathiar University,)
Dr. N.G.P. Nagar - Kalapatti Road
Coimbatore-641 048

MASTER OF SCIENCE IN MICROBIOLOGY

REGULATIONS

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.

OBJECTIVE OF THE COURSE

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

- Present intense knowledge in areas of organization and functioning of micro-organisms.
- Familiarize with the operations of bio instruments and related techniques.
- Enable students to understand the applications of microbiology in healthcare, agriculture, food technology & environmental protection.
- Provide opportunities to develop skills and participate in Research projects.

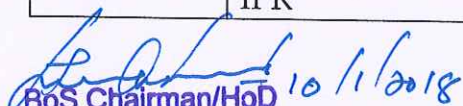
Programme Outcomes

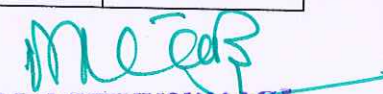
On the successful completion of the programme, the following are the expected outcomes.

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.

SCHEME OF EXAMINATIONS

Subject Code	Subject	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
17PMB13A	CORE- I: PRINCIPLES OF MICROBIOLOGY	5	3	25	75	100	5
17PMB13B	CORE - II: MICROBIAL DIVERSITY	5	3	25	75	100	5
17PMB13C	CORE - III: MICROBIAL PHYSIOLOGY	5	3	25	75	100	5
17PMB13D	CORE - IV: BIOINSTRUMENTATION	5	3	25	75	100	5
17PMB13P	CORE PRACTICAL- I	5	9	40	60	100	2
	ELECTIVE- I :	5	3	25	75	100	4
		30				600	26
Second Semester							
17PMB23A	CORE - V: MICROBIAL GENETICS AND MOLECULAR BIOLOGY	4	3	25	75	100	4
17PMB23B	CORE - VI: VIROLOGY	4	3	25	75	100	4
17PMB23C	CORE - VII: GENETIC ENGINEERING	4	3	25	75	100	4
17PMB23D	CORE - VIII: ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	4	3	25	75	100	4
17PMB23E	CORE - IX: BIOETHICS, BIOSAFETY AND IPR	4	3	25	75	100	4


 BoS Chairman/HoD 10/11/2018
 Department of Microbiology
 Dr. N. G. P. Arts and Science College
 Coimbatore - 641 048


 Dr. P. R. MUTHUSWAMY,
 PRINCIPAL
 Dr. NGP Arts and Science College
 Dr. NGP - Kalapatti Road
 Coimbatore - 641 048
 Tamilnadu, India

M.Sc., Microbiology (Students admitted from 2017-18 and onwards)

17PMB23P	CORE PRACTICAL- II	6	9	40	60	100	3
	ELECTIVE- II:	4	3	25	75	100	4
		30				700	27
Third Semester							
17PMB33A	CORE - X: PRINCIPLES OF IMMUNOLOGY	4	3	25	75	100	4
17PMB33B	CORE - XI: BIOPROCESS TECHNOLOGY	4	3	25	75	100	4
17PMB33C	CORE - XII: BIOTECHNOLOGY	4	3	25	75	100	4
17PMB33D	CORE - XIII: MEDICAL MICROBIOLOGY	4	3	25	75	100	4
17PMB33E	CORE - XIV: BIOSTATISTICS AND RESEARCH METHODOLOGY	4	3	25	75	100	4
17PMB33P	CORE PRACTICAL- III	6	9	40	60	100	3
	ELECTIVE - III:	4	3	25	75	100	4
17PMB33T	INTERNSHIP TRAINING	A to C					
		30				700	27
Fourth Semester							
17PMB43V	CORE- PROJECT AND VIVA VOCE	25	-	75	75	150	8
	ELECTIVE - IV:	5	9	40 / 25	60 / 75	100	2
		30				250	10
TOTAL						2250	90

ELECTIVE - I

(Student shall select any one of the following Course as Elective - I in first semester)

S.No	Course Code	Name of the Course
1.	17PMB1EA	Principles of Quality Assurance
2.	17PMB1EB	Basics in Plant Science

ELECTIVE - II

(Student shall select any one of the following Course as Elective-II in Second semester)

S.No	Course Code	Name of the Course
1.	17PMB2EA	Pharmaceutical Quality Control
2.	17PMB2EB	Basics in Animal Science

ELECTIVE - III

(Student shall select any one of the following Course as Elective-III in Third semester)

S.No	Course Code	Name of the Course
1.	17PMB3EA	Food Microbiology and Food Quality Control
2.	17PMB3EB	Ecology

ELECTIVE - IV

(Student shall select any one of the following Course as Elective - IV in Fourth semester)

S.No	Course Code	Name of the Course
1.	17PMB4EA	Evolution
2.	17PMB4EP	Practical

Total Credit Distribution

Subjects	Credits	Total		Credits	Cumulative Total
Core	5	4 x 100 =	400	20	68
Core	4	10x100	1000	40	
Core Lab	3	2x100	200	6	
Core Lab	2	1 x 100 =	100	2	
Elective	4	3 x 100 =	300	12	14
Elective	2	1 x 100 =	100	2	
Project	8	1 x 150 =	150	08	08
Total			2250	90	90

FOR COURSE COMPLETION

Students have to complete the following Courses:

- Core courses in I, II, III and IV Semesters.
- Elective courses in I, II, III and IV Semesters.
- Core practicals in I, II and III Semesters.
- Project and Viva - Voce in IV Semester.
- Compulsory 15 days internship training for Programme completion. Based on their performance of the Students Grade will be Awarded as A to C.

A- 75marks and above

B- 60-74 marks

C- 40-59 marks

Below 40 marks - (Re-Appear)

Earning Extra credits is not mandatory for course completion

Extra Credits

Part	Subject	Credit	Total credits
1.	Publication with ISSN Journal	1	1
2.	Hindi /Other Foreign language	1	1
3.	Paper Presented in Sponsored National/ International Seminar/conference/	1	1
4.	Online Courses Prescribed By Department / Self study paper	1	1
5.	Representation - Academic/Sports /Social Activities/ Extra Curricular Activities at University/ District/ State/ National/	1	1
	Total	5	5

Rules:

The students can earn extra credits only if they complete the above during the course period (I to III sem) and based on the following criteria. Proof of Completion must be submitted in the office of the Controller of Examinations before the commencement of the IV Semester. (Earning Extra credits are not mandatory for Course completion)

1. Publication with ISSN Journal by a student and co-authored by staff member will be given one credit extra.
2. Student can opt Hindi/ French/ Other foreign Language approved by certified Institutions to earn one credit. The certificate (Hindi) must be obtained from **Dakshina Bharat Hindi Prachar Sabha** and he/ she has to enroll and complete during their course period (first to fifth semester)
3. Award winners in Paper Presentation in Sponsored International Seminar/conference/Participation in short term workshop (minimum 5 days) will be given one credit extra.
4. Student can earn one credit, if they complete any one Online certification courses/ Self study paper prescribed by the concerned department.

Self study paper offered by the Department of Microbiology

S. No.	Semester	Course Code	Course Title
1.	sem III	17PMBSS1	Developmental Biology
2.		17PMBSS2	Inheritance Biology

List of online courses Prescribed by the Department

1. Spoken Tutorial - IIT Mumbai
 2. Coursera
 3. Edx
 4. Udacity
 5. Big Data University
5. Award Winners in /Social Activities/ Extra Curricular /Co-Curricular Activities / Representation in Sports at University/ District/ State/ National/ International level can earn one extra credit.

17PMB13A	CORE - I PRINCIPLES OF MICROBIOLOGY	SEMESTER - I
-----------------	--	---------------------

PREAMBLE:

The course will impart knowledge on the

- History of Microorganisms
- Basic techniques in Microbiology
- Structure and composition of prokaryotic and eukaryotic cell.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> • Explain the theories to understand the importance of microorganisms. • Summarise the contributions and discoveries of various scientists to microbiology. 	K2
CO2	<ul style="list-style-type: none"> • Apply the principles of sterilization and disinfection. • Make use of the types of Media. • Apply knowledge on Culture Maintenance and Preservation. • Summarise the objectives and importance of Culture Collection Centres. 	K2, K3
CO3	<ul style="list-style-type: none"> • Compare and contrast the principles of Microscopy. 	K4
CO4	<ul style="list-style-type: none"> • To compare and understand the characteristics of internal and external structures of prokaryotic cells. 	K2, K4
CO5	<ul style="list-style-type: none"> • Distinguish microbes based on their characteristics. 	K3

Mapping with Programme Outcomes

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	S	S	S	S
CO3	M	S	M	S	S
CO4	S	S	M	S	M
CO5	S	S	M	S	M

S-Strong, M-Medium, L-Low

17PMB13A	CORE - I: PRINCIPLES OF MICROBIOLOGY	SEMESTER - I
-----------------	---	---------------------

Total Credits: 5
Hours per week: 5

CONTENTS

UNIT - I

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.

UNIT - II

Sterilization and disinfection - Physical and chemical control of microorganisms- 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 NFMCC.

UNIT - III

Principles of Microscopy- Light microscope, Inverted microscope, Electron microscope - TEM and SEM, Polarization microscope, Confocal, Perifocal, Atomic force microscope. Stains and staining principles: Simple, Gram staining, Negative staining, Capsule staining, Spore staining, Flagellar staining and Acid fast staining.

UNIT - IV

Characteristics of Prokaryotic cells - Basic cell types: Prokaryotic cells - Size, shape and Arrangement - Overview of structure - Cell membrane. Internal membrane structure - Cytoplasm - Nucleoid - Inclusions - chlorosomes - carboxyomes - magnetosomes - phycoblisomes - Endospores. External structure - Cell Wall - Flagella and its function - Glycogalyx - Slime layer.

UNIT - V

Characteristics of Eukaryotic cells - Overview of structure - Plasma membrane - Cytoplasm - Cell nucleus - Mitochondria and Chloroplast - Endoplasmic reticulum - Golgi Apparatus - Lysosomes. External structures -Flagella - Cilia. General characters and Cell wall structure of Algae, Fungi and Protozoa.

TEXT BOOKS:

1. *Black, J.G.* 2013. **Microbiology**, 8th Edition. John Wiley and Sons.
2. *Joanne Wiley, Linda Sherwood, Christopher J Woolverton.* 2016. **Prescott's Microbiology**, 10th Edition. Mc Graw Hill Company.
3. *Salle A.J.* 2014. **Fundamental Principles of Bacteriology** 7th edition, Tata Mc Hill Publishing Company Ltd.,
4. *Michael Pelczar.* 2001. **Microbiology**, 5th Edition. Mc Graw Hill Book Company.

REFERENCE BOOKS:

1. *Micheal T Madigan.* 2014. **Brock Biology of Microorganisms**, 10th edition. Peareson Education. New Delhi.
2. *Jeffrey C Pommerville.* 2010. **Alcamo's Fundamentals of Microbiology**, 9th Edition. Jones and Bartlett Publishers.
3. *Pollard, Thomas D. Earnshaw, William C, Lippincott-Schwartz, Jennifer.* 2014. **Cell Biology**. Saunders Publishers, USA.
4. *Celis Julio E, Carter Nigel, Simons Kai, Small J. Victor, Shotton David.* 2005. **Cell Biology, Four-Volume Set: A Laboratory Handbook**. Academic Press, USA.

17PMB13B	CORE II- MICROBIAL DIVERSITY	SEMESTER - I
-----------------	-------------------------------------	---------------------

PREAMBLE:

The course will impart knowledge on the

- Phylogeny and Taxonomy of microbes
- Bergey's manual and its importance
- Diversity of Bacteria, Actinomycetes, Fungi, Algae, and Viruses.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> • Describe the components of microbial systematic. • Explain and evaluate methods and approaches used to study microbes. • Apply the knowledge on taxonomic strategies and approaches used to name microorganisms and the criteria used to define genera, species and sub specific divisions within species. 	K3, K4
CO2	<ul style="list-style-type: none"> • Develop an understanding diversity of Archaeobacteria and to compare the characteristics of archaeobacteria with eubacteria. 	K3, K4
CO3	<ul style="list-style-type: none"> • Understand the characteristics of eubacteria, their diversity and classification. 	K3, K4
CO4	<ul style="list-style-type: none"> • Understand the general characteristics of fungi and algae. • Apply the knowledge to identify algae and fungi. 	K3, K4
CO5	<ul style="list-style-type: none"> • Make use of microbes for human 	K3, K4

	welfare.	
--	----------	--

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong, M-Medium, L-Low

17PMB13B	CORE - II: MICROBIAL DIVERSITY	SEMESTER - I
----------	--------------------------------	--------------

Total Credits: 5

Hours per week: 5

CONTENTS

UNIT - I

Microbial systematic - Taxonomic ranks - Classification system - Phenetic classification - Numerical taxonomy and Phylogenetic classification - Major characteristics used in taxonomy - Assessing microbial phylogeny - Constructing Phylogenetic Trees from Aligned Sequences, Interpreting Phylogenetic Trees, A Case Study of Phylogenetic Analysis- Major Division of Life - Whittaker's Five Kingdom concept - Bergey's manual (9th Edition) and its importance.

UNIT - II

Introduction to Archaea - Archaeal cell wall, lipids and membranes, Genetics and molecular biology, metabolism. Archaeal taxonomy - Outline characteristics of Phylum - Crenarchaeota and Euryarchaeota.

UNIT - III

Eubacteria - Photosynthetic bacteria - Spirochaetes - Bacteroidetes. Characteristics of major groups. Proteobacteria - Alpha proteobacteria: Rhizobiales - Rickettsiales. β Proteobacteria: Neisseriales. Gamma proteobacteria: Enterobacteriales - Pseudomonadales - Vibrionales.

UNIT - IV

Fungi - Alexopolus Classification of Fungi - General Characteristics of fungi - Algae - Fritsch Classification of algae - Properties of major groups of algae: Chlorophyta, Euglenophyta, Dinoflagellata, Crisophyta, Phaeophyta, Rhodophyta.

UNIT - V

Practical Aspects of Microbial Diversity Concept, mechanism, advantages and applications of unique micro biome- VAM, Lichens, Seaweeds.

TEXT BOOKS:

1. *Joanne Wiley, Linda Sherwood, Christopher J Woolverton.* 2016. **Prescott's Microbiology**, 10th Edition. Mc Graw Hill Company.
2. *Michael Madigan,* 2015. **Brock Biology of Microorganisms**, 14th Edition. Pearson publishers. New Delhi.

REFERENCE BOOKS:

1. *Jeffrey C Pommerville.* 2010. **Alcarno's Fundamentals of Microbiology**, 9th Edition. Jones and Bartlett Publishers.
2. *Colwell, R.R., U.Simidu, and K. Ohwada.* 1996. **Microbial diversity in time and space.** New York: Plenum Press, c1996. ISBN 0306451948.

17PMB13C	CORE III- MICROBIAL PHYSIOLOGY	SEMESTER - I
----------	--------------------------------	--------------

PREAMBLE:

To comprehend the physiological, biochemical, metabolic, respiratory and nutritional pathways of microorganisms and its significance in microbial growth.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> To discuss the nutritional classification of microorganism based on carbon, energy and electron source. To explain the effects of physical parameters on the growth of microorganisms. To understand the physiology of growth and modes of nutrient uptake by microorganisms. 	K3
CO2	<ul style="list-style-type: none"> To comprehend nomenclature, classification, kinetics and types of enzymes with an emphasis on nature of enzyme Inhibitions. 	K3
CO3	<ul style="list-style-type: none"> To confer the significance of different pathways of Carbohydrate metabolism. To infer the concepts of fermentation, energy generation and Bioluminescence. 	K3
CO4	<ul style="list-style-type: none"> To acquire the knowledge on the concepts of biosynthesis of 	K3

	aminoacids, nucleotides, fatty acids and cell wall of Gram positive and Gram negative bacteria.	
CO5	<ul style="list-style-type: none"> To interpret and define the mechanism of photosynthesis, CO₂ fixation and study about nutritional categorisation of microorganism based on organic carbon source. 	K3

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong, M-Medium, L-Low

17PMB13C	CORE III- MICROBIAL PHYSIOLOGY	SEMESTER - I
-----------------	---------------------------------------	---------------------

Total Credits: 5

Hours per week: 5

CONTENTS

UNIT - I

Nutrition and Growth: Nutritional types of microorganisms - Phototrophs - Autotrophs - Lithotrophs - Organotrophs. Nutritional requirements. Environmental effects on Microbial growth - Temperature, pH, Pressure, Oxygen. Physiology of Growth - Growth curve. Growth measurements - batch, continuous and synchronous. Membrane transport - Diffusion, active and passive transport, group translocation, ion uptake.

UNIT - 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 co-operatively, enzyme inhibition: Reversible - Competitive, Noncompetitive, uncompetitive and irreversible inhibition. Regulatory and Allosteric enzymes.

UNIT - III

General pathways of Carbohydrate metabolism: EMP pathway - Substrate level Phosphorylation - HMP Pathway - EntnerDoudroff pathway - Glyoxalate pathway - Krebs cycle. Fermentations of carbohydrates - Homolactic - Mixed acid - Butane di ol - Propionic acid fermentation. β - Oxidation of Fatty acids. Energy production: Electron transport chain and Oxidative phosphorylation. Pasteur Effect. Bioluminescence.

UNIT - IV

Biosynthesis of aspartate, pyruvate, histidine and serine amino acid families - purine and pyrimidine nucleotides, denovo and salvage

pathway. Biosynthesis of fatty acids. Biosynthesis of gram positive and gram negative cell wall.

UNIT - V

Photosynthesis and Inorganic metabolism: Characteristics and metabolism of Autotrophs - Photosynthetic bacteria and Cyanobacteria - Autotrophic CO₂ fixation and Mechanisms of Photosynthesis - Hydrogen bacteria - Nitrifying bacteria. Sulfur bacteria, Iron bacteria. Methylophs - Methanogens.

TEXT BOOKS:

1. *David White and George D. Hageman.* 2000. **Microbial Physiology and Biochemistry Laboratory.** Oxford University Press, India.
2. *Gerhard Gottschalk,* 2006.**Bacterial Metabolism.** Springer-Verlag New York.
3. *Moat. A.G. J.W.Foster.* 1988. **Microbial physiology.** 4th edition. John Wiley & sons. Australia.

REFERENCE BOOKS:

1. *Doelle. H.W.*1960.**Bacterial Metabolism.** 2nd edition. Academic Press. USA.
2. *Geoffrey Michael Gadd,* 2008. **Bacterial Physiology and Metabolism,** Cambridge University Press.UK.

17PMB13D	CORE IV-BIOINSTRUMENTATION	SEMESTER - I
----------	----------------------------	--------------

PREAMBLE:

To comprehend the protocol and instrumentation of diverse instruments for microbiology and to appreciate its application in diverse fields.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> To understand the principles, instrumentation, types of centrifuge with an emphasis on applications of Analytical centrifuge. To impart knowledge on various techniques of purification of bio molecules by chromatography and their application. 	K3
CO2	<ul style="list-style-type: none"> To become equipped with the operational principle and working methods of spectral instruments. 	K3
CO3	<ul style="list-style-type: none"> To procure knowledge on the principles and techniques of various types of electrophoresis with emphasis on recovery and identification of electrophoresed molecules. 	K2
CO4	<ul style="list-style-type: none"> To acquaint the concept of radioactivity and its types of decay. To describe the methods of detection and measurement of radioactivity based on different 	K3

	principles.	
CO5	<ul style="list-style-type: none"> Application of knowledge for the characterization of Biomolecules. 	K4

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	M
CO4	S	S	M	S	M
CO5	S	S	S	S	S

S-Strong, M-Medium, L-Low

17PMB13D	CORE - IV: BIOINSTRUMENTATION	SEMESTER - I
-----------------	--------------------------------------	---------------------

Total Credits: 5
Hours per week: 5

CONTENTS

UNIT - I

Centrifugation: Preparative Centrifugation - Differential and Density Gradient Centrifugation, 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 and GCMS.

UNIT - II

Colorimetry: Instrumentation, Application and Analysis - Qualitative and Quantitative. Spectrophotometry: Instrumentation and Applications of UV, Visible, IR, NMR, FTIR, Atomic absorption, Mass Spectroscopy and MALDI - TOF. Instrumentation and Applications of Spectrofluorometry and Flame Photometry.

UNIT - III

Electrophoresis: Electrophoresis 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. Electrophoresis of Nucleic acids - Agarose Gel Electrophoresis - staining and destaining, Analysis of Electrophoresis

Results - Electrophoresis of RNA – Capillary Electrophoresis – Microchip Electrophoresis.

UNIT - IV

Detection and Measurement of Radioactivity –Detection based on gas ionization - Autoradiography and its applications– Scintillation Counting- Safety Aspects – Biosensors and its applications.

UNIT - V

Separation and Quantitative determination of Macromolecules: Carbohydrates, Lipids, Amino acids - Isolation and Characterization of Microbial pigments: Chlorophylls and Carotenoids. Determination of Protein structure. Determination of Molecular weight of proteins.

TEXT BOOKS:

1. *Swahney S K and Singh R.* 2014. **Introductory Practical Biochemistry**, Narosa Publishing House.
2. *Keith Wilson and John Walker.* 2010. **Principles and Techniques of Biochemistry and Molecular Biology**. 7th edition. Cambridge University Press.

REFERENCE BOOKS:

1. *Plummer .T David.* 2004. **An Introduction to Practical Biochemistry**. 3rd Edition. TMH Publishers.
2. *Terrance G Cooper,* 2010. **The tools of Biochemistry**, 2nd edition. John Wiley and sons.
3. *Rodney Boyer,* 2000. **Modern Experimental Biochemistry**. 3rd Edition, Pearson education Publishers.

17PMB13P	CORE PRACTICAL I	SEMESTER - I
----------	------------------	--------------

Total Credits: 2
Hours per week: 5

CONTENTS

1. Bacterial Staining techniques
 - a. Gram, b. Acid-fast, c. Spore d. Capsule and e. Negative staining.
2. Fungal Mount -LCB 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 and fungi - pH, Temperature
8. Anaerobic technique - Roll tube method
9. IMViC test
10. Hydrogen sulphide test
11. Oxidase test
12. Catalase test
13. Urease test
14. Polymer degradation - Starch, Gelatin, Casein.
15. Carbohydrate fermentation.
16. Preferential utilization of sugar - TSI
17. Quantitative determination of Sugar by DNSA method
18. Quantitative determination of Protein by Lowy *et al* method
19. Separation techniques: Chromatography- Paper, TLC and Column.

LABORATORY MANUALS:

1. *Kannan, N.* 1997. **Laboratory Manual of General Microbiology**, 1st edition, Panima Publishing house.
2. *Aneja. K.R.,* 2012. **Experiments in Microbiology, Plant Pathology and Biotechnology**, 2nd edition. New age publishers.

17PMB1EA	ELECTIVE I- RINICIPLES OF QUALITY ASSURANCE	SEMESTER - I
----------	--	---------------------

PREAMBLE:

To understand the quality assurance in microbiology laboratory, role of quality assessment in diagnostic procedures and significance of quality management and standards.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> Knows the definition of quality assurance, able to design microbiology laboratory and control of quality. 	K2
CO2	<ul style="list-style-type: none"> Understands the quality assessment of laboratory environments and able to maintain records and reports. 	K2
CO3	<ul style="list-style-type: none"> Importance of quality assessment in sterilization and disinfection, preservation and quality control of media and stains. 	K2
CO4	<ul style="list-style-type: none"> Elucidates the quality assessment of disposal on decontaminated matters and gains knowledge on biological references and standards. 	K2
CO5	<ul style="list-style-type: none"> Clearly able to categorize good laboratory practices with management 	K2

	of laboratory hazards and first aid procedures.	
--	---	--

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	M	M	M	S	S
CO3	M	S	S	S	S
CO4	M	M	M	S	S
CO5	S	M	S	S	S

S-Strong, M-Medium, L-Low

17PMB1EA	ELECTIVE I- PRINCIPLES OF QUALITY ASSURANCE	SEMESTER - I
----------	--	---------------------

Total Credits: 4
Hours per week: 5

CONTENTS

UNIT - I

Quality assurance - Introduction and overview - Definition. Designing of microbiology laboratory - Control of quality - Applications.

UNIT - II

Quality assessment of Equipments, chemicals, glass wares and laboratory environments - Quality management - Maintenance of records and reports.

UNIT - III

Quality assurance in sterilization and disinfection - Preservation of stock cultures, media and diagnostic kits - Quality control of media and stains.

UNIT - IV

Quality assessment of disposal - decontaminated matters and other biological effluents - Quality management in transportations of cultures. National control of biologicals - Biological references and standards.

UNIT - V

Good laboratory practices - Management of laboratory hazards and knowledge in First aid procedures.

TEXT BOOKS:

1. *Rajesh Bhatia and Rattan lalIchhpujani*. 1995. I ed. "**Quality assurance in Microbiology**".
2. *Anne. A. Hurley*. 2001. **Principles of Quality Control**. John Wiley and sons.

17PMB1EB	ELECTIVE I- BASICS IN PLANT SCIENCE	SEMESTER - I
-----------------	--	---------------------

PREAMBLE:

This course illustrates the nutritional requirements and mechanisms involved in the growth and development of plants and the responses on plant to biosphere.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> Understand the relationship of complementary metabolic pathways such as photosynthesis and respiration in energy acquisition and use during plant development. 	K2
CO2	<ul style="list-style-type: none"> Demonstrate the mechanisms for procurement of nitrogen and other nutrients by plants. 	K2
CO3	<ul style="list-style-type: none"> Demonstrate the major effects and physiological mechanisms of growth regulators (hormones) in plants. 	K2

CO4	<ul style="list-style-type: none"> Understand the information on transport system supports for the cell nourishment and growth. 	K2
CO5	<ul style="list-style-type: none"> To know the importance of hormones and secondary metabolites. 	K2

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	M	M	M
CO3	S	M	M	M	M
CO4	S	M	M	M	M
CO5	S	M	S	S	S

S-Strong, M-Medium, L-Low

17PMB1EB	ELECTIVE I- BASICS IN PLANT SCIENCE	SEMESTER - I
-----------------	--	---------------------

Total Credits: 4

Hours per week: 5

CONTENTS

UNIT - I

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation- C₃, C₄ and CAM pathways. Respiration and photorespiration -Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway.

UNIT - II

Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis.

UNIT - III

Plant hormones-Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

UNIT - IV

Solute transport and photo assimilate translocation - uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem;

transpiration; mechanisms of loading and unloading of photo assimilates.

UNIT - V

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Stress physiology -Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses

TEXT BOOKS:

1. *Devlin, Robert M.;Witham, Francis H. Plant Physiology*; 4th edition, Delhi. CBS Publishers & Distributors, 2001.

17PMB23A	CORE V - MICROBIAL GENETICS AND MOLECULAR BIOLOGY	SEMESTER - II
-----------------	--	----------------------

PREAMBLE:

The Course aims to build the concepts regarding:

- the fundamentals behind classical genetics
- Molecular genetics
- Genetic material exchange and mutations.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> • Understand and appraise the biological process by a historical approach to study classical systems of gene regulation in bacteria. 	K2, K4
CO2	<ul style="list-style-type: none"> • Understand the topology of DNA and RNA. • To compare and contrast the mechanisms of replication, transcription and translation. 	K2
CO3	<ul style="list-style-type: none"> • Explain the processes behind mutation and other modifications. 	K2
CO4	<ul style="list-style-type: none"> • Develops knowledge and summarize the DNA transfer mechanisms and the role of transposons. 	K2
CO5	<ul style="list-style-type: none"> • Identify and distinguish genetic 	K2

	regulatory mechanisms at different levels.	
--	--	--

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	M	S	M
CO3	M	S	S	S	S
CO4	M	S	S	S	M
CO5	S	S	M	S	M

S-Strong, M-Medium, L-Low

17PMB23A	CORE V- MICROBIAL GENETICS AND MOLECULAR BIOLOGY	SEMESTER - II
-----------------	---	----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

History of Genetics. Mendel's Laws, concept of dominance, segregation, independent assortment; Chromosome theory of inheritance. Chromosomes & crossing over. Sex-influenced and limited inheritance. Chromatin structure and organization.

UNIT - II

DNA and RNA as genetic material - Duplex DNA. Chemical composition, Cvalue paradox, Physical structures of DNA, Circular and Superhelical DNA. RNA- Structure and types. DNA Replication - Basic rule for replication of all nucleic acids - Geometry of DNA replication - Enzymology.

UNIT - III

Transcription - Enzymatic synthesis of RNA -polymerases - RNA chain initiation - Elongation - Termination and release of newly synthesized RNA. Transcription in Eukaryotes - Transcription unit concept. Genetic code. Translation - Transfer of RNA and aminoacyl synthetases - codon, anticodon interactions - Wobble hypothesis. Post transcriptional and translational modification.

UNIT - IV

Mutation – types of Mutation - Biochemical basis of mutation – Spontaneous and induced mutation. Mutagenicity testing. DNA repair mechanisms: Photo reactivation – Excision repair – Recombination repair – SOS repair.

UNIT - V

Mechanisms of Gene transfer in bacteria – Transformation – Transduction and Conjugation. Phage genetics, Phage T mutants, Genetic recombination, Genetic mapping of T-4 Phage. Regulation of gene activity – Operon model- positive and negative operon: (Lac, Trp), Autoregulation – translational regulation.

TEXT BOOKS:

1. *Freidfelder, D.* 1995. **Microbial genetics**, 1st edition. Narosa Publishing House.
2. *Freifelder, D.* 2004. **Molecular Biology**, 1st edition. Narosa Publishing House.

REFERENCE BOOKS:

1. *Klug .W.S. and Cummings, M.R.* 2016. **Essentials of Genetics**, 9th Edition. Pearson Publishers.
2. *Robert H Tammarin.* 2008. **Principles of Genetics**, 7th edition, McGraw Hill Publishers.

17PMB23B	CORE VI- VIROLOGY	SEMESTER - II
-----------------	--------------------------	----------------------

PREAMBLE:

To get the basic knowledge on general properties, structure and diagnosis of bacterial, animal and plant viruses, antivirals and their mode of action.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> • Understands the basic classification of viruses, cultivation and characterization. 	K3
CO2	<ul style="list-style-type: none"> • Develops the skills of Routine and Molecular Diagnosis with special reference to Virology. 	K3
CO3	<ul style="list-style-type: none"> • Basic knowledge on structure, genome replication, protein synthesis and assembly of DNA and RNA containing bacteriophages. • Classify the structure, genome replication, protein synthesis and assembly of DNA and RNA containing plant viruses. 	K2
CO4	<ul style="list-style-type: none"> • Able to differentiate DNA and RNA containing animal viruses. 	K3

CO5	<ul style="list-style-type: none"> Application of virology in viral vaccines, preparation, recombinant viruses and gene therapy. 	K2
-----	---	----

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	M	M	M
CO3	S	M	M	M	M
CO4	S	M	M	M	M
CO5	S	S	S	S	M

S-Strong, M-Medium, L-Low

17PMB23B	CORE VI- VIROLOGY	SEMESTER - II
-----------------	--------------------------	----------------------

Total Credits: 4

Hours per week: 4

CONTENTS

UNIT - I

General properties and Classification of Viruses. Cultivation and purification of viruses - In vivo, in vitro and in ovo systems for virus growth - Principles of bio-safety, containment facilities, maintenance and handling of laboratory animals and requirements of virological laboratory.

