MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL - 624 102
Tamil Nadu.

SYLLABUS FOR

M.SC MICROBIOLOGY

From 2018 – 2019 Onwards

MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

Common Course structure for

PG Programmes under CBCS

M.Sc Microbiology

From 2018 – 2019 Onwards

MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

M.Sc Microbiology

Course Structure (CBCS)

Papers offered in each semester/Scheme of Examinations.

P. No.	Paper Code	Course Title	Hours	Credits	Internal	End Semester Exam (ESE)	Total
Semester I							
1.	PMBT11	Core I – Introduction to Microbiology & Microbial Diversity	5	5	25	75	100
2.	PMBT12	Core II – Bacteriology & Virology	5	5	25	75	100
3.	PMBT13	Core III – Microbial Physiology & Metabolism	5	5	25	75	100
4.	PMBP11	Practical-I Lab in Microbiology	5	5	25	75	100
5	PMBE11	Elective I – Choice1:Bioinstrumentation Choice2:Biophysical methodology	5	5	25	75	100
		Total	**25**	**25**			**500**
Semester II							
6.	PMBT24	Core IV – Cell & Molecular Biology	5	5	25	75	100
7.	PMBT25	Core V – Microbial Genetics	5	5	25	75	100
8.	PMBT26	Core VI – rDNA technology	5	5	25	75	100
9.	PMBP22	Practical-II – Lab in Microbial Genetics & Molecular Biology	5	5	25	75	100
10.	PMBE22	Elective II – Choice 1:Biostatistics Choice2:Research methodology	5	5	25	75	100
		Total	**25**	**25**			**500**
Semester III							
11.	PMBT37	Core VII – Environmental Microbiology	5	5	25	75	100
12.	PMBT38	Core VIII – Industrial Microbiology	5	5	25	75	100
13.	PMBT39	Core IX – Food & Dairy Microbiology	5	5	25	75	100

14.	PMBP33	Practical-III – Lab in Applied Microbiology	5	5	25	75	100
15.	PMBE33	Elective III – Choice1:Bioinformatics Choice2:IPR,Biosafety and Bioethics	5	5	25	75	100
		Total	**25**	**25**			**500**
Semester IV							
16.	PMBT410	Core X – Medical Microbiology	5	5	25	75	100
17.	PMBT411	Core XI – Immunology	5	5	25	75	100
18.	PMBP44	Dissertation/Project	5	5	25	75	100
		Total	**15**	**15**			**300**
Grand Total			**90**				**1800**

Regulations:

1. Course Objectives

To enable the students

- To understand the beneficial and harmful aspects of microbes in our daily life.
- To get familiarized with the techniques in Microbiology and for easy handling of Microbiology lab oriented instruments and equipments.
- To develop practical and theoretical knowledge in Applied Microbiology and
- To get an exposure to the advanced Microbiology field.

2. Qualification for Admission:

i. Candidate should have passed a UG degree (B.Sc Microbiology/ Biochemistry/ Zoology/ Botany/ Immunology/ Biotechnology/ Applied Microbiology / Integrated Biology / Medical Microbiology) or equivalent life science degree.

ii. Candidate should have secured at least 50%.

iii. A relaxation of 5-10% in the total percentage will be given to SC, ST candidates.

iv. Candidates sponsored by industries/hospitals/Clinical laboratories may be considered for admission.

3. **Duration of the course:**

The students will undergo the prescribed course of study for a period of not less than two academic years (Four semesters).

4. **Medium of Instruction**: English

5. **Subject of Study**: As given in Appendix A

6. **Scheme of Examination**: As given in Course Structure and Scheme of Examination Appendix B

7. **Eligibility of the degree**:

i. Candidates will be eligible if they complete the course with the required credits and pass in the prescribed examinations.

8. The candidate requires 75% of attendance to attend the semester exam.

9. The internal marks would be divided as 5 for assignment 5 for seminar and 15 for written tests. One or two seminars/assignments can be given and a consolidate of them can be considered.

11. The passing minimum is 50 percent (both in internal and external separately) in each paper.

12. The candidate has to undergo a project individually.

13. To complete the course the students should gain the prescribed credits i.e. 90 credits.

Core –The candidate has to study 14 cores including practical and gain the respective credits. (14 * 5 credits each = 70 credits).

Elective- Each candidate has to study three electives and gain the respective credits. (3 * 5 credits each = 15 credits).

Project – The candidate has to undergo one project in the fourth semester and gain 5 credits.

SEMESTER I

CORE I- INTRODUCTION TO MICROBIOLOGY & MICROBIAL DIVERSITY- PMBT11

Credits :5 **Hours :5**

Objectives

- To know the microbial world, including a comprehensive look at diversity, physiology, genetics and molecular biology, and applied microbiology of prokaryotes, but also including protists, fungi, and viruses.
- To know the economic importance of prokaryotes
- To describe both the beneficial and harmful impact of microbial interactions on their environment
- To Compare and distinguish the basic groups of microbes, including prokaryotic microbes (Archaea, Bacteria), and Viruses, and eukaryotic microbes.

