

MASTER OF SCIENCE IN MICROBIOLOGY

SYLLABUS 2018-19

(Outcome Based Education)



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

(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore)

Approved by Government of Tamil Nadu and Accredited by NAAC with 'A' Grade (2nd Cycle)

Dr. N.G.P.- Kalapatti Road, Coimbatore-641048, Tamil Nadu, India

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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 PROGRAMME

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

Course Code	Course	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	6	9	40	60	100	3
	ELECTIVE- I :	4	3	25	75	100	4
		30				600	27
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
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	26	-	75	75	150	7
	ELECTIVE - IV:	4	9	40 / 25	60 / 75	100	2
		30				250	09
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.	17PBC1EA	Cancer: Biology, Diagnosis and Therapy
3.	18PBT1EA	Biodiversity and bio prospecting

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.	17PBC2EA	Biochemistry of Toxicology
3.	18PBT2EA	Organic Farming

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.	18PBC3EA	Nutrition and Clinical Nutrition
3.	18PBT3EA	Stem Cell Technology

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.	18PMB4EP	Practical: Microbiological Laboratory Techniques
2.	18PBC4EP	Practical: Nutritional Science
3.	18PBT4EP	Practical: Applied Biotechnology

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 PROGRAMME 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- 50-59 marks

Below 50 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.	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 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

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
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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

COs/ POs	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
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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,Polarizationmicroscope,Confocal,Perfocal, 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 - carboxysomes - magnetosomes - phycobilisomes - Endospores. External structure - Cell Wall - Flagella and its function - Glycocalyx - 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
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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 welfare. 	K3, K4

MAPPING WITH PROGRAMME OUTCOMES

COs/ POs	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
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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. **Alcamo'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
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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 aminoacids, nucleotides, fatty acids and cell wall of Gram positive and Gram negative bacteria. 	K3

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
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MAPPING WITH PROGRAMME OUTCOMES

COs/ POs	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
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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 diol - 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, de novo 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. Methylophiles – 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
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PREAMBLE:

1. 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	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	To become equipped with the operational principle and working methods of spectral instruments.	K3
CO3	To procure knowledge on the principles and techniques of various types of electrophoresis with emphasis on recovery and identification of electrophoresed molecules.	K2
CO4	To acquaint the concept of radioactivity and its types of decay. To describe the methods of detection and measurement of radioactivity based on different principles.	K3
CO5	Application of knowledge for the characterization of Biomolecules.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/ POs	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
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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.** 7thedition. 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
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Total Credits: 3
Hours per week: 6

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- PRINCIPLES OF QUALITY ASSURANCE	SEMESTER – I
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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 of laboratory hazards and first aid procedures. 	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/ POs	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
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Total Credits: 4
Hours per week: 4

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 Lal Ichhpurani*. 1995. I ed. **“Quality assurance in Microbiology”**.
2. *Anne. A. Hurley*. 2001. **Principles of Quality Control**. John Wiley and sons.

17PBC1EA	ELECTIVE-I: CANCER- BIOLOGY, DIAGNOSIS AND THERAPY	SEMESTER-I
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PREAMBLE:

- This course offers an overview on cancer, mutations causing cancer, repair mechanism and multiples of diagnostic and treatment methods for cancer.
- Students can gain an in-depth knowledge and understanding on the basic principles of cancer development and available therapeutic approaches.

COURSE OUTCOMES:

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

CO number	CO Statement	Knowledge Level
CO1.	Compare and contrast benign and malignant tumors. Explain morphological characteristics of cancer cells.	K4 & K5
CO2.	Justify molecular basis of the cancer. Distinguish interdisciplinary areas in cancer biology. Elaborate the carcinogenetic process.	K4, K5 & K6
CO3.	Discuss about molecular mechanism of oncogenesis and tumor biology. Compare and explain the role of cell cycle in cancer. Value the importance of nutrition given to cancer patients.	K4, K5 & K6
CO4.	Judge the role of tumor suppressor genes and apoptosis. Elaborate on epigenetics.	K5 & K6
CO5.	Elaborate on the choice of diagnosis and therapy available for cancer patients.	K5 & K6

MAPPING WITH PROGRAMME OUTCOMES:

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

L-Low; M-Medium and S-Strong.

17PBC1EA	ELECTIVE-I: CANCER- BIOLOGY, DIAGNOSIS AND THERAPY	SEMESTER-I
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Total Credits: 4
Hours per week: 4

CONTENTS

UNIT-I Introduction

Introduction: Cancer cell-morphology and growth characteristics. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Differences between benign and malignant tumors.

UNIT-II Carcinogenesis

Cancer epidemiology. Cancer endocrinology. Cancer causing agents- radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Para-neoplastic syndromes. Mutation- definition, significance, rates and frequency. Mutagenic agents. Molecular basis of mutagenesis, induced and spontaneous mutations, crossing over and segregation. Various types of mutations- addition, deletion, inversion, reciprocal, translocation, insertional translocation and frame-shift mutations. Chemical carcinogenesis- genetic and epigenetic carcinogens, pro-carcinogens and co-carcinogens, promoters and initiators, testing for carcinogenicity, Ames test. Cancer biology and biochemistry- aberrant metabolism during cancer development.

UNIT-III Tumor Markers and Signal Transduction

Oncogenes- RNA and DNA tumor viruses, retroviruses and viral oncogenes. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer.

Tumormarkers; cellular proto-oncogenes-oncogene activation. Radiation-effect of ionising radiations on DNA, chromosomal aberrations. Genetic basis of cancer, metastasis, use of tumor markers in detection and monitoring of cancer. Signal transduction in cancer: cell- cell interactions, cell adhesion-invasion and metastasis - VEGF signaling and angiogenesis; role of transcription factors. Growth factors-EGF, TNF- α and TGF- β and growth factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.

UNIT-IV Cell Cycle, Cell Death and Cancer

Cell Cycle Regulation cancer: control of the cell cycle-cyclins and CDKs, and tumor suppressor genes p53, p21 Rb, BRACA1 and BRACA2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes. Role of DNA-methylation in gene silencing-epigenetic silencing of tumor-suppressor genes; Death-signaling pathways-mitochondrial and death receptor pathways, apoptosis and cancer (Intrinsic and extrinsic pathways). Mechanism of apoptosis. Impact of apoptosis on oncogenesis. Principles and methods of cancer diagnosis-biochemical, genetic, cytotoxic, cell growth and viability tests.

UNIT-V Cancer Diagnosis and Cancer Therapy, Stem Cells and Cancer

Diagnostics of cancer by histo-pathology, MRI scan, PET-scan, cytogenetic test, karyotype, FISH. Strategies of anticancer drug therapy-chemotherapy-gene therapy. Immuno-therapy and Radiotherapy. Immune therapy, surgical therapy and biologic therapy. Principles of cancer biomarkers and their applications. Stem Cells and Cancer.

TEXT BOOKS:

1. McKinnell R. G, Parchment R. E., Perantoni A. O, BarryPierce,Damjanov.I.,2006. **The Biological Basis of Cancer**, Second Edition, Cambridge University Press, United Kingdom.
2. **The Biology of Cancer:** R. A. Weinberg. Garland Science. 2006.
3. Franks,L.M. and Teich,N.M. 1991. **An introduction to Cellular and Molecular Biology of cancer**, 2nd Edition, Oxford University Press.
4. Vincent,T. *et al.*, 2011. **Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer**, 1st Edition, Lippincott Williams and Wilkins.

REFERENCE BOOKS:

1. Weinberg,R.A. 2013. **The Biology of Cancer**, 2nd Edition, Garland Science.
2. Hesketh,R. 2013. **Introduction to Cancer Biology**, Cambridge University Press.
3. Pelengaris,S. and Khan,M. 2002. **The Molecular Biology of Cancer**, 2nd Edition, Wiley Blackwell.

18PBT1EA	ELECTIVE- I: BIODIVERSITY & BIOPROSPECTING	SEMESTER - I
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Preamble :

1. To learn the importance of biodiversity and various methods of conservation.
2. To identify the Bioprospecting potentials of available natural resources.

Course outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	To understand about the biodiversity species, conservation methods of the species then organization involved for the conservation	K3, K4, K5
CO2	Elucidate the Biodiversity Data Requirements, Web Resources for Biodiversity Informatics and Major Bioinformatic Resources	K4, K5
CO3	Focus on Major areas of Bio-prospecting and Natural products from plants	K3, K4, K5
CO4	Elucidate Screening for bioactive compounds and highlight drug discovery and product development	K4, K5
CO5	To understand the role of various techniques in drug development and regulatory legislation in Bioprospecting	K3, K4, K5

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

18PBT1EA	ELECTIVE- I: BIODIVERSITY & BIOPROSPECTING	SEMESTER - I
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Total Credits: 4
4 Hours / Week

CONTENTS

UNIT-I

Biodiversity

*Biodiversity – definition, history, mapping and Human impacts, maintaining biodiversity. **Organizations involved for Conservation in India-** ENVFOR, AWBI, CEEINDIA, ENVIS, NBA, NCF – INDIA, NBPGR and WWF - INDIA. **Sustaining Biodiversity-** The Species and Ecosystem Approach, Sustaining Aquatic Biodiversity.

Case Studies: Cockroaches: Nature's Ultimate Survivors, Where have all the honey bees gone?

UNIT-II

Biodiversity Data Requirements

*Botanical Survey of India, Zoological Survey of India, National Parks, Wildlife Sanctuaries, Parks and Zoos. **Biodiversity Data Requirements-** Taxonomic and Historical Data – Museum and Herbarium, Molecular Data- Geonomics and Barcode Data. Spatial datasets. Data Standards: TDWG, DELTA, Darwin core, Barcode Data Standards. Indian Biodiversity Portal. **Web Resources for Biodiversity Informatics-** GBIF, Catalogue of Life, OBIS, MANIS, COP, UNEP-WCMC, ITIS, FAO, GLCF, NCBI Taxonomy, IBIS.

Case Studies: New trends in biodiversity informatics (particulate any one kind of species).

UNIT-III

Bio-prospecting

*Bio prospecting-definition, history, values of Bioresources and current Practices **Major areas of Bio-prospecting:** Chemical prospecting, Bionic prospecting and Gene prospecting. Bioresources mapping, inventorisation and monitoring of biological diversity. Biodiversity prospecting – the INBio experiences, contracts for Bioprospecting. **Natural products from plants:** Antitumor agents, Cardiotonics, Antiinflammatory drugs, Antimalarial drugs and analgesic drugs.

Case Study: Antimalarial and Antiinflammatory drugs from natural sources.

UNIT-IV

Screening for bioactive Compounds

Antimicrobials, Bioprospecting for industrial enzymes, plant growth promoting agents, Bioprospecting novel antifoulants and anti-biofilm agents from microbes. Bioprospecting of marine organisms. **Drug discovery and product development:** Discovery from traditional medicine. Modern tools in drug discovery.

Case Study: Antimicrobial drugs from marine sources.

UNIT-V

Role of techniques in drug analysis

*HPLC, GC - LC and GC Mass spectrometry, FTIR, NMR. Product development procedures and policies. **Regulating Bioprospecting:** Rules and regulations in patenting of products. Approval and IPR. Drug R&D and the structure of the industry, International policy dimensions of Bioprospecting, Transaction costs and their impact on the market for Bioprospecting, Intellectual property rights on traditional medicinal knowledge, Scope.

Case Study: Analysis of Traditional medicine for therapeutic purpose (Note;*Self study)

TEXT BOOKS:

1. Alan T. Bull.2004. **Microbial Diversity and Bioprospecting.** ASM Press.
2. Kevin J. Gaston, John I. Spicer. 2004. **Biodiversity: An Introduction.** Second Edition. Blackwell Publishing Company.

REFERENCE BOOKS:

1. Londa Schiebinger. 2007. **Plants and Empire - Colonial Bioprospecting in the Atlantic World.** 1st Edition. Harvard University Press.
2. Vanessa Sunkel. 2010. **Marine Bioprospecting and Natural Product Research.** LAP Lambert Academic Publishing.
3. Russell Paterson, Nelson Lima. 2017. **Bioprospecting - Success, Potential and Constraints.** Springer International Publishing

- Padmashree Gehl Sampath.* 2005. **Regulating Bioprospecting: Institutions for drug research, access, and benefit-sharing.** United Nations University Press.
4. *G. Tyler miller, Jr, Scott E. Spoolman.* 2007. **Essentials of Ecology.** Fifth Edition. Yolanda Cossio Publishers

17PMB23A	CORE V - MICROBIAL GENETICS AND MOLECULAR BIOLOGY	SEMESTER - II
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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 regulatory mechanisms at different levels. 	K2

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
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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
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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
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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: Immuno-diagnosis, haemagglutination and haemagglutination-inhibition tests, Complement fixation, neutralization, Western blot, RIPA, flow cytometry 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
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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 characterisation of cloned DNA. 	K2
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
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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
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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	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	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	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. To acquaint knowledge on the chemical and microbial assessment of water quality	K2,K3
CO4	To compare the characteristic features of microbial populations of symbiotic and non symbiotic nitrogen fixers, phosphate solubilizers and phytopathogens.	K3
CO5	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
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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
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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

COs/ POs	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
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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
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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
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PREAMBLE:

The Course aims to build the concepts regarding:

1. Sterility in pharmaceutical products
2. role of a qualified microbiologist in Pharma Industry
3. 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	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	Acquire a working knowledge of Indian GMP (Good Manufacturing Practice) requirements to the manufacture of pharmaceuticals, blood products, and natural health products	K3
CO3	Interpret the requirements for testing of raw materials, in-process samples, and finished product in accordance with pharmacopoeia compendia standards.	K3
CO4	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	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
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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 biofilms 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.

17PBC2EA	ELECTIVE-II: BIOCHEMISTRY OF TOXICOLOGY	SEMESTER-II
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PREAMBLE:

- This course offers an overview of the biochemical basis of toxicology and the effects & metabolism of toxins.
- Students can gain an in-depth knowledge and understanding of general toxicology, methods of toxicity testing, toxins from microbes, carcinogenic & teratogenic toxins, pesticide, metal and chemical toxicology.

COURSE OUTCOMES:

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

CO number	CO Statement	Knowledge Level
CO1.	Value the importance of toxicology. Explain about factors, which influence toxicity.	K5
CO2.	Distinguish and evaluate the biochemical effects of toxic agents on cellular macromolecules and tissues.	K4 & K5
CO3.	Compare and perceive different genetic methods used for testing toxicity.	K4 & K5
CO4.	Examine the effects and metabolism of various microbial toxins, teratogens and carcinogens.	K4
CO5.	Justify the mode of action of toxic pesticides, heavy metals, chemicals and air pollutants.	K5

MAPPING WITH PROGRAMME OUTCOMES:

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

L-Low; M-Medium and S-Strong.

17PBC2EA	ELECTIVE-II: BIOCHEMISTRY OF TOXICOLOGY	SEMESTER-II
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Total Credits: 4
Hours per week: 4

CONTENTS

UNIT-I Introduction to Toxicology

Definition and scope of toxicology, Classification of toxic agents. Dose-response relationship: Synergism and Antagonism - Determination of ED₅₀ and LD₅₀. Acute and chronic exposures, Factors influencing toxicity - Abiotic and Biotic factors, Chemical interactions - Bioaccumulation and Bio-magnification.

UNIT-II Biochemical basis of Toxicology

Mechanisms of Toxicity, Interaction of toxicant with target molecules - Disturbance of excitable membrane function. Altered calcium homeostasis. Covalent binding to cellular macromolecules. Tissue specificity of toxicity - Metabolism of haloalkanes, haloalkenes and their toxic effects on tissues.

UNIT-III Principles and procedures of testing for acute toxic effects

Toxicity testing- Genetic toxicity testing and mutagenesis assays- *In-vitro* test systems- Bacterial mutation tests: Reversion test and Fluctuation tests. *In-vivo* mammalian mutation tests- Host mediated assay and Dominant lethal test. Use of drosophila in toxicity testing. DNA Repair assays, Chromosome damage test. Toxicity testing in animals.

UNIT-IV Effects and Metabolism of toxins

Fungal toxins, Mycotoxins - Aflatoxins, Bacterial toxins- Exotoxins (types-I, -II and -III) and Endotoxins, Viral toxins, Algal toxins, Teratogens, Carcinogens, Mutagens, Snake venom toxin, Spider, Scorpion and Jellyfish toxins, Antivenom. Xenobiotic metabolism: Phase 1- III

reactions, Cytochrome-P450's.

UNIT-V Pesticide toxicology, Metal toxicology, Chemical toxicology, Air and water pollutants

Mechanism and site of action of Chlorinated organics (DDT, BHC), organophosphates and carbamates. Mode of action of toxic heavy metals - arsenic, mercury, cadmium and lead. Biochemical effects of ozone, peroxyacetyl nitrate (PAN), carbon monoxide, nitrogen oxides, sulphur dioxide and cyanide. Common air pollutants, water pollutants and their sources, air pollution due to methyl-isocyanate (MIC) and asbestos. Case studies.

TEXT BOOKS:

1. *Duffus and Worth*, 2006. **Fundamental Toxicology**, Royal Society of Chemistry.
2. *De A.K*, 2017. **Environmental Chemistry**, Eighth edition, Newage International Publishers, New Delhi.
3. *Manahan and Stanley*, 2003. **Toxicological Chemistry and Biochemistry**, CRC Press.

REFERENCE BOOKS:

1. *Klaassen and Watkins III*, 2015. **Casarett and Doull's Essentials of Toxicology**, Third edition, McGraw Hill.
2. *Cockerham and Shane*, 1993. **Basic Environmental Toxicology**, CRC Press.
3. *Marrs and Turner*, 1999. **General and Applied Toxicology**, Third edition, John Wiley and Sons.

18PBT2EA	ELECTIVE- II: ORGANIC FARMING	SEMESTER - II
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PREAMBLE:

- The importance of organic farming and standardization/certification process has been highlighted.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Know about the basic of organic farming national and international level	K2, K3
CO2	Understand the farming systems and its management	K3, K4
CO3	Imparts knowledge on the plant protection and weed management	K3, K4, K5
CO4	In depth understanding of Organic crop production practices	K4, K5
CO5	Focus on Organic Certification and terrace farming technology	K4, K5

Mapping with Programme Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	M	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

18PBT2EA	ELECTIVE- II: ORGANIC FARMING	SEMESTER - II
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Total Credits: 4
4 Hours / Week

CONTENTS

UNIT - I

Concept of organic farming

Introduction: Farming, *organic farming, concept and development of organic farming. Principles of organic farming, types of organic farming, biodynamic farming. Benefits of organic farming, need for organic farming, conventional farming v/s organic farming Scope of organic farming; Tamil nadu, National and International status. Agencies and institutions related to organic agriculture. Requirements for organic farming, farm components for an organic farm.

Case Study: Conventional farming methods

UNIT - II

Organic plant nutrient management

Organic farming systems, soil tillage, land preparation and mulching. Choice of varieties. Propagation-seed, planting materials and seed treatments, *water management Green manuring, composting-principles, stages, types and factors, composting methods, Vermi composting Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges. Bio-fertilizers-types, methods of application, advantages and disadvantages, standards for organic inputs- fertilizers

Case Study: Benefits of vermicompost to different types of soil.

UNIT - III

Organic plant protection

Plant protection- cultural, mechanical, botanical pesticides, control agents. *Weed management, Standards for organic inputs- plant protection.

Case Study: Pesticides and its causes to plants

UNIT - IV

Organic crop production practices

Organic crop production methods- rice, coconut. Organic crop production methods- vegetables- okra, amaranthus, cucurbits. Livestock component in organic farming. Sustainable Agriculture-Apiculture, Mushroom cultivation.

Case Study: Organic food and its benefits

UNIT - V

Organic Certification

Farm economy: Basic concept of economics- demand & supply, economic viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/cost ratio, *marketing, imports and exports. Policies and incentives of organic production. Farm inspection and certification. Terrace farming. (Note: * Self study)

TEXT BOOKS:

1. *Palaniappan SP & Anandurai K. 1999. Organic Farming–Theory and Practice.* Scientific Publishers, Jodhpur.

REFERENCE BOOKS:

1. *S.P.Palaniappan and K.A. Annadurai. Organic Farming: Theory and Practice.* First edition, Scientific Publishers Journals Dept.
2. *A.K. Sharma. 2002. A hand book of Organic Farming.* Agro-Bios.
3. *S.A.Solaimalai, 2003. Farming system : Theory and Practice.* Manohar Publishers & Distributors, New Delhi.
4. *Joshi, M. 2014. New Vistas of Organic Farming* 2nd Ed. Scientific Publishers, Jodhpur.

17PMB33A	CORE X- PRINCIPLES OF IMMUNOLOGY	SEMESTER - III
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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 laboratories and research laboratories. 	K ₂ , K ₃ and K ₄ .
CO4	<ul style="list-style-type: none"> • Understand the role of cytokines in immunity and 	K ₂ , K ₃

	<p>immune cell activation; and be able to identify and characterize cytokines of particular immune importance;</p> <ul style="list-style-type: none"> • 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. 	
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
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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

Antigen and antibody reactions – Introduction and classification of antigen 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. Mosboy 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
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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 microbial transformations.	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

17PMB33B	CORE XI- BIOPROCESS TECHNOLOGY	SEMESTER - III
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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 acid and Acetic acid) Enzymes (Amylase and Protease) Aminoacids (Lysine and Glutamic acid), Antibiotics (Penicillin, Streptomycin and Griseofulvin), Vitamins (Riboflavin, Cyanocobalamine 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**, 1str 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
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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 	K ₂ , K ₃

	<p>significance of embryonic stem cell methods.</p> <ul style="list-style-type: none"> • To know the applications of genetic engineering in forensic science. • To upgrade the application of gene therapy to treat genetic disorders. 	
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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
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Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Microbial production of Therapeutic agents and Vaccines: Pharmaceuticals – Interferons, Insulin and Growth Hormones, Enzymes – Dnase I and Alginate lyase, Monoclonal antibodies – production, structure and functions, hybrid Human-mouse monoclonal antibodies and 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 – *pstI*, 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**, 2nd edition. ASM Press, Washington.

REFERENCE BOOKS:

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

17PMB33D	CORE XIII-MEDICAL MICROBIOLOGY	SEMESTER - III
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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	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	To describe the morphology, cultural characteristics and pathogenesis of gram positive cocci and rods.	K ₂ , K ₃
CO3	To describe the morphology, cultural characteristics and pathogenesis of gram negative cocci and rods.	K ₄
CO4	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	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
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Total Credits: 4

Hours per week: 4

CONTENTS

UNIT-I

Introduction to medical microbiology - Infectious Diseases process - Diagnosis: Collection, Preservation, 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

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, H1N1, Ebola, Chikungunya and HIV.

UNIT-V

Myiology: 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 falciparum and 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 JayaramPanicker*, 2005. 2nd edition. **Introduction to Medical Microbiology**. Orient Longman. Kerala.
3. *CK JayaramPaniker*. 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 CVMosby Publications.
2. *Jawetz E Melnic JL and Adel berg EA* 1998, **Review of Medical Microbiology**. LangeMedical Publications, USA.
3. *MackieandMcCatney*,1994,**MedicalMicrobiologyNoIandII**.Church illLivingston,14th edition.

17PMB33E	CORE XIV- BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER- III
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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. Demonstrate competence in statistical theory and methodology by open defense presentation. 	K4 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
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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.

UNIT - V: Structure of Scientific Reports and Thesis

General structure of scientific reports: IMRAD; Different types of scientific documents - journal articles, books, thesis, conference and project reports. Components of a research paper - abstract, key words, main text, illustrations, supporting information; Publication process, copyright transfer. Open access terms. Thesis: Structure and Content; Style manuals with examples (Harvard, Vancouver, APA, MLA); Citation styles: reference writing. Open Defense Presentation.

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
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Total Credits: 3
Hours per week: 6

CONTENTS

1. Collection, transport and processing of clinical samples -Urine, Stool, Sputum, Pus, Wound samples.
2. Isolation and identification of clinically important fungi- *Aspergillus sp.*, *Candida albicans*,
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
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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 in food industry 	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

17PMB3EA	ELECTIVE III- FOOD MICROBIOLOGY AND FOOD QUALITY CONTROL	SEMESTER- III
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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.* 2008. **Food Microbiology**. 5th ed. Tata McGraw Hill publishing Co., New Delhi.
2. *Jay, J.M* .2007. **Modern Food Microbiology** 7th edition, Van Nostra and Rainhokdd Co.

REFERENCE BOOKS:

1. *Adams. M. R and M. D Moss.*2008. **Food Microbiology**, 3rd edition. Panama Publishers.
2. Food safety and standards regulations, 2010.
3. The ministry of health and family welfare, The Gazette of India : Extraordinary, Part - III, section
4. D Kumar Bhatt, Priyanka Tomar, 2010.**An Introduction to Food Science Technology and Quality Management** 1st Edition, Kalyani Publishers.
5. Chris Bell, Paul Neavas and Anthony P. Williams, 2006. Food Microbiology and Laboratory Practices, Blackwell Publishing.

18PBC3EA	ELECTIVE - III: NUTRITION AND CLINICAL NUTRITION	SEMESTER -III
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PREAMBLE:

- This course offers an overview of food science and human nutrition knowledge help in achieving and maintaining good health
- Students can gain an in-depth knowledge and understanding on appropriate nutritional care for prevention/and treatment of the various diseases.

COURSE OUTCOMES:

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

CO number	CO Statement	Knowledge Level
CO1.	Inspect the composition of fiber and nutritional changes in inborn errors. Asses the nutritional status and Understand the nutritional changes due to preservation of food process.	K ₄ & K ₅
CO2.	Examine the clinical test for Cardiovascular diseases. Explain the importance of nutritional support during treatment of diseases.	K ₄ & K ₅
CO3.	Test for liver function. Relationship with food habits during treatment of livers diseases such as Hepatitis, Cirrhosis and Hepatic coma.	K ₄ & K ₅
CO4.	Examine the clinical test for renal functions. Compare the nutritional care- acid and alkaline ash diet and also diet modification with minerals for treatment of renal calculi.	K ₄ & K ₅
CO5.	Understand the dietary management during treatment of infectious diseases and cancer.	K ₄ & K ₅

MAPPING WITH PROGRAMME OUTCOMES:

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

L-Low; M-Medium and S-Strong

18PBC3EA	ELECTIVE - III: NUTRITION AND CLINICAL NUTRITION	SEMESTER -III
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Total Credit: 4
Hours per week: 4

CONTENTS

UNIT I

Concept of Balanced diet, Calories requirement – sedentary, moderate & heavy worker, Fast foods, Additives in the diet, Dietary allergies. Lactose intolerance. Quality of protein – animal versus plant protein, Parenteral nutrition, Types of diets – Paleo diet, keto diet, Prebiotics and Probiotics. Chemical composition of dietary fiber and its importance - Physiological effects and metabolic adaptation during exercise - Nutritional management of inborn errors of metabolism

Diet and nutrition in India

Assessment of nutritional status - Factors affecting digestion and absorption of food - Effects of irradiation, cooking, refining, sprouting and fermentation on nutritional quality of food

UNIT II

Dietary management of Cardio Vascular Diseases

Clinical diagnostic tests and nutrition management for - Dyslipidemias, Atherosclerosis, Angina Pectoris and Myocardial Infarction (MI) and Congestive Cardiac Failure (CCF), Prevention through life style modifications.

Dietary management of Hypertension

Dietary management - Diet related factors influencing hypertension, DASH diet

UNIT III

Dietary management of Liver disease

Types, Etiology, Symptoms and Complications, Physiology, functions of the liver and liver function tests. Metabolic consequences of alcohol consumption, Dietary management for - Hepatitis, Cirrhosis and Hepatic coma.

UNIT IV

Dietary management of Kidney Diseases

Kidney function tests; Types of kidney diseases:- Glomerulonephritis, Nephrotic Syndrome, Acute Renal Failure (ARF), Chronic Renal Failure (CRF), End Stage Renal Disease (ESRD)-Dialysis and Kidney Transplant. Nephrolithiasis/Renal Calculi : Etiology, Types of stones and nutritional care- acid and alkaline ash diet. Use of sodium, potassium and phosphorous exchange lists in diet planning of kidney diseases patient.

UNIT V

Dietary management in Febrile condition: Metabolic changes during infection and dietary treatment for - Typhoid, Influenza, Malaria, Tuberculosis and HIV & AIDS

Dietary management of cancer:

Dietary management to cancer patients.

TEXT BOOKS

1. Swaminathan S,(1985): Advanced Textbook on Food & Nutrition Vol. 1 & N (2nd Ed. Revised _ Enlarged) Bapp Co..
2. Mahan L.K., Sylvia Escott-Stump (2000): Krause" s Food Nutrition and Diet Therapy ,10th Edition, W.B. Saunders Company London.

3. B. Srilakshmi, (2007): Dietetics, published by K.K. Gupta For New age International Pvt. Ltd. New Delhi.
4. Swaminathan, M. 1974. Essentials of food and nutrition Vol. II, Applied aspects, Ganesh Pubishers, Madras

REFERENCE BOOKS

1. James Orten and Otto Neuhaus, 2003. Human biochemistry, 10th edition, CV Mosby Company, London.
2. Antia F.P. And Philip Abraham (2001) Clinical Nutrition and Dietetics, Oxford Publishing Company.
3. Passmore P. And M.A. East Wood: Human Nutrition And Dietetics, Churchill Living Stone.
4. WohlShils and Goodheart: Modern Nutrition In Health And Disease, McLaren And Ubrman, Philadelphia.
5. Robinson Ch., M.B. Lawlea, W.L., Chenoweth, and A.E., Carwick: Normal and Therapeutic Nutrition, Macmillan Publishing Company.
6. NIN books Nutritional values of Indian food.

18PBT3EA	ELECTIVE - III: STEM CELL TECHNOLOGY	SEMESTER - III
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PREAMBLE:

- To study the types of Stem cells
- To learn about the applications of Tissue Engineering

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Know the process of stem cell and storage	K3
CO2	Understand the stem cell importance in plants	K3, K4
CO3	Imparts knowledge on the stem cells in animals	K3, K4, K5
CO4	In depth understanding of haemopoietic stem cell	K4, K5
CO5	Focus on stem cell therapies and its application	K4, K5

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

18PBT3EA	ELECTIVE-III: STEM CELL TECHNOLOGY	SEMESTER - III
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Total Credits: 4
Hours / Week: 4

CONTENTS

UNIT - I

Stem Cells and Cellular Pedigrees

Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation, maturation, proliferation, pluripotency, self – maintenance and self – renewal – problems in measuring stem cells – preservation protocols.