UNIT - II

Diagnostic methods: Immnuodiagnosis, haemagglutination and haemagglutination-inhibition tests, Complement fixation, neutralization, Western blot, RIPA, flowcytometry and immunohistochemistry - Nucleic acid based diagnosis: Nucleic acid hybridization, polymerase chain reaction, microarray and nucleotide sequencing.

UNIT - III

Structure, genome replication, protein synthesis and assembly of: DNA containing bacteriophages - T4, lambda, Mu, Φ X174 & M13 phages and RNA containing bacteriophages - MS2 and Φ 6 group. Mechanism of viral entry, multiplication and release from host cell of DNA containing plant

viruses – CaMV and Gemini Virus - RNA containing plant viruses - TMV, Cowpea mosaic viruses, Bromo mosaic viruses and Satellite viruses.

UNIT - IV

Mechanism of viral entry, multiplication and release from host cell. Pathogenicity and Clinical manifestation of DNA containing animal viruses - Adeno viruses, Herpes viruses, Pox viruses –Variola virus. RNA containing animal viruses: Picorna virus, Rhabdo virus, Hepatitis viruses, Orthomyxo virus – Influenza H1N1, Paramyxovirus, Retroviruses - HIV and Rubella virus. Emerging viruses – Zika and Ebola virus. Biology, life history and control of Aedes, Culex and Anopheles, their behavior and ecology with special reference to Dengue, chikungunya, Japanese encephalitis, West Nile and Kyasanur Forest Disease (KFD) Virions and Prions.

UNIT - V

Viral Vaccines - Conventional vaccines - killed and attenuated, modern vaccines –recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines). Antivirals - Interferons, mechanisms of action, antiretrovirals – mechanism of action and drug resistance. Modern approaches of virus control - Anti-sense RNA, siRNA, ribozymes.

TEXT BOOKS:

1. *Dimmock, N. J., Easton, A. J., and Leppard, K. N.* 2001. **Introduction to Modern Virology**. 5th edition. Blackwell publishing, USA.
2. *Black JG,* 2002. **Microbiology - Principles and Explorations**. John Wiley & Sons Inc. New York.
3. *Rogger Hull.* 2001. **Mathews Plant Virology**. 4th edition. Academic press.

REFERENCE BOOKS:

1. *Luria S.E. Darnel, J.E Jr. Baltimore. D and Campbell A.* 1978. **General Virology**, 3rd edition, Wiley and sons.
2. *Ananthanarayanan R and CK Jayaram Panicker,* 2005. **Introduction to Medical Microbiology**, 2nd edition .Orient Longman.

17PMB23C	CORE VII- GENETIC ENGINEERING	SEMESTER - II
-----------------	--------------------------------------	----------------------

PREAMBLE:

To demonstrate the cloning, availability of different kinds of vectors and characterization of cloned DNA.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> Describe the cloning: isolation and purification of nucleic acids (Chromosomal DNA, RNA and Plasmids). Explain the methods of handling and quantification of DNA and RNA. Understand the types of enzymes in gene cloning. 	K3
CO2	<ul style="list-style-type: none"> Recall the Vectors, properties of vectors. Analyze the types of vectors for gene cloning. Describe the plant vectors and animal vectors. 	K2, K3
CO3	<ul style="list-style-type: none"> Understand the direct and indirect method of screening of recombinants. Types of blotting techniques. Appraise Chromosome walking and chromosome jumping. 	K3, K4
CO4	<ul style="list-style-type: none"> To compare and understand the 	K2

	characterisation of cloned DNA.	
CO5	<ul style="list-style-type: none"> • Demonstrate Site directed mutagenesis, design and construction of novel proteins and enzymes. Protein folding. • Explain the drug design and delivery. 	K3

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	M	S	M
CO3	S	S	M	S	M
CO4	S	S	M	S	M
CO5	S	S	M	S	M

S-Strong, M-Medium, L-Low

17PMB23C	CORE - VII: GENETIC ENGINEERING	SEMESTER - II
-----------------	--	----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Cloning: Isolation and purification of nucleic acids (chromosomal DNA, RNA & Plasmids) – Methods of handling and quantification of DNA and RNA. Restriction endonucleases – types and characteristics - DNA methylases–Ligases – Adapters, Linkers and Homo and Hetero polymer tailing.

UNIT - II

Vectors – properties - types of vectors – plasmids- host range and incompatibility – Vectors constructed based on bacteriophages (M13 & Lambda), cosmids, phasmids, phagemids and BACs - Eukaryotic vectors - Yeast vectors (YAC) – animal (retroviruses, adenoviruses) and plant vectors (Ti plasmid based vectors and caulimoviral vector) – expression vectors - shuttle vectors.

UNIT - III

Gene transfer techniques in plants, animals and microbes - Transformation, electroporation, microprojectile system, liposome mediated transfer, gene gun etc. Agro bacterium-mediated gene transfer in plants - Ti plasmid: structure and functions, Ti plasmid based vectors - advantages. Chloroplast transformation. Screening: Direct: Insertional inactivation, plaque phenotype and indirect methods: Immunochemical detection - Nucleic acid hybridization, Blotting - Dot and Colony Blotting. Chromosome walking. Chromosome jumping.

UNIT - IV

Characterization of cloned DNA: Restriction mapping - restriction fragment length polymorphism (RFLP) - Polymerase chain reaction (PCR) - Types of PCR and their applications. DNA sequencing: Primer walking, Maxim and Gilbert method, dideoxy method, automated sequencing and micro array. Genomic DNA libraries - cDNA libraries.

UNIT - V

Site Directed Mutagenesis, Protein Engineering. Design and construction of novel proteins and enzymes. Protein Folding - Designer Enzymes - Semi synthetic enzyme used in organic solution, Abenzyme and other antibody protein conjugates.

TEXT BOOKS:

1. *Old. RW and Primrose*, 2001. **Principle of Gene Manipulation**, 6th edition. Blackwell Scientific Publication, Boston.
2. *T.A Brown* 1st edition, 2002. **Genomes**, John- Wiley & Son. Australia.
3. *SanthiyaMitra*, 2009. **Genetic Engineering - Principles and Practices**. Mac Millen Publications. Bangalore.

REFERENCE BOOKS:

1. *Winnecker, E.D*, 2003. **From Gene to Clones**, Introduction to Gene Technology, 1 st edition. Panima educational book agency. New Delhi.
2. *Glick B .R and Pasternak J .J* .2010. **Molecular Biotechnology. Principles and Application of recombinant DNA**, 4th edition. ASM Press, Washington.

17PMB23D	CORE VIII- ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	SEMESTER - II
-----------------	---	----------------------

PREAMBLE:

To explore the diverse distribution of micro biome in different milieu and to appreciate its beneficial role in the process of recycling.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> To explore the community of microflora present in air and indicators of air pollution To understand the types of Bacterial, Viral and Fungal airborne diseases and the effect of air pollution on plants and animals 	K2
CO2	<ul style="list-style-type: none"> To analyse and study the properties of soil and groups of soil microflora To understand the sources of soil pollution and concept of Biogeochemical cycling 	K2
CO3	<ul style="list-style-type: none"> To comprehend the distribution of microorganisms in various sorts of aquatic environments To impart information on the concepts of water pollution, waterborne pathogens and waste water treatment process. 	K2,K3

	<ul style="list-style-type: none"> To acquaint knowledge on the chemical and microbial assessment of water quality 	
CO4	<ul style="list-style-type: none"> To compare the characteristic features of microbial populations of symbiotic and non symbiotic nitrogen fixers, phosphate solubilizers and phytopathogens. 	K3
CO5	<ul style="list-style-type: none"> To analyse the concepts of Landfills, composting and Mushroom cultivation. 	K3

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	M	S	S	M
CO3	S	S	S	S	S
CO4	S	M	S	M	M
CO5	S	S	S	S	S

S-Strong, M-Medium, L-Low

17PMB23D	CORE VIII- ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	SEMESTER - II
-----------------	---	----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Aerobiology-Microbial contamination of air-Sources of contamination-Biological indicators of air pollution. Enumeration of bacteria from air, Air sampling devices. Significance of air Micro flora, Outline of Airborne diseases (Bacterial, Fungal and Viral), Air sanitation. Effect of Air pollution of plants and Humans.

UNIT - II

Soil Microbiology-Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration)-Weathering and Humus formation, Soil pollution-Sources. Biogeochemical cycling - Nitrogen, Carbon, Phosphorous, Sulphur cycles and its importance.

UNIT - III

Aquatic Microbiology-Microbiology of water (Fresh and Marine)-Water Pollution and Waterborne Pathogens. Assessment of water quality (Chemical and Microbial) Bacteriological examination of water-Indicator

organisms. Microbiology of Sewage-Waste water treatment – BOD and COD.

UNIT - IV

Nitrogen Fixing Microorganisms-Symbiotic and free-living nitrogen fixers (Rhizobium, Azotobacter, Azospirillum, Frankia, BGA and Azolla) -Phosphate solubilizers (Phosphobacterium and Aspergillus)-Phytopathogens-Bacterial, Fungal, Viral diseases (Wilt, Blight, Canker, Mosaic)-Control measures.

UNIT - V

Recycling of Solid wastes – Composting- Biogas, Mushroom and SCP production from Waste. Biodegradation of Complex Polymers (Cellulose, Hemicellulose, Lignin, Chitin and Pectin), Bioremediation (In- situ, Ex - situ, Intrinsic and Engineered), Bioleaching (Copper and Uranium) – Introduction to biodegradation of recalcitrant's (xenobiotics).

Text Books:

1. *Atlas R. M and Bartha.* 2005. **Microbial Ecology**, 4th edition. Pearson education.
2. *Michael Madigan,* 2015. **Brock Biology of Microorganisms**, 14th Edition. Pearson publishers.

3. *Alexander M.* 1977. **Introduction to soil microbiology.** John Wiley & Sons, Inc., New York.
4. *Gerhard Rheinheimer,* 1991. **Aquatic Microbiology.** 4th Edition. John Wiley and sons.

Reference Books:

1. *Black, J.G.* 2013. **Microbiology,** 8th Edition. John Wiley and Sons.