Unit I

History of Development of Microbiology - Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology - Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman. Establishment of fields of medical microbiology and immunology - Paul Ehrlich, Elie Metchnikoff, Edward Jenner. An overview of Scope of Microbiology

Unit II

Diversity of Microbial World - Systems of classification - Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms - General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit III

Algae - History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultrastructure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction – lifecycle : Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food.

Unit IV

Fungi - Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.

Unit V

Protozoa - General characteristics with special reference to Amoeba, Paramecium, Plasmodium, Leishmania and Giardia.

Reference

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson
Education

2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.
14th edition. Pearson International Edition

3. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.

4. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

CORE II-BACTERIOLOGY & VIROLOGY-PMBT12

Credits :5 **Hours :5**

Objectives

- To know Bacterial Systematic – taxonomy, classification
- To know the structure and function of bacterial cell organization
- To understand the nature and mechanism of viral infection
- To gain knowledge about bacteria & viral cellular organization

Unit I

Bacterial Systematics - Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Differences between eubacteria and archaebacteria. Bergey's Manual of classification.

Unit II

Cell organization - Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall - Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation.

Unit III

Growth and nutrition - Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media. Physical methods of microbial control - heat, low temperature, high pressure, filtration, desiccation,

osmotic pressure, radiation, Chemical methods of microbial control: disinfectants, types and mode of action, Reproduction in Bacteria Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.

Unit IV

Nature and Properties of Viruses - Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses. Isolation, purification and cultivation of viruses. Viral taxonomy: Classification and nomenclature of different groups of viruses.

Bacteriophages Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

Unit V

Salient features of viral nucleic acids and Replication of viruses.: TMV,T4 phage, lambda Hepatitis B virus, HIV, Influenza virus, Picornavirus. Vaccinia, Pox. Assembly, maturation and release of virions.

Reference

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.

2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall

3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.

4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers,Dordrecht

6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson,Education.

8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition.McGraw Hill Higher Education

CORE III-MICROBIAL PHYSIOLOGY & METABOLISM-PMBT13

Credits :5 **Hours :5**

Objectives

- To understand the Microbial Growth and Effect of Environment on Microbial Growth
- To understand Microbial toxins and its mode of infection in Human
- To understand the Prokaryotes Membrane transport system and biochemical pathways
- To attain knowledge about the physiology and metabolism of microbial system

Unit 1

Microbial Growth and Effect of Environment on Microbial Growth - Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve and growth kinetics. Microbial growth in response to environment - Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe),barophilic.

Unit II

Microbial toxins**.** Chemotaxis**.** Sporulation including genetic aspects**.** Microbial reserve compounds. Siderophores – Bacterial respiration – Anaerobic and aerobic respiration – Respiratory pathway in Nitrobacter group and Methanogens. Bacterial photosynthesis – Carbondioxide fixation.

Unit III

Membrane transport - Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na+ -glucose symporter. ABC transporters. Ion channels -

voltage-gated ion channels (Na+ /K+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores.

Unit IV

Chemoheterotrophic Metabolism - Aerobic Respiration - Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle. Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial. ETC, electron transport phosphorylation, uncouplers and inhibitors.

Unit V

Lipids, lipid metabolism: Biosynthesis of fatty acids and lipids. Oxidation of fatty acids. Nucleotide metabolism: Biosynthesis of purine and pyrimidine nucleotides. Catabolism of nucleotides. Cell wall Synthesis

Reference

1) Lehninger Principles of Biochemistry. D. L. Nelson and M.M. Cox.
2) Biochemistry: Lubert Stryer
3) Microbial Physiology: Moat and Foster, 4^{th} edition.
4) Caldwell D.H. 1995 Microbial Physiology and Metabolism. Win C Brown publishers.
5) Biochemistry – Sathyanarayana

PRACTICAL I-LAB IN MICROBIOLOGY-PMBP11

Credits :5 **Hours :5**

Objectives

- To learn preparation of culture media, sterilization methods.
- To learn isolation and identification of microbes both morphological and biochemical methods
- To identify different types of bacteria from the morphological point of view
- To develop skill isolation and identification of microbes in laboratory

1) Microscope – components and its operation.
2) Principles and methods of sterilization
3) Preparation of culture media
4) Inoculation techniques – Serial dilution and plating techniques.
5) Morphological characteristics of bacteria and identification of microbes – staining techniques – Simple, Gram's, Capsule and Spore.
6) Determination of growth phases of yeast and E.coli
   a) Calculation of generation time
   b) Relationship between OD and colony forming units
   c) Calculation of growth rate.
7) pH Metry

   Preparation of buffers
   i. Phosphate buffer
   ii. Acetate buffer
   iii. Citrate buffer
   iv. Tris buffer

8) Spectrophotometry – Principles and operation, methods of quantification.
9) Biochemical analysis
    a) IMViC
    b) Hydrolysis – Starch, Protein, Lipid
    c) Oxidative fermentation, Oxidase, Catalase, Coagulase.
10) Chromatography

Separation of aminoacids – i) Paper chromatography – ascending and descending.