UNIT - II

Stem Cell Concept in Plants

Stem cell and founder zones in plants – particularly their roots – stem cells of shoot meristems of higher plants.

UNIT - III

Stem Cell Concept in Animals

Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles – Tumour stem cells, Embryonic stem cell biology - factors influencing proliferation and differentiation of stem cells – hormone role in differentiation.

UNIT - IV

Haemopoietic Stem Cell

Biology – growth factors and the regulation of haemopoietic stem cells.

Hematopoietic stem cell niche, Embryonic stem cell-derived Hematopoietic stem cells. Cord blood hematopoietic stem cells- Cord

blood transplantation Characteristics of cord blood stem cells Genomics and proteomics of cord blood stem cells

UNIT - V

Potential Uses of Stem Cells

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering – blood and bone marrow – Fc cells. Stem cells for the treatment of muscular dystrophy- Cellular environment of a dystrophic muscle, Myogenic stem cells from embryonic stem cells and inducible pluripotent stem cells.

TEXT BOOKS:

1. *CS Potten* , 1997. **Stem cells**. Elsevier.
2. *Robert Paul Lanza*, 2006. **Essentials of stem cell biology**. 2nd edition. Academic Press;

REFERENCE BOOKS:

1. *Song Li, Nicolas L'Heureux, Jennifer Elisseeff*. 2011. **Stem Cell and Tissue Engineering**. 1st edition. World Scientific Publishers.
2. *Robert Lanza, John Gearhart, Brigid Hogan*. 2006. **Essentials of Stem Cell Biology**. 2nd edition. Macmillan Publishing Solutions.

17PMBSS1	SELF STUDY PAPER - I: DEVELOPMENTAL BIOLOGY	SEMESTER- III
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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
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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.*

18PMB4EP	ELECTIVE IV- PRACTICAL MICROBIOLOGICAL LABORATORY TECHNIQUES	SEMESTER - IV
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Total Credits: 2
Hours per week: 4

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.

18PBT4EP	ELECTIVE IV PRACTICAL- APPLIED BIOTECHNOLGY	SEMESTER IV
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**Total Credits: 2
4 Hours/Week**

CONTENTS

1. Morphology and anatomy of any 5 food crops.
2. Plant fibers - Morphology microscopic study anatomy of whole fibers, using staining methods.
3. Medicinal plants: At least 5 medicinal plants and their morphology, anatomy, phyto-chemistry.
4. Case study – On environmental Management (air and soil)
5. Preparation of Compost/ Vermicompost for agricultural development.
6. Production of spawn for mushroom cultivation.
7. Water quality assessment (acidity and alkalinity tests)
8. Estimation of minerals in soil
9. Agarose Gel Electrophoresis.
10. SDS PAGE
11. Restriction Digestion
12. Ligation

REFERENCES:

1. *Arora, R.K. and Nayar, E.R.* 1984. **Wild relatives of crop plants in India.** NBPGR Science, Monograph No.7.
2. *Thakur, R.S., Puri, H.S. and Husain, A.* 1969. **Major medicinal plants of India, Central Institute of medicinal and aromatic plants.** Lucknow.

3. *Walters, Michele, Scholes, Robert J. (Eds.).* **The GEO Handbook on Biodiversity Observation Networks.** 2017. 1st Edition. Springer International Publishing.
4. *Paterson, Russell, Lima, Nelson (Eds.).* **Bioprospecting.** 2017. 1st Edition. Springer International Publishing.
5. *Joseph Sambrook, Michael R. Green.* 2012. **Molecular Cloning: A Laboratory Manual.** 4th edition. Cold Spring Harbor.

18PBC4EP	PRACTICAL-NUTRITIONAL SCIENCE	SEMESTER-IV
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Total Credits: 2
Hours per week: 4

PREAMBLE:

- This course provides an overview of experimental aspects involving Nutritional science

CONTENTS

1. Ashing of food and preparation of ash solution.
2. Estimation of calcium in food.
3. Estimation of phosphorus in food.
4. Estimation of iron in food.
5. Estimation of ascorbic acid in cabbage by dye method.
6. Estimation of thiamine in food
7. Estimation of Protein in food
8. Estimation of Fat
9. Estimation of Carbohydrate
10. Estimation of Vitamin A and carotene
11. Estimation of Antioxidants

REFERENCE BOOK

1. Swaminathan, M, 1974. **Essentials of food and nutrition**, Vol. II, Applied aspects, Ganesh Publishers, Madras.

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20/12/2019

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