17PMB23E	CORE IX- BIOETHICS, BIOSAFETY AND IPR	SEMESTER - II
----------	--	---------------

PREAMBLE:

To introduce Biosafety regulations and ethical concepts in life science.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none">• To gain awareness about IPR and to take measures for protecting their ideas.	K3
CO2	<ul style="list-style-type: none">• To emphasize on IPR issues and need for knowledge in patent.	K2
CO3	<ul style="list-style-type: none">• To introduce basic concepts of bio safety and to study its impact on the quality of human life.	K3
CO4	<ul style="list-style-type: none">• To recognise the importance of bio safety practices and guidelines in research.	K2
CO5	<ul style="list-style-type: none">• To make students learn about the legal safety and public policy issues raised due to the rapid progress in microbiology and development of new products.	K2

Mapping with Programme Outcomes

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	M	M	S	M
CO3	S	S	S	S	S
CO4	S	M	S	M	M
CO5	S	S	M	S	S

S-Strong, M-Medium, L-Low

17PMB23E	CORE IX- BIOETHICS, BIOSAFETY AND IPR	SEMESTER - II
----------	--	----------------------

Total Credits: 4

Hours per week: 4

CONTENTS

UNIT - I

Introduction to Intellectual Property Rights- Concepts of IPR- Designs- Trademarks- Trade secrets- Domain name- Geographical indications- Copy Rights- Evolution of patent law- History of Indian patent system- International conventions and treaties.

UNIT - II

Classification of patents in India- Classification of patents by WIPO- categories of patent- special patent- Patenting of biological products- Patentable and non patentable inventions in India and abroad- Rights of patent holder and co-owner- Infringement of patent rights and offenses- Patent law- Patenting life forms- Biodiversity and IPR- Bioinformatics patenting- Gene Patenting.

UNIT - III

Introduction to Biosafety- Risk assessment- Cartagena protocol on bio safety- Capacity building- Bio safety guidelines in India evolved by DBT- Rules for the storage and manufacture of hazardous microorganisms and GMO- Bio safety management

UNIT - IV

Classification of biological agents- Categories of bio hazardous waste- labelling and disposal. General safety- permit for the movement and import of GMOs- Bio safety issues of products developed by RDNA technology- Ecological safety assessment of recombinant organisms- web based information on bio safety of GMOs.

UNIT - V

Bioethics and its scope- different approaches to ethics- biological weapons- social and ethical implications of biological weapons- Importance of Good Laboratory practices-

TEXT BOOKS:

1. *Deepa goel and ShominiPrasas*. 2013. **IPR, Biosafety and Bioethics**. Pearson Education, India.

REFERENCE BOOKS:

1. *M.K.Satheesh*. 2008. **Bioethics and Biosafety**. I.K.InternationalPvt limited, India.

17PMB23P	CORE PRACTICAL II	SEMESTER - II
-----------------	--------------------------	----------------------

Total Credits: 3
Hours per week: 6

CONTENTS

1. Isolation of chromosomal DNA from bacteria.
2. Isolation of plasmid DNA from microbes
3. Separation of DNA by Agarose gel electrophoresis
4. Isolation of Auxotrophic mutants
5. Isolation of Antibiotic resistant mutants
6. Isolation of Coli phage.
7. Egg inoculation for cultivation of virus
8. Isolation of TMV
9. Enumeration of microorganisms from rhizosphere and non-rhizosphere soil.
10. Enumeration of microorganisms from rhizoplane.
11. Isolation of nitrogen fixers - free living (Azotobacter)
12. Isolation of nitrogen fixers - free living (Azospirillum)
13. Isolation of nitrogen fixers -symbiotic (Rhizobium)
14. Isolation of Phosphate solubilizers.
15. Isolation air borne bioparticles (Settling plate method)
16. Determination of DO
17. Estimation of BOD

18. Isolation of coliforms from sewage

Laboratory Manuals:

1. James G. Cappuccino. **2016. Microbiology: A Laboratory Manual**, 10th edition. Benjamin/Cummings Publishing House.
2. *Aneja. K.R.* 2012. **Experiments in Microbiology, plant pathology and biotechnology**, 4th Edition. New age publishers.

17PMB2EA	ELECTIVE II- PHARMACEUTICAL QUALITY CONTROL	SEMESTER - II
----------	--	----------------------

PREAMBLE:

The Course aims to build the concepts regarding:

- Sterility in pharmaceutical products
- role of a qualified microbiologist in Pharma Industry
- Validation and its importance in quality assurance of pharmaceutical products.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none">• Identify and analyse unexpected results during routine analyses and help to provide solutions based on scientific and regulatory considerations by implementing preventive action and corrective actions programs.	K3
CO2	<ul style="list-style-type: none">• Acquire a working knowledge of Indian GMP (Good Manufacturing	K3

	Practice) requirements to the manufacture of pharmaceuticals, blood products, and natural health products	
CO3	<ul style="list-style-type: none"> Interpret the requirements for testing of raw materials, in-process samples, and finished product in accordance with pharmacopoeia compendia standards. 	K3
CO4	<ul style="list-style-type: none"> Operate, validate, and calibrate a variety of laboratory equipment used in pharmaceutical industrial labs. Assess instruments malfunction and troubleshoot analytical equipment failure in compliance with regulatory requirements. 	K3
CO5	<ul style="list-style-type: none"> Understand the concept of quality systems and compliance in the regulated industry and the role of quality assurance. Understand the use of controlled documentation. 	K2

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong, M-Medium, L-Low

17PMB2EA	ELECTIVE II- PHARMACEUTICAL QUALITY CONTROL	SEMESTER - II
-----------------	--	----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

An introduction to pharmaceutical microbiology. WHO good manufacturing practices: main principles for pharmaceutical products- Quality management in the drug industry: philosophy and essential elements- Heating Ventilation and air-conditioning systems for non-sterile pharmaceutical dosage forms- Validation- Water for pharmaceutical use.

UNIT - II

Types of spoilage, Factors affecting microbial spoilage – assessment of microbial spoilage – preservation. Ecology of microorganisms as it affects the pharmaceutical industry – Sterilization control - methods of sterility testing- sterilization monitors and Quality assurance of products.

UNIT - III

Sterile pharmaceutical products – injections, Non-injectable sterile fluids, ophthalmic preparations, dressings & implants. The microbiological quality and regulatory requirements for natural and nutraceutical products - The regulatory control and quality assurance of immunological products, Containment system integrity – sterile products, Regulatory guidelines (microbiology) for veterinary

antimicrobial products- Microbiological quality and regulatory requirements for bio therapeutics and manufactured products,

UNIT - IV

The role of the Qualified Person in microbiological quality assurance, Safety in microbiology, Rapid enumeration and identification methods, Selection and use of cleaning and disinfection agents in pharmaceutical manufacturing, Measurement of biocide effectiveness, International disinfectant testing protocols, Prevention and elimination of microbial bio films in the manufacturing environment using Clean-in-Place, Cleanroom design, operation and regulatory standards.

UNIT - V

Microbiological quality assurance. Validation of aseptic processing and media fills, the role of the microbiologist in HACCP, Auditing the pharmaceutical microbiology department.

TEXT BOOKS:

1. World Health Organization. 2007. **Quality assurance of pharmaceuticals A compendium of guidelines and related materials** Volume 2, 2nd updated edition Good manufacturing practices and inspection.
2. *W.B.Hugo&A.D.Russel*, 2007. **Pharmaceutical Microbiology**, 4th Edition, Blackwell Scientific Publications.

REFERENCE BOOKS:

1. *Dr Norman Hodges and Professor Geoff Hanlon* (University of Brighton), 2013. **Industrial Pharmaceutical Microbiology - Vol I & Vol II: standards & Controls.**
2. *Madigan M.T.* 2006. **Brock Biology of Microorganisms** 11th Edition. Pearson-Prentice Hall, USA.

17PMB2EB	ELECTIVE II- BASICS IN ANIMAL SCIENCE	SEMESTER - II
-----------------	--	----------------------

PREAMBLE:

This course has been designed to understand the physiology of various organs and systems in human.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> Understand the functions of circulatory system and the responses to the external and Environmental stimuli. 	K2
CO2	<ul style="list-style-type: none"> Demonstrate the structure and function of Cardio vascular system and their relationship with pumping of Blood. Appreciate the significance of ECG in the diagnosis of Blood Pressure. 	K2
CO3	<ul style="list-style-type: none"> Summarize the entire mechanism of kidney involved in the excretion of urine and the regulation of water balance. 	K2
CO4	<ul style="list-style-type: none"> Gain the information regarding the structure and functions of reproductive system and elimination of gases. 	K2
CO5	<ul style="list-style-type: none"> Enhance the concepts involved in basic mechanisms of hormones and 	K2

	reproduction.	
--	---------------	--

Mapping With Programme Outcomes

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	S	S	S
CO3	S	M	S	S	S
CO4	S	M	M	M	M
CO5	S	M	M	M	M

S-Strong, M-Medium, L-Low

17PMB2EB	ELECTIVE II- BASICS IN ANIMAL SCIENCE	SEMESTER - II
-----------------	--	----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Blood and Circulation - Blood corpuscles, Haemopoiesis, Plasma function, Blood groups, Haemoglobin, Immunity and Haemostasis.

UNIT - II

Cardiovascular system - Comparative anatomy of Heart structure, Myogenic heart, Specialized tissue, ECG - its principle and significance, Cardiac cycle, Heart as a pump, Blood pressure.

UNIT - III

Excretory system - Comparative physiology of Excretion, Kidney, Formation of Urine, Urine Concentration, Waste elimination, Micturition, Regulation of water balance.

UNIT - IV

Respiratory system - Comparison of respiration in different species, Anatomical considerations, transport of gases, Exchange of gases, Waste elimination, Neural and chemical regulation of respiration.

UNIT - V

Endocrinology and Reproduction - Endocrine glands, Basic mechanism of hormone action, Hormones and diseases, reproductive processes, Gametogenesis, Ovulation, Neuroendocrine regulation.

TEXT BOOKS:

1. *Guyton C and Hall E.* 2015. **Textbook of medical physiology, 13th Edition.** Elsevier Saunders publication, Chennai.
2. *ChandiCharan Chatterjee.* 2016. **Human Physiology** 11th edition. Central Book Agency. West Bengal.

17PMB33A	CORE X- PRINCIPLES OF IMMUNOLOGY	SEMESTER - III
----------	---	-----------------------

PREAMBLE:

- To enlighten the structural features of the components of the immune system, Functions of Immune system.
- To comprehend the mechanisms involved in immune system development and responsiveness.

Course Outcomes

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

CO Number	CO Statement	Knowledge level
CO1	<ul style="list-style-type: none"> • Describe how the immune system works • state the role of the immune system; • Distinguish various cell types involved in immune responses and associated functions and to describe lymphocyte development and the expression of their receptors. 	K ₂ ,K ₃
CO2	<ul style="list-style-type: none"> • Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity. • Define the pathways of humoral/cell-mediated adaptive responses. • Distinguish and characterize antibody isotypes, and functions • Understand the importance of the three pathways of complement activation. 	K ₂ , K ₃
CO3	<ul style="list-style-type: none"> • Gain detailed knowledge and understanding of application of immunology in diagnostic and therapeutic techniques and research • Acquire knowledge and practical skills in undertaking simple immunological experiments that mimic those undertaken in diagnostic 	K ₂ , K ₃ and K ₄ .

	laboratories and research laboratories.	
CO4	<ul style="list-style-type: none"> • Understand the role of cytokines in immunity and immune cell activation; and be able to identify and characterize cytokines of particular immune importance; • Explain the mechanisms and factors associated with development of autoimmunity and Compare the four types of hypersensitivity for the Immunologic mechanism involved. • Understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation. • be able to provide an overview of the interaction between the immune system and pathogens • Identify the mechanisms and stages of graft rejection • Recognize the features of graft versus host disease • Interpret results of tissue typing assays. 	K ₂ , K ₃
CO5	<ul style="list-style-type: none"> • Recognize the general characteristics and types of cancer, • Distinguish between tumor specific and tumor associated antigens, Describe the immune responses against cancer cells • Recognize immunodeficiency diseases and understand the consequences of general types of immunodeficiency diseases • Explain the mechanisms and factors associated with development of autoimmunity. • Categorise the conventional and modern vaccine preparation technologies. Appreciate the genetically developed living and subunit vaccines. • Describe their importance in disease prevention. • Compare the different vaccination methods. 	K ₂ , K ₃

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	S
CO3	S	M	S	M	M
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong, M-Medium, L-Low

17PMB33A	CORE X- PRINCIPLES OF IMMUNOLOGY	SEMESTER - III
-----------------	---	-----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Historical background and scope of immunology, Basis of Human Defence mechanisms: First line defence - Anatomical and physiological barriers - second line defence - Fever, inflammation, Phagocytosis and interferon - Third line defence. Cells and organs of immune system.

UNIT - II

Immunity - types of immunity - Natural, acquired, specific and non specific, cell mediated and humoral, active and passive immunity. Antigens - properties, Epitopes, haptens, adjuvant, cross reactivity. Antibodies - properties, structure (primary & secondary) and isotypes. Diversity and specificity. Anti antibodies. Complement pathway.

UNIT - III

Antigens and antibody reactions - Introduction and classification of antigens and antibody reactions - Agglutination and precipitation reaction. Strength of antigen and antibody bindings - affinity & avidity. Therapeutic applications of monoclonal antibodies. and complement fixation reaction. Immunofluorescence RIA, RAST, ELISA and Flow cytometry.

UNIT - IV

Response of B-cell and T-cell to antigens. B-cell and T-cell products. Hyper sensitivity - Type I, II, III and IV - MHC antigens - types and functions. Immunity to infectious diseases - Viral, bacterial and protozoan.

UNIT -V

Transplantation immunology - Tissue transplantation and grafting. Mechanism of graft acceptance and rejection. HLA typing Tumor immunology. Immunodeficiency diseases and auto immunity. Vaccines - Types and vaccination methods.

TEXT BOOKS:

1. *Roitt, IM.* 2011. **Immunology** 1st edition. Mosby Publishers.
2. *Kuby.J.* 2002. **Immunology** 5th edition. W.H.Freeman, NY.

REFERENCE BOOKS:

1. *Tizard, I R.* 1998. **Immunology an Introduction**, 4th edition. Thomson publishers, Australia.
2. *Kenneth Murphy.* 2011. **Janeway's Immunology**, 8th Edition. Garland Science Publisher.

17PMB33B	CORE XI- BIOPROCESS TECHNOLOGY	SEMESTER - III
-----------------	---------------------------------------	-----------------------

PREAMBLE:

To comprehend the concept of fermentation, fermentor types, Upstream and Downstream processing and application of economical microorganisms for the industrial production of bioactive compounds.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge level
CO1	To introduce the concept of fermentation and its range To impart information on the component parts of Fermentation process To explain the fermentor design, construction, types and Application of diverse types of fermentors.	K ₂ ,K ₃
CO2	To describe the characteristics and applications of industrially important microorganisms To procure knowledge on the types and methods of screening industrially important microorganisms To illustrate the methods of preservation and improvement of industrially important strains	K ₂ , K ₃
CO3	To comprehend the methods of inoculum development, Formulation and Sterilization of fermentation media for Upstream processing	K ₂
CO4	To categorise the different types of fermentation and cultures To explain the different methods of product recovery in Downstream processing	K ₄ ,K ₂
CO5	To confer the mechanism of industrial production of commercially important molecules from microorganisms To define the concept and applications of	K ₂ , K ₃

	microbial transformations.	
--	----------------------------	--

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	M	S	S	S
CO3	S	M	S	M	M
CO4	S	S	M	M	S
CO5	S	S	M	S	M

S-Strong, M-Medium, L-Low

17PMB33B	CORE XI- BIOPROCESS TECHNOLOGY	SEMESTER - III
-----------------	---	---------------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

An introduction to Fermentation Process. The range of Fermentation Process (Microbial biomass, Enzymes, Metabolites, Recombinant products, Transformation processes). Component parts of Fermentation process. Fermentor Design and Construction, Fermentor types - Bioreactors for Aerobic fermentation- Stirred bioreactors- Reactors for immobilized cells. Heat exchange, Stirring and Mixing, Gas exchange and Mass transfer.

UNIT - II

Industrially important Microorganisms. Isolation (Primary and Secondary screening), Preservation and Strain improvement (Mutation, Recombination, Regulation, Gene technology and Use of Genetic methods).

UNIT - III

Upstream processing-Development of Inoculum for Fermentation process- Media for Industrial Fermentation - Formulation, Optimization and Sterilization, Various stages in Upstream (Inoculum preservation, Growth of the inoculum, Fermenter preculture and Production fermentation).

UNIT - IV

Fermentation Types and Cultures -Batch, Continuous, Fed-batch, -Basic Growth Kinetics- Submerged and Solid state Fermentation -Downstream Processing-Recovery and Purification of Intracellular and Extracellular Products (Flocculation, Flotation, Filter systems, Centrifugation, Disintegration, Chromatography, Extraction, Crystallization, Precipitation and Drying).

UNIT - V

Microbial production of Organic acids (Citric and Acetic) Enzymes (Amylase and Protease) Aminoacids (Lysine and Glutamic acid), Antibiotics (Penicillin, Streptomycin and Griseofulvin), Vitamins (Riboflavin, Cyanocobalamin and Ascorbic acid)-Biosynthesis of Ergot alkaloids-Microbial transformation-Steroids and Sterols, Non-steroid compounds, Antibiotics and Pesticides.

TEXT BOOKS:

1. *Crueger W and Crueger A.* 1991. **Biotechnology. A textbook of Industrial Microbiology.** Sinauer Associates Inc.,U.S.
2. *Stanbury P T and Whitaker* 1984. **Principles of Fermentation Technology**, 1st Edition. Adithya Books pvt ltd. New Delhi.

REFERENCE BOOKS:

1. *Peppler. H.J.* 1997. 2 nd edition. **Microbial Technology.** Microbial Processes. Vol I & II. Academic Press.Cambridge.
2. *Demain A.J. and Solomon INA,* 1999. 2nd edition. **Manual of Industrial Microbiology and Biotechnology.** ASM press.USA.

17PMB33C	CORE XII- BIOTECHNOLOGY	SEMESTER - III
----------	-------------------------	----------------

PREAMBLE:

To understand the principle of getting recombinant tools like restriction enzymes for effective biotechnological approach and confer thorough idea on exploration of microbial resources for bettered living society with minimal ecological disturbances and maximal potential tapping.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge level
CO1	<ul style="list-style-type: none"> To introduce the concept of Bio pharmaceuticals. To understand the principle of recombinant methods in commercial production of interferons, antibiotics, vaccines, growth hormones and monoclonal antibodies. 	K ₂ ,K ₃
CO2	<ul style="list-style-type: none"> To describe the characteristics and applications of industrially important microorganisms. To exploit them for commercial production of small and large bio-molecules like Xanthan gum, melanin etc., 	K ₂
CO3	<ul style="list-style-type: none"> To describe the method of genetic modification in obtaining crops with resistance to insects and microbial diseases. To explain and understand the role of Ti plasmid in genetic recombination. To improve the yield of crops through genetic modification by growth promotion. 	K ₂
CO4	<ul style="list-style-type: none"> To be familiarise with gene transfer methods to plant cells. To apply knowledge of rDNA technology in improving quality of plant products. 	K ₄ ,K ₂

CO5	<ul style="list-style-type: none"> • To comprehend the methods of producing transgenic animals. • To demonstrate and create awareness on significance of embryonic stem cell methods. • To know the applications of genetic engineering in forensic science. • To upgrade the application of gene therapy to treat genetic disorders. 	K ₂ , K ₃
-----	---	---------------------------------

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	M	S	S	S
CO3	S	M	S	M	M
CO4	S	S	M	M	S
CO5	S	S	M	S	M

S-Strong, M-Medium, L-Low

17PMB33C	CORE - XII: BIOTECHNOLOGY	SEMESTER - III
----------	---------------------------	----------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Microbial production of Therapeutic agents and Vaccines: Pharmaceuticals - Interferons and Growth Hormones, Enzymes - Dnase I and Alginate lyase, Monoclonal antibodies - HIV therapeutic agents. Vaccines - Subunit vaccines - herpes simplex virus, Foot and Mouth disease virus and TB, Peptide vaccine - Genetic immunization - attenuation through recombinant DNA technology, Vector vaccines.

UNIT - II

Synthesis of commercial products by Recombinant microorganisms: Restriction endonucleases - *pstII*, Small biological molecules: Indigo, Synthesis of novel antibiotics, Biopolymers: Xanthan gum, Melanin, Byssal adhesive, rubber and PHA.

UNIT - III

Microbial Biotechnology - Plant growth promoting bacteria (PGPR) - Genetic engineering of nitrogenase gene cluster, hydrogenase and Nodulation. Biocontrol of pathogens - Siderophores, antibiotics and enzymes. Microbial insecticides: Insecticidal toxin of BT - Genetic engineering of BT strains - Baculovirus.

UNIT - IV

Plant Biotechnology: Genetic engineering of plant: Ti Plasmid, Ti plasmid derived vector systems - microprojectile bombardment - Development of insect, virus and herbicide resistant plants, stress and senescence tolerant plants, modification of flower pigmentation, nutritional content, discoloration and sweetening by genetic engineering. Plant as bioreactors.

UNIT - V

Animal Biotechnology - Transgenic animals: methods of creating transgenic mice, cattle and sheep. Human gene therapy - in vivo and ex vivo gene therapy. Gene delivery system. Molecular diagnostics of genetic diseases. Regulating the use of biotechnology: recombinant DNA Technology, food and agricultural ingredients, human gene therapy, deliberate release of genetically engineered organisms.

TEXT BOOKS:

1. *Brown T.A.*, 2002. **Genomes**, 1st edition, John- Wiley & Son. Australia.
2. *Glick B .R and Pasternak J .J* .1994. **Molecular Biotechnology. Principles and Application of recombinant DNA**, 2 nd edition. ASM Press, Washington.

REFERENCE BOOKS:

1. *Winnecker, E.D*, 1987. **From Gene to Clones**, Introduction to Gene Technology, 1 st edition. Panima educational book agency. New Delhi.
2. *Old. RW and Primrose*, 1995. **Principle of Gene Manipulation**, 5th edition. Blackwell Scientific Publication, Boston.

17PMB33D	CORE XIII- MEDICAL MICROBIOLOGY	SEMESTER - III
-----------------	--	-----------------------

PREAMBLE:

To comprehend the concept of infectious disease process, transport, processing and examination of medically important microorganisms and their pathogenesis.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge level
CO1	<ul style="list-style-type: none"> • To understand the concept of infectious disease process. • To acquire knowledge on the collection and processing of clinical samples. • To interpret the results of antibiogram and serological tests for diagnosis of infectious disease. 	K ₂ , K ₃
CO2	<ul style="list-style-type: none"> • To describe the morphology, cultural characteristics and pathogenesis of gram positive cocci and rods. 	K ₂ , K ₃
CO3	<ul style="list-style-type: none"> • To describe the morphology, cultural characteristics and pathogenesis of gram negative cocci and rods. 	K ₄
CO4	<ul style="list-style-type: none"> • To understand the basic concepts of virology. • To know the importance of conventional and modern techniques in the diagnosis of viral infections. • To familiarise with important viral infections of human. 	K ₄ , K ₅

CO5	<ul style="list-style-type: none"> • To classify human fungal infections and to understand the important systemic fungal infections. • To understand the pathogenicity of parasitic infections of human and to appraise their laboratory diagnosis. 	K ₄ , K ₅
-----	---	---------------------------------

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	M
CO2	S	M	S	S	S
CO3	M	M	S	M	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S

S-Strong, M-Medium, L-Low

17PMB33D	CORE XIII- MEDICAL MICROBIOLOGY	SEMESTER - III
-----------------	--	-----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Introduction to medical microbiology - Infectious Diseases process -
Diagnosis: Collection, transport and processing of clinical samples -
Urine, sputum, blood, stool, CSF, Pus. Antibigram and serological test.

UNIT - II

Gram positive organisms - Morphology, cultural characteristics,
pathogenicity and laboratory diagnosis of Staphylococcus aureus,
Streptococcus pyogenes, Pneumococcus, Bacillus anthracis,
Corynebacterium diphtheriae, Clostridium tetani, Clostridium botulinum,
Mycobacterium tuberculosis, Mycobacterium leprae, Spirochaetes -
Treponema pallidum and Leptospira icterohaemorrhagiae.

UNIT - III

Gram negative organisms:- Morphology, cultural characteristics,
pathogenicity and laboratory diagnosis of E.coli, Klebsiella sp, Salmonella
typhi, Shigella dysenteriae, Pseudomonas aeruginosa, Vibrio cholera,
Proteus sp.,and Neisseria gonorrhoea , Neisseria meningitidis.

UNIT-IV

Virology: Basic concepts of virology - General properties of Human
viruses, Approaches to viral diagnosis- Serological and Molecular
techniques, Pathogenicity and Laboratory diagnosis of viral infections -
Hepatitis, Polio, Rabies, Influenza, Measles, Mumps, Rubella, Dengue
virus and HIV.

UNIT-V

Mycology: General properties and approaches to laboratory diagnosis. Mycosis - Superficial, Subcutaneous and Systemic infections - Cryptococcosis, Madura mycosis, Histoplasmosis, Candida albicans, Aspergillosis.

Parasitology: Pathogenicity and laboratory diagnosis of Entamoeba histolytica, Trichomonas vaginalis, Plasmodium vivax, Leishmania donovani, Wucheraria bancrofti, Taenia solium.

TEXT BOOKS:

1. *Patrick.K.Murray*. 2012. 4th edition. **Medical Microbiology**. Mosby Publishers. USA.
2. *Ananthanarayanan R and CK Jayaram Panicker*, 2005. 2nd edition. **Introduction to Medical Microbiology**. Orient Longman. Kerala.
3. *CK Jayaram Paniker*. 2007. **Medical Parasitology**, 6th Edition. Jaypee Brothers Medical Publishers (p) Ltd. New Delhi.

REFERENCE BOOKS:

1. *Bailey and Scotts*, 1994, **Diagnostic Microbiology**, 9th edition, Baron and Finegold CV Mosby Publications.
2. *Jawetz E Melnic JL and Adel berg EA* 1998, **Review of Medical Microbiology**. Lange Medical Publications, USA.
3. *Mackie and Mc Catney*, 1994, **Medical Microbiology No I and II**. Churchill Livingstone, 14th edition.

17PMB33E	CORE XIV- BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER- III
-----------------	---	----------------------

PREAMBLE:

The course provides exposure to a range of conceptual, methodological and statistical skills that are likely to be encountered during the completion of thesis as well as in future research and professional work.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	<ul style="list-style-type: none"> • Practice in collection, classification and tabulation of data. • Formulate and interpret graphs appropriately. 	K3 K5
CO2	<ul style="list-style-type: none"> • Understand and compute the basic descriptive statistical measures. • Estimate the sample for standard deviation and sample mean. 	K4 K2
CO3	<ul style="list-style-type: none"> • Calculate association measures such as correlation and regression. . • Practice the methodology of hypothesis testing, the concepts of p value, the level of significance and confidence interval, the types of I and II errors. 	K4 K3
CO4	<ul style="list-style-type: none"> • Learn how to categorize and design a research study. • Understand principles of conducting ethical research. 	K5 K3
CO5	<ul style="list-style-type: none"> • Understand the interpretation and appropriate reporting requirements for statistical and qualitative data. 	K4

	<ul style="list-style-type: none">Demonstrate competence in statistical theory and methodology by open defense presentation.	K6
--	--	----

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	S	S	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S - Strong; M - Medium; L- Low

17PMB33E	CORE XIV: BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER- III
----------	---	----------------------

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I: Introduction to Biostatistics and Descriptive statistics

Definition - Scope of Biostatistics. Variables in Biology. Collection, Classification and Tabulation of data. Graphical and diagrammatical representation - Scale diagram, Histogram and frequency curve.

UNIT - II: Descriptive statistics - Univariate Analysis

Measures of central tendency - Arithmetic mean, Median, Mode. Calculation of Mean, median, Mode in series of individual observations, discrete series, continuous, open end classes. Measure of dispersion - Standard deviation and standard error.

UNIT - III: Inferential statistics - Bivariate and Multivariate Analysis

Correlation - simple and coefficient of correlation. Regression - simple and linear regression. Probability analysis. Basic ideas of significant test - Hypothesis testing, Level of significant test, test based on studies: t-test, chi square and Goodness of fit.

UNIT - IV: Research Methodology: An Introduction

Research Methodology-Meaning and objectives and types of research. Research approaches - research Process. Defining the research problem - Research design. Sampling - types and design. Data collection methods

for bioscience research - processing and analysis of data. Hypothesis testing: applications in Biological Science. Fundamentals of Bioethics.

UNIT - V: Master's Thesis Preparation and 'Open defence presentation'

Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Summary, Acknowledgements and Bibliography. Computer and Research. Preparation for 'Open Defense Presentation'. Bibliometrics

TEXT BOOKS:

1. *Gupta, S. P.*, 2009. Specifications of Statistical methods, 28th Edition. Sultan Chand & sons.
2. *Kothari, C. R.*, 2004. **Research Methodology: Methods and Techniques**, New Age International, New Delhi.
3. *Shaleesha A. Stanley*, 2008. **Bioethics**, 1st edition. Wisdom educational service.

REFERENCE BOOKS:

1. *Khan, Irfan A. and Atiya Khanum*. 1994. **Fundamentals of Biostatistics**, Ukaaz Publications, Hyderabad.
2. *Martin, M.W. and Schinzinger R*. 2003. **Ethics in engineering**, III Edition, Tata Mc Graw- Hill, New Delhi.
3. *Zar, J.H.* (2006). **Biostatistical analysis**, 4th Edn. Pearson education Inc. New Jersey.
4. *Sundar Rao, P.S.S. and Richard, J.* (2006). **Introduction to Biostatistics & Research methods**. Prentice -Hall of India (P) Ltd, New Delhi.

17PMB33P	CORE PRACTICAL - III	SEMESTER -III
----------	----------------------	---------------

Total Credits: 3
Hours per week: 6

CONTENTS

1. Collection, transport and processing of clinical samples -Urine, Pus, Sputum, Stool, Wound samples.
2. Isolation and identification of clinically important fungi- *Candida albicans*, *Aspergillus sp.*,
3. Antibiotic susceptibility test - Kirby Bauer technique
4. Antibiotic susceptibility test – Stokes method
5. Observation of parasites - *Entamoeba histolytica*, *Trichomonas vaginalis*, *Plasmodium vivax*, *Leishmania donovani*.
6. Serological test for HBsAg and HBcAg
7. Dot ELISA
8. Organic acid production – Citric acid – Submerged fermentation.
9. Production and Assay of Extracellular enzymes – Protease by submerged fermentation
10. Production and Assay of Extra cellular enzymes – Amylase by Solid state fermentation.
11. Screening and assay of Antibiotics.
12. Blotting techniques - Western Blotting.
13. PCR(Demonstration)

LAB MANUALS:

1. *Aneja. K.R.* 2012. **Experiments in Microbiology, plant pathology and biotechnology**, 4th Edition. New age publishers.
2. *James.C.Cappuccino.* 2013. **Microbiology A laboratory manual**. 1st edition, Pearson education publishers.
3. *Rajan S. and Selvi Christy.* **Experimental Procedures in Life Sciences**. Anjana book House.

4. *Kannan, N.* 1997. **Laboratory Manual of General Microbiology**, 1st edition, Panima Publishing House.