Reference

1. Cappuccino, G. James. and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 4th edition.
2. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks, Gram stain, Experimental Microbiology, 1995.
3. Handbook of Microbiological Media – HiMedia.
4. Biochemical Methods – Wilson & Walker, 2004.

ELECTIVE I – CHOICE1: BIOINSTRUMENTATION-PMBE11

Credits :5 **Hours :5**

Objectives

- To know the fundamental principles and applications of basic instruments in biology
- To learn the types of electrophoresis and spectroscopy
- To understand, design and evaluate systems and devices that can measure, test and/or acquire biological information
- Ability to apply advanced control theory to practical research problems.

Unit I

Microscopy – Bright field and dark field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry. Atomic Force Microscope, Scanning Tunnelling Microscope, Friction Force Microscope.

Unit II

Centrifugation - Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

Chromatography - Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC.

Unit III

Electrophoresis - Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit IV

Spectrophotometry - Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

Unit V

RFLP, RAPD, DNA finger printing, Blotting Techniques, (Protein, RNA, DNA). VNTR & Finger Printing.

Reference

1. Keith Wilson and John Wilson, 2004. Practical Biochemistry – Fifth edition.
2. Palanivelu.P, 2001. Analytical Biochemistry & Separation Techniques –, 2nd edition.
3. Alexander.J Ninfa. Fundamental Laboratory & Approach for Biochemistry & Biotechnology –, 2nd edition.

ELECTIVE 1 -CHOICE2: BIOPHYSICAL METHODOLOGY-PMBE11

Credits :5 **Hours :5**

Objectives

- To know the fundamental principles of microscopes
- To learn the Principles and applications of biomolecules separation methods
- To understand and know the Radioactivity measuring techniques.
- To gain knowledge about various working principles and applications of bioinstruments

Unit I

Biological relevance of pH, measurement of pH, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Osmotic pressure in biological systems, viscosity and determination of molecular weight using viscometers.

Unit II

Microscopy: Basic principles of light microscopy, phase contrast microscopy, electron microscopy, and fluorescence microscopy. Sedimentation methods: Principles of centrifugation, preparative, differential and density gradient centrifugations, analytical, ultra centrifugation.

Unit III

Radioactivity: half-life, decay constant, average life, units of radioactivity, Radioactivity measuring techniques. Radiation dose units, Roentgen, REM maximum permissible dose, dosimetry and dosimeters; radiation monitoring hazards, Biological effects of radiation, Radioisotopes in medicine.

Unit IV

Principles and applications of separation methods: Paper, Thin layer, ion exchange, and gas chromatography, affinity chromatography, Gel filtration, HPLC, Electrophoresis: SDS-PAGE and isoelectric focusing, Capillary electrophoresis, Northern blot, Southern blot, Western blot Analyses. 2D electrophoresis, Pulse- field gel electrophoresis.

Unit V

Spectroscopy: Electromagnetic radiations, Principles and Biological applications of Colorimetry, Spectrophotometry. UV, Atomic absorption spectroscopy, Electron spin resonance spectroscopy, NMR spectroscopy, Polarimetry, Principles and applications of X-ray Diffraction. MALDI- LCMS.

References

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker & Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata Mac Grew-Hill.
7. Biophysical chemistry, Edshall & Wyman, Academic press Vol II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley & sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David

SEMESTER II

CORE IV-CELL AND MOLECULAR BIOLOGY-PMBT24

Credits :5 **Hours :5**

Objectives

- To understand about the physical and chemical organization of living organisms; cell structure, function, and metabolism
- To learn the classical and molecular genetics; gene regulation; genetic engineering; molecular aspects of development
- To understand the Regulation of gene Expression in Prokaryotes and Eukaryotes
- Ability to understand the structure, mechanisms and role of genetic material of living organisms

Unit I

Structure and organization of Cell - Cell Organization – Eukaryotic (Plant and animal cells) and prokaryotic. Plasma membrane: Structure and transport of small molecules. Cell Wall: Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects). Mitochondria, chloroplasts and peroxisomes. Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules. Nucleus - Nuclear envelope, nuclear pore complex and nuclear lamina Chromatin – Molecular organization Nucleolus

Unit II

Protein Sorting and Transport - Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids. Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus.

Lysosomes. Cell Signalling - Signalling molecules and their receptors - Function of cell surface receptors - Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway.

Unit III

Structures of DