

MASTER OF SCIENCE IN MICROBIOLOGY

REGULATIONS

ELIGIBILITY

A pass in any one of the following Degree Cores 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, subject 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 core study of two academic years.

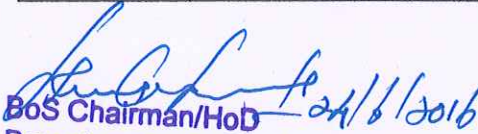
OBJECTIVE OF THE CORE

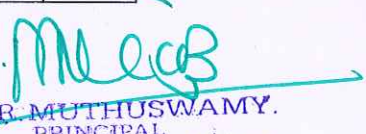
The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

- To provide opportunities to participate in Research projects and develop clinical and laboratory research skills.
- To present intense knowledge in areas of organization and functioning of micro-organisms.
- To train with latest bioinstrumentation and related techniques.
- To enable students to understand the applications of microbiology in healthcare, agriculture, food technology & environmental protection.

SCHEME OF EXAMINATIONS

Subject Code	Subject	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
16PMB13A	CORE - I: PRINCIPLES OF MICROBIOLOGY	5	3	25	75	100	4
15PMB13B	CORE - II: MICROBIAL DIVERSITY	5	3	25	75	100	4
15PMB13C	CORE - III: MICROBIAL PHYSIOLOGY	5	3	25	75	100	4
16PMB13D	CORE - IV: BIOINSTRUMENTATION	5	3	25	75	100	4
16PMB13P	CORE PRACTICAL - I	5	9	40	60	100	4
	ELECTIVE - I:	5	3	25	75	100	4
		30				600	24
Second Semester							
16PMB23A	CORE - V: MICROBIAL GENETICS AND MOLECULAR BIOLOGY	5	3	25	75	100	4
16PMB23B	CORE - VI: VIROLOGY	5	3	25	75	100	4
16PMB23C	CORE - VII: GENETIC ENGINEERING	5	3	25	75	100	4
16PMB23D	CORE - VIII: ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	5	3	25	75	100	4
16PMB23P	CORE PRACTICAL - II	5	9	40	60	100	4
	ELECTIVE - II:	5	3	25	75	100	4
		30				600	24
Third Semester							
16PMB33A	CORE - IX: PRINCIPLES OF IMMUNOLOGY	5	3	25	75	100	4
15PMB33B	CORE - X: BIOPROCESS TECHNOLOGY	5	3	25	75	100	4
16PMB33C	CORE - XI: BIOTECHNOLOGY	5	3	25	75	100	4
16PMB33D	CORE - XII: MEDICAL MICROBIOLOGY	5	3	25	75	100	4


 BoS Chairman/HoD
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M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

16PMB33P	CORE PRACTICAL- III	5	9	40	60	100	4
	ELECTIVE - III:	5	3	25	75	100	4
		30				600	24
Fourth Semester							
16PMB43A	CORE - XIII: BIostatistics AND RESEARCH METHODOLOGY	5	3	25	75	100	4
16PMB43B	CORE - XIV: BIOETHICS, BIOSAFETY AND IPR	5	3	25	75	100	4
16PMB43V	CORE- PROJECT AND VIVA VOCE	15	-	75	75	150	6
	ELECTIVE - IV:	5	9	40 / 25	60 / 75	100	4
		30				450	18
TOTAL						2250	90

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

ELECTIVE - I

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

S.No	Subject Code	Name of the Subject
1.	16PMB1EA	Principles of Quality Assurance
2.	16PMB1EB	Plant Science

ELECTIVE - II

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

S.No	Subject Code	Name of the Subject
1.	16PMB2EA	Pharmaceutical Quality Control
2.	16PMB2EB	Animal Science

ELECTIVE - III

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

S.No	Subject Code	Name of the Subject
1.	16PMB3EA	Food Microbiology and Food Quality Control
2.	16PMB3EB	Ecology

ELECTIVE - IV

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

S.No	Subject Code	Name of the Subject
1.	16PMB4EA	Evolution
2.	16PMB4EP	Practical

Total Credit Distribution

Subjects	Credits	Total		Credits	Cumulative Total
Core	4	14 x 100 =	1400	56	68
Core Lab	4	3 x 100 =	300	12	
Elective	4	4 x 100 =	400	16	16
Project	6	1 x 150 =	150	06	06
Total			2250	90	90

FOR COURSE COMPLETION

Students have to complete the following Subjects:

- Core cores in I, II, III and IV Semesters.
- Elective cores in I, II, III and IV Semesters.
- Core practical in I, II and III Semesters.
- Project and Viva - Voce in IV Semester.
- Compulsory 15 days internship for core completion.

Earning Extra credits is not mandatory for course completion

Extra Credits

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

Rules:

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

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

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

Self study paper offered by the Department of Microbiology

S. No.	Semester	Course Code	Course Title
1.	I sem to III	16PMBSS1	Developmental Biology
2.	sem	16PMBSS2	Inheritance Biology

List of online courses Prescribed by the Department

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

16PMB13A	CORE - I: PRINCIPLES OF MICROBIOLOGY	SEMESTER - I
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The course will impart knowledge on the

1. History of Microorganisms
2. Basic techniques in Microbiology
3. Structure and composition of prokaryotic and eukaryotic cell

CONTENTS

UNIT -I

Basic concepts – Discovery of microbes – 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 Hesse – Elie Metchnikoff.

UNIT- II

Sterilization and disinfection – Control of sterilization and Testing of sterility. Culturing of Bacteria – Pure culture Methods – Streak plate – Pour plate. Culture Media – Types of Media – Selective, Differential and Enriched Media. Cultivation of Anaerobes. Culture maintenance and Preservation. Culture Collection centers.

UNIT- III

Microscopy – Principles, Light microscope, Phase Contrast, Dark field, Bright field, Fluorescent – Inverted microscope – Electron microscope – TEM, SEM. 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 – 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. *Prescott, L.M J.P. Harley and C.A. Klein* 1995. **Microbiology** 2nd Edition Wm, C. Brown Publishers.
3. *Salle A.J.* 1984. **Fundamental Principles of Bacteriology** 7th Edition, Tata Mc Hill Publishing Company Ltd.,
4. *Michael J. Pelczar, Jr. E.C.S. Chan,* 1986. **Microbiology**. Mc Graw Hill Book Company.

REFERENCE BOOKS:

1. *Micheal T Madigan.* **Brock Biology of Microorganisms**, 10th edition. Peareson Education. New Delhi.
2. *Edward I Alcamo,* 2000. **Fundamentals of Microbiology**, 6th Edition. Jones and Bartlett Publishers. Baltimore.
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.

15PMB13B	CORE - II: MICROBIAL DIVERSITY	SEMESTER - I
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The course will impart knowledge on the

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

CONTENTS

UNIT- I

Microbial systematic - Taxonomic ranks - Classification system - Phenetic classification - Numerical taxonomy and Phylogenetic classification - Major characteristics used in taxonomy - Assessing microbial phylogeny - 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 protobacteria: Rhizobiales - Rickettsiales. β Proteobacteria: Neisseriales. Gamma proteobacteria: Enterobacteriales - Pseudomonadales - Vibrionales. Delta proteobacteria: Bdellovibrio and Desulfovibrio. General characteristics of: Mollicutes - Low G+C gram positive bacteria - High G+C gram positive bacteria.

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

Virus – Structure and General Properties – Symmetry – Genome – Enzymes in virions. Baltimore scheme of Classification of viruses. Bacterial viruses – Cyanophages - Eukaryotic viruses – Plant viruses – Animal viruses. Subviral agents – Viroid and Prions.

TEXT BOOKS:

1. *Prescott, L.M J.P. Harley and C.A. Klein.* 1995. **Microbiology** 2nd Edition Wm, C. Brown Publishers.
2. *Michael Madigan,* 2015. **Brock Biology of Microorganisms,** 14th Edition. Pearson publishers. New Delhi.

REFERENCE BOOK:

1. *Edward I Alcamo,* 2000. **Fundamentals of Microbiology,** 6th Edition. Jones and Bartlett Publishers. Baltimore.

15PMB13C	CORE - III: MICROBIAL PHYSIOLOGY	SEMESTER - I
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Nutritional requirements of microorganisms
2. Microbial growth and metabolism
3. Anaerobic respiration, fermentation and Photosynthesis

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 – Entner Doudroff pathway – Glyoxalate pathway – Krebs cycle. Fermentations of carbohydrates – Homolactic – Mixed acid – Butane di ol – Propionic acid fermentation. β – Oxidation of Fatty acids. Energy production: Electron transport chain and Oxidative phosphorylation. Pasteur Effect. Bioluminescence.

UNIT-IV

Biosynthesis of aspartate, pyruvate, histidine and serine amino acid families - purine and pyrimidine nucleotides, denovo and salvage pathway. Biosynthesis of fatty acids. Biosynthesis of gram positive and gram negative cell wall.

UNIT-V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. *Doelle. H.W.*1975.**Bacterial Metabolism.** 2nd edition. Academic Press. USA.
2. *Geoffrey Michael Gadd,* 2008. **Bacterial Physiology and Metabolism,** Cambridge University Press.UK.

16PMB13D	CORE - IV: BIOINSTRUMENTATION	SEMESTER - I
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Total Credits: 4
Hours per Week: 5

OBJECTIVES:

The subject aims to build knowledge on

1. Instrumental aspects in microbiology
2. Separation, Purification & Quantification of Biomolecules
3. Applications of analytical techniques in various fields

CONTENTS

UNIT - I

Basic principles; Mathematics & theory (RCF, sedimentation coefficient etc); Types of centrifuge – Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

UNIT - II

Chromatography: Principles, Instrumentation, Detection methods and Applications – Paper, TLC, Column, Ion-exchange, HPLC, Gel permeation, Chiral and Affinity Chromatography – GC – MS.

UNIT -III

Colorimetry: - Beer Lamberts law – Principles, Instrumentation and Applications – Analysis – Qualitative and Quantitative. Basic principles of Spectrophotometry: The laws of absorption, principles and instrumentation for UV – visible and IR spectroscopy. Principles, theory and applications of Spectrofluorometry and Flame photometry.

UNIT -IV

Electrophoresis – General Principles – SDS – PAGE – Native gel – Gradient gel – Isoelectric focusing – 2D Page – Cellulose acetate electrophoresis – Detection, Estimation and Recovery of Proteins in gel – Western blotting – Electrophoresis of Nucleic acids – Agarose gel Electrophoresis – DNA sequencing gels – Pulse Field Gel

Electrophoresis – Electrophoresis of RNA – capillary electrophoresis – Microchip Electrophoresis.

UNIT-V

Radioisotopes – Nature of Radioactivity – Types of Radioactive decay – Rate of Radioactive decay – Units of Radioactivity – Interaction of Radioactivity with matter – Detection and Measurement of Radioactivity – based on Gas ionization – based on Excitation – based on Exposure of Photographic Emulsion – Safety aspects.

TEXT BOOKS:

1. *Swahney S K.* 2000. **Introductory Practical Biochemistry**, Narosa Publishing House.

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.

16PMB13P	CORE PRACTICAL - I	SEMESTER - I
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Total Credits: 4
Hours per week: 5

CONTENTS

1. Bacterial Staining techniques
 - a. Gram, b. Acid-fast, c. Spore d. Capsule and e. Negative staining.
2. Fungal Mount –LCB Mount
3. Micrometry – Measurement of microorganisms.
4. Motility determination- Hanging drop and soft agar inoculation.
5. Enumeration of Microorganisms from soil: Bacteria, Fungi and Actinomycetes.
6. Determination of bacterial generation time - Direct microscopic method and turbidity method
7. Effect of various intrinsic factors on the growth of bacterium and fungi - pH, Temperature
8. Anaerobic technique - Roll tube method
9. IMViC test
10. Hydrogen sulphide test
11. Oxidase test
12. Catalase test
13. Urease test
14. Polymer degradation - Starch, Gelatin, Casein.
15. Carbohydrate fermentation.
16. Preferential utilization of sugar - TSI
17. Quantitative determination of Sugar by DNSA method
18. Quantitative determination of Protein by Lowy *et al* method

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19. Separation techniques: Chromatography- Paper, TLC and Column.
20. Isolation and enumeration of food spoilers from spoiled food (Bacteria)
21. Microscopic Examination of Curd

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.

REFERENCE BOOK:

1. *James.C.Cappuccino.* 2013. **Microbiology A laboratory manual**. 1st edition, Pearson education publishers.

16PMB1EA	ELECTIVE - I: PRINCIPLES OF QUALITY ASSURANCE	SEMESTER - I
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Total Credits: 4

Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Quality assurance in microbiological labs
2. To understand the role of quality assessment in diagnostic procedures
3. Understand the significance of quality management and standards.

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 BOOK:

1. *Rajesh Bhatia and Rattan Lal Ichhpujani*. 1995. I ed. **“Quality assurance in Microbiology”**.

16PMB1EB	ELECTIVE - I: PLANT SCIENCE	SEMESTER - I
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Total Credits: 4
Hours per Week: 5

OBJECTIVES:

This course illustrates

1. Nutritional requirements and classification of microorganisms.
2. Microbial growth and physical factors affecting growth
3. General metabolic pathways of microorganisms

CONTENTS

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

Solute transport and photoassimilate translocation - uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

UNIT V

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

TEXT BOOK:

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

16PMB23A	CORE - V: MICROBIAL GENETICS AND MOLECULAR BIOLOGY	SEMESTER - II
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. To know the fundamentals behind classical genetics
2. Molecular genetics
3. Genetic material exchange and mutations.

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, 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 -polymerase - RNA chain initiation - Elongation - Termination and release of newly synthesized RNA. Transcription on Eukaryotes - Transcription unit

concept. Genetic code. Translation – Transfer of RNA and aminoacyl synthetases – The codon, anticodon interactions – Wobble hypothesis. Post transcriptional and translational modification.

UNIT -IV

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

UNIT -V

Genetic transfers 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, S.* 1987 **Microbial Genetics**, 1st edition. Jones & Bartlett, Boston.

REFERENCE BOOKS:

1. *Klug .W.S. and Cummings, M.R.* 1996. **Essentials of Genetics**, Mentics Hail, NewJersey.
2. *Tamarin, Robert H.* 1999. **Principles of Genetics**, 5th edition, Cm Brown Publishers.

16PMB23B	CORE - VI: VIROLOGY	SEMESTER - II
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aim to understand the concept on

1. The history, ultra structure and diagnosis of Bacterial, Animal and Plant viruses.
2. Advances in the virology like antivirals & their mode of action, Antisense RNA etc.,

CONTENTS

UNIT - I

General properties and Classification of Viruses. Cultivation of viruses - Egg Inoculation - Animal Inoculation and Tissue culture methods. Isolation and Purification of Viruses. Characterization and Enumeration of viruses - Quantitative assay.

UNIT - II

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.

UNIT - III

General properties, structure, genome replication, protein synthesis and assembly, pathogenesis and laboratory diagnosis 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. Arbo virus – Dengue virus, Ebola virus, Prions.

UNIT - IV

Classification - General properties, structure, genome replication, protein synthesis and assembly of: DNA containing plant viruses – CaMV and Gemini Virus - RNA containing plant viruses - TMV, Cowpea mosaic viruses, Bromo mosaic viruses and Satellite viruses.

UNIT V:

Applied virology: Introduction to viral vaccines, preparation of vaccines, new vaccine technology; antiviral drugs. Modern approaches of virus control - Antisense RNA. Applications of Recombinant Viruses - Genetically engineering of protein expression - Gene therapy - Genetically engineering a virus as vaccine.

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.

16PMB23C	CORE - VII: GENETIC ENGINEERING	SEMESTER - II
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Cloning and its requirements
2. Availability of different kinds of vectors
3. Characterization of cloned DNA

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

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. Protein Engineering. Genomic DNA libraries - cDNA libraries.

UNIT - V

Site Directed Mutagenesis - 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. Drug Design and Delivery.

TEXT BOOKS:

1. *Old. RW and Primrose, 1995. Principle of Gene Manipulation*, 5th edition. Blackwell Scientific Publication, Boston.
2. *T.A Brown 1st edition, 2002. Genomes*, John- Wiley & Son. Australia.
3. *Santhiya Mitra, 2009. Genetic Engineering - Principles and Practices*. Mac Millen Publications. Bangalore.

REFERENCE BOOKS:

1. *Winnecker, E.D, 1987. From Gene to Clones*, Introduction to Gene Technology, 1 st edition. Panima educational book agency. New Delhi.
2. *Glick B .R and Pasternak J .J .1994. Molecular Biotechnology. Principles and Application of recombinant DNA*, 2nd edition. ASM Press, Washington.

16PMB23D	CORE - VIII: ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	SEMESTER - II
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Exploration and dissemination of micro flora in environment
2. To understand the role of microbes to better ecological niche
3. To understand the role of microbes in Agriculture and waste management

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 (Aquatic environment-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

Treatment of solid waste – Landfills – Composting- Biogas Production. Mushroom Cultivation-Measuring microbial activities in nature – Chemical radio isotopic and micro sensor methods.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

2. *N.S. Subba Rao* 2014. **Soil Microbiology (Fourth Edition of Soil Microorganisms and Plant Growth)**, Science Publishers, USA.
3. *Michael J. Pelczar* 2001, **Microbiology**, Tata Mc Graw Hill Eduaction, India.

16PMB23P	CORE PRACTICAL - II	SEMESTER - II
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Total Credits: 4
Hours per week: 5

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

LAB MANUALS:

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

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.

16PMB2EA	ELECTIVE - II: PHARMACEUTICAL QUALITY CONTROL	SEMESTER- II
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Sterility in pharmaceutical products
2. Need of a qualified microbiologist and his role in Pharma Industry
3. Validation and its importance in expiry of medicines

CONTENTS

UNIT- I

An introduction to pharmaceutical microbiology. Chemical growth control. Chemical antimicrobial agents for external use - naturally occurring antimicrobial drugs: Antibiotics. Antibiotics from prokaryotes, antiviral drugs, antifungal drugs, antimicrobial drug resistance, the search for new antimicrobial drugs.

UNIT- II

Types of spoilage, Factors affecting microbial spoilage – assessment of microbial spoilage – preservation. Ecology of microorganisms as it affects the pharmaceutical industry – Sterile pharmaceutical products – injections, Non injectable sterile fluids, Ophthalmic preparations, dressings & implants.

UNIT- III

Sterilization control - methods of sterility testing- sterilization monitors and Quality assurance of products. 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.

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, 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, International disinfectant testing protocols, Measurement of biocide effectiveness, Microbiological quality and regulatory requirements for biotherapeutics and manufactured products, The role of the microbiologist in HACCP, Auditing the pharmaceutical microbiology department.

TEXT BOOK:

1. *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 & Vol II: standards & Controls.**

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

2. *Madigan M.T.* 2006. **Brock Biology of Microorganisms** 11th Edition. Pearson-Prentice Hall, USA.

16PMB2EB	ELECTIVE - II: ANIMAL SCIENCE	SEMESTER - II
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

This course has been designed to

1. Enable students to know the general structure and functions of various systems and organs.
2. This will help students to understand the physiology various organs in several species.

CONTENTS

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT- V

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

TEXT BOOKS:

1. *Guyton, Arthur C.* 1987 .11th edition. **Textbook of medical physiology. Elsevier Saunders publication, Chennai.**
2. *Chandi Charan Chatterjee.* 2016. **Human Physiology** 11th edition. Central Book Agency. West Bengal.

16PMB33A	CORE - IX: PRINCIPLES OF IMMUNOLOGY	SEMESTER- III
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The objective of this course is to

1. Learn about the structural features of the components of the immune system
2. Functions of Immune system
3. Understand the mechanisms involved in immune system development and responsiveness.

CONTENTS

UNIT -I

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

UNIT- II

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

UNIT - III

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

UNIT - IV

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

UNIT -V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

15PMB33B	CORE - X: BIOPROCESS TECHNOLOGY	SEMESTER- III
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build knowledge on

1. Design and types of fermentor and fermentation process
2. Upstream and Downstream processes
3. Industrial scale production of microbial products

CONTENTS

UNIT- I

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

UNIT- II

Industrially important Microorganisms. Isolation (Primary and Secondary screening), Preservation and Strain improvement

(Mutation, Recombination, Regulation, Gene technology and Use of Genetic methods).

UNIT- III

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

UNIT- IV

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

UNIT- V

Microbial production of Organic acids (Citric and Acetic) Enzymes (Amylase and Protease) Aminoacids (Lysine and Glutamic acid), Antibiotics (Penicillin, Streptomycin and Griseofulvin), Vitamins (Riboflavin, 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**, 1st Edition. Adithya Books pvt ltd. New Delhi.

REFERENCE BOOKS:

1. *Peppler. H.J.* 1997. 2 nd edition. **Microbial Technology.** Microbial Processes. Vol I & II. Academic Press.Cambridge.

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

2. *Demain A.J. and Solomon INA, 1999. 2nd edition. Manual of Industrial Microbiology and Biotechnology. ASM press.USA.*

16PMB33C	CORE - XI: BIOTECHNOLOGY	SEMESTER - III
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Microbial production of therapeutic and commercial products
2. Engineering of microorganisms, plants and animals.

CONTENTS

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOKS:

1. *Brown T.A.*, 2002. **Genomes**, 1st edition, John- Wiley & Son. Australia.

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

2. *Glick B .R and Pasternak J .J .1994. **Molecular Biotechnology. Principles and Application of recombinant DNA**, 2 nd edition. ASM Press, Washington.*

REFERENCE BOOKS:

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

16PMB33D	CORE - XII: MEDICAL MICROBIOLOGY	SEMESTER - III
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. Medically important Gram positive and Gram negative organisms
2. Human viral diseases and its diagnosis
3. fungal and parasitic infections of Human beings.

CONTENTS

UNIT-I

Introduction to medical microbiology - Infectious Diseases process - Diagnosis: Collection of clinical samples, transport and examination, Antibioqram 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 cholerae*, *Bordetella pertusis*, *Yersinia pestis* and *Neisseria gonorrhoea* , *Neisseria meningitidis*.

UNIT-IV

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

UNIT-V

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

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

TEXT BOOKS:

1. Patrick.K.Murray. 2012. 4th edition. **Medical Microbiology**. Mosby Publishers. USA.

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

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

16PMB33P	CORE PRACTICAL - III	SEMESTER -III
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Total Credits: 4

Hours per week: 5

CONTENTS

1. Collection, transport and processing of clinical samples - Urine, Pus, Sputum, Stool, Wound samples.
2. Isolation and identification of clinically important fungi- *Candida albicans*, *Aspergillus sp.*,
3. Antibiotic susceptibility test. - Kirby Bauer technique and Stokes method.
4. Observation of parasites - *Entamoeba histolytica*, *Trichomonas vaginalis*, *Plasmodium vivax*, *Leishmania donovani*.
5. Serological test for HBsAg and HBcAg
6. Dot ELISA
7. Organic acid production - Citric acid - Submerged fermentation.

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

8. Production and Assay of Extracellular enzymes – Protease by submerged fermentation
9. Production and Assay of Extra cellular enzymes – Amylase by Solid state fermentation.
10. Screening and assay of Antibiotics.
11. Blotting techniques - Western Blotting.
12. 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.

16PMB3EA	ELECTIVE - III : FOOD MICROBIOLOGY AND FOOD QUALITY CONTROL	SEMESTER - III
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The subject aims to build the concepts regarding:

1. To Understand the relation between Food and microorganisms
2. Fermented food and food borne diseases
3. Food Quality control

CONTENTS

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

In house Committee for quality assurance, Persons involved, Internal Microbial Quality control Policy, Quality Check at every step from collection of raw materials till it reaches the customer, GMP, SSOP, HACCP- Principles & Applications.

UNIT - V

Food laws and regulations

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

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

C. Regulatory Agencies – WTO, FSSAI.

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

16PMB3EB	ELECTIVE - III: ECOLOGY	SEMESTER - III
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Total Credits: 4
Hours per Week: 5

OBJECTIVES:

This course illustrates the:

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

CONTENTS

UNIT - I

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

UNIT - II

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and

Kselection); concept of metapopulation –demes and dispersal, interdemic extinctions, age structured populations.

UNIT - III

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

UNIT - IV

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; bio geographical zones of India.

UNIT - V

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

TEXT BOOK:

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

16PMB43A	CORE - XIII: BIostatISTICS AND RESEARCH METHODOLOGY	SEMESTER - IV
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The objective of the course is to impart advanced practical knowledge in conducting a research project. Upon completion of the course, the student will know how to:

1. Apply methods from the basic statistics.
2. To manage descriptive statistical measures for summary data and compare the results between populations using representative samples.

CONTENTS

UNIT- I

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

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

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-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. Testing of Hypothesis. Fundamentals of Bioethics.

UNIT- V

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

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.

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

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.

16PMB43B	CORE - XIV: BIOETHICS, BIOSAFETY AND IPR	SEMESTER - IV
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The objective of the course is to impart knowledge in

1. Concepts of IPR and Copy Rights
2. The importance of Biosafety and Bioethics

CONTENTS

UNIT - I

Introduction to Intellectual Property Rights- Concepts of IPR- Designs- Trade marks- 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- 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 BOOK :

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

REFERENCE BOOK:

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

16PMB4EA	ELECTIVE -IV: EVOLUTION	SEMESTER- IV
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Total Credits: 4
Hours per week: 5

OBJECTIVES:

The objective of the course is to impart knowledge in

1. Concepts of Origin of life
2. The importance of Evolution theory

CONTENTS

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

TEXT BOOK:

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

16PMB4EP	ELECTIVE - IV: PRACTICAL	SEMESTER - IV
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Total Credits: 4

Hours per week: 5

CONTENTS

1. Staining Techniques (Grams and LPCB)-Food samples- vegetables and packed foods.
2. Sterility tests for Instruments - Autoclave & Hot Air Oven
3. Air quality checking by settle plate method.
4. Sterility testing of Microbiological media
5. Sterility testing of Pharmaceutical products -Antibiotics, Vaccines & fluids
6. Enumeration of microbes from industrial effluents.
7. Evaluation of Drug potency by MIC.

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

8. Isolation & characterization of Bacteria from wood and Paints.
9. Water quality analysis – MPN.
10. Estimation of BOD and COD.
11. Isolation of microorganisms from spoiled foods – Meat, milk, Cereals and Bread.
12. Milk quality – Dye reduction test.
13. Determination of Thermal death point and thermal death time.

LABORATORY MANUAL:

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.

16PMBSS1	SELF STUDY PAPER - I: DEVELOPMENTAL BIOLOGY	SEMESTER- I to 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,

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

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.

16PMBSS2	SELF STUDY PAPER - II: INHERITANCE BIOLOGY	SEMESTER- I to 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

M. Sc., Microbiology (Students admitted during 2016 – 2017 onwards)

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

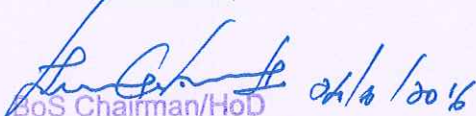
Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.


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.**


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