17PMB3EA	ELECTIVE III- FOOD MICROBIOLOGY AND FOOD QUALITY CONTROL	SEMESTER- III
-----------------	---	----------------------

PREAMBLE:

This course has been designed for students to learn and understand the relation between food and microbes, fermented food, food borne diseases and food quality control.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge level
CO1	<ul style="list-style-type: none"> • To understand the relation between the food and microbes and types of microorganisms in related to food. • To acquaint the knowledge on spoilage of various types of food by microbes • To Understand the principles of food preservation and some preservation methods 	K2, K3
CO2	<ul style="list-style-type: none"> • To describe the characteristics food infections and poisoning and various food borne microorganisms. • To understand the role of microbes and the process involved in the production of various fermented food products. 	K3
CO3	<ul style="list-style-type: none"> • To acquaint the knowledge on indicator organisms and examination of food for the identification of spoilage causing microorganisms. 	K3, K4
CO4	<ul style="list-style-type: none"> • To become equipped with in house quality assurance in food industry and, GMP, SSOP and HACCP Principles 	K3, K4
CO5	<ul style="list-style-type: none"> • To describe about the food laws and regulations. • To understand the GHP and waste disposal 	K3

	in food industry	
--	------------------	--

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	S
CO3	S	M	S	M	M
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong,M-Medium,L-Low

17PMB3EA	ELECTIVE III- FOOD MICROBIOLOGY AND FOOD QUALITY CONTROL	SEMESTER- III
-----------------	---	----------------------

Total credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Food as a substrate - Incidence and types of microorganisms in food - Contamination and Spoilage of Meat, Poultry, Sea foods, Vegetables, Fruits. Principles of food preservations: Asepsis, Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives.

UNIT - II

Food poisoning - Food borne diseases- Bacterial and Non- Bacterial. Fermented foods - Meat and fishery products - Country cured hams, Dry sausages, Katsuobushi. Fermented milk products -, Yoghurt and Cheese.

UNIT - III

Indicator organisms - Direct examination - culture techniques - enumeration methods - plate - Viable & Total Count; Alternative methods - Dye reduction tests , electrical methods , ATP determination: Rapid methods, immunological methods - DNA / RNA methodology - Laboratory accreditation.

UNIT - IV

In house Committee for quality assurance, Persons involved, Internal Microbial Quality control Policy, Quality Check at every step from

collection of raw materials till it reaches the customer, GMP, SSOP, HACCP- Principles & Applications.

UNIT - V

Food laws and regulations

A. National – PFA Essential Commodities Act (FPO, MPO etc.)

B. International – Codex Alimentarius, ISO – 9000 series, ISO 22000 & BS 5750.

C. Regulatory Agencies – WTO, FSSAI.

Hygiene and sanitation in food sector General Principles of Food Hygiene, GHP for commodities, equipment, work area and personnel, cleaning and disinfection (Methods and agents commonly used in the hospitality industry), Safety aspects of processing water (uses & standards) and Waste Water & Waste disposal.

TEXT BOOKS:

1. *Frazier. W.C and D.C Westhoff.* 1978. **Food Microbiology.** 3rd ed. Tata McGraw Hill publishing Co., New Delhi.
2. *Jay, J.M .*1991. **Modern Food Microbiology** 4th edition, Van Nostra and Rainhokdd Co.

REFERENCE BOOKS:

1. *Adams. M. R and M. D Moss.*2007. **Food Microbiology,** 2nd edition. Panama Publishers.
2. *Roger.Y.Stanier.* 1987. **Basic Food Microbiology.** 2nd edition, CBS Publishers.
3. Food safety and standards regulations, 2010.
4. The ministry of health and family welfare, The Gazette of India : Extraordinary, Part - III, section
5. D Kumar Bhatt, Priyanka Tomar, 2010. **An Introduction to Food Science Technology and Quality Management** 1st Edition, Kalyani Publishers

17PMB3EB	ELECTIVE III-ECOLOGY	SEMESTER - III
-----------------	-----------------------------	-----------------------

PREAMBLE:

This course illustrates the:

1. Conceptual foundations of ecology
2. Ecological and environmental issues

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge level
CO1	<ul style="list-style-type: none"> To understand the relation between the environment and organisms. 	K3
CO2	<ul style="list-style-type: none"> To describe the characteristics of population and population growth. 	K3
CO3	<ul style="list-style-type: none"> To acquaint the knowledge on species interaction and diversity. 	K4
CO4	<ul style="list-style-type: none"> To become equipped with structure of ecosystem. 	K3, K4
CO5	<ul style="list-style-type: none"> To describe about the Environmental ecology. To understand the concept of global environmental changes. 	K3

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	S
CO3	S	M	S	M	M
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong, M-Medium, L-Low

17PMB3EB	ELECTIVE III- ECOLOGY	SEMESTER - III
-----------------	------------------------------	-----------------------

Total Credits: 4
Hours per Week: 4

CONTENTS

UNIT - I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

UNIT - II

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemographic extinctions, age structured populations.

UNIT - III

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

UNIT - IV

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems:

terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

UNIT - V

Applied Ecology: Environmental pollution; global environmental change; biodiversity :status, monitoring and documentation; major drivers of biodiversity change ; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

TEXT BOOK:

1. *N. Arumugam*, 2007. **Organic Evolution**. Saras Publications.

17PMB4EA	ELECTIVE IV- EVOLUTION	SEMESTER- IV
-----------------	-------------------------------	---------------------

PREAMBLE:

The course implemented to impart knowledge in concepts of Origin of life and the importance of Evolution theory.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge level
CO1	<ul style="list-style-type: none"> To understand the Evolution theory. To acquaint the knowledge on Natural selection. 	K2, K3
CO2	<ul style="list-style-type: none"> To describe the characteristics of polymorphism and Variation. 	K3
CO3	<ul style="list-style-type: none"> To acquaint the knowledge on species selection and types of evolution. 	K3, K4
CO4	<ul style="list-style-type: none"> To equip with pattern and categories of evolution. 	K3, K4
CO5	<ul style="list-style-type: none"> To describe about the fossils and zoogeography. 	K3

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	S
CO3	S	M	S	M	M
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong, M-Medium, L-Low

17PMB4EA	ELECTIVE IV- EVOLUTION	SEMESTER - IV
-----------------	-------------------------------	----------------------

Total Credits: 2
Hours per week: 5

CONTENTS

UNIT - I

Introduction - Origin of Life - Evidences of Evolution - Lamarckism - Neo-Lamarckism - Darwinism- Neo-Darwinism - Mutation Theory of De Vries - Modern Version of Mutation Theory - Natural Selection- Modern Synthetic Theory of Evolution.

UNIT - II

Genetic Assimilation and Genetic Homeostasis - Non-Adaptive Traits - Polymorphism - Variation - Elemental Forces of Evolution - Polyploidy - Hardy-Weinberg Law - Genetic Drift.

UNIT - III

Species Concepts- Speciation- Isolating Mechanisms- Neoteny and Evolution - Molecular Evolution, - Post-adaptation and Pre-adaptation.

UNIT - IV

Patterns of Evolution - Origin of Higher Categories - Orthogenesis - Evolution of Horse - Evolution of Elephant - Evolution of Man.

UNIT - V

Fossils - Geological Time Scale - Indian Fossils - Living Fossils - Extinction - Animal Distribution- Zoogeography - Insular Fauna - Mimicry, Colouration and Evolution - Adaptive Radiation,

TEXT BOOK:

1. *N.Arumugam. Organic Evolution.* Saras Publications, India.

17PMB4EP	ELECTIVE IV- PRACTICAL	SEMESTER - IV
----------	------------------------	---------------

Total Credits: 2
Hours per week: 5

CONTENTS

1. Staining Techniques (Grams and LPCB)–Food samples- vegetables and packed foods.
2. Sterility tests for Instruments – Autoclave & Hot Air Oven
3. Air quality checking by settle plate method.
4. Sterility testing of Microbiological media
5. Sterility testing of Pharmaceutical products –Antibiotics, Vaccines & fluids
6. Enumeration of microbes from industrial effluents.
7. Evaluation of Drug potency by MIC.
8. Isolation & characterization of Bacteria from Wood.
9. Isolation & characterization of Bacteria from Paints.
10. Water quality analysis – MPN.
11. Estimation of BOD
12. Estimation of COD.
13. Isolation of microorganisms from spoiled foods – Meat, milk, Cereals and Bread.
14. Milk quality – Dye reduction test.
15. Determination of Thermal death point and thermal death time.

LABORATORY MANUALS:

1. *Cappuccino & Sherman, Microbiology - A laboratory manual*, 6th Ed, Pearson Education.
2. *Dr.B.J.Wadher & Dr.G.L.Bhoosreddy, Manual of diagnostic microbiology*, 1st Ed., Himalaya publishing house, Nagpur.
3. *George.A.Wistreich & Max.D.Lechtman, Laboratory Exercises in Microbiology*, 3rd Ed, Glencoe press, London.

M.Sc., Microbiology (Students admitted from 2017-18 and onwards)

17PMBS1	SELF STUDY PAPER - I: DEVELOPMENTAL BIOLOGY	SEMESTER- III
---------	--	--------------------------

Total credit: 1

OBJECTIVES:

1. To understand the concepts in development of life.

CONTENTS

UNIT - I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

UNIT - II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm - egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants;

UNIT - III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis - vulva formation in Caenorhabditis elegans , eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development - larval formation, metamorphosis; sex determination.

UNIT - IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum

UNIT - V

Programmed cell death, aging and senescence.

TEXT BOOKS:

1. *Scott F Gilbert, Developmental Biology 10th Edi.* 2013.
SinauerAssociates, inc.

17PMBSS2	SELF STUDY PAPER - II: INHERITANCE BIOLOGY	SEMESTER- III
-----------------	---	----------------------

Total credit: 1

OBJECTIVES:

1. To understand the fundamental concepts of genetics.

CONTENTS

UNIT - I

Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

UNIT - II

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.

UNIT - III

Microbial genetics: Methods of genetic transfers - transformation, conjugation, transduction and sex - Induction, mapping genes by interrupted mating, fine structure analysis of genes.

UNIT - IV

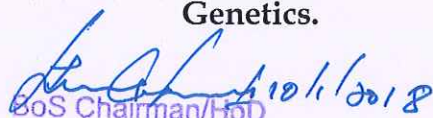
Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.


UNIT - V

Mutation: Types, causes and detection, mutant types lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non - homologous recombination including transposition.

TEXT BOOKS:

1. Gardner, E. J. Simmons, M. J & Snustad, D. P. **Principles of Genetics.**


SoS Chairman/HOD
Department of Microbiology
Dr. N. G. P. Arts and Science College
Coimbatore - 641 048


Dr. P. R. MUTHUSWAMY
PRINCIPAL
Dr. NGP Arts and Science College
Dr. NGP - Kalapatti Road
Coimbatore - 641 048
Tamilnadu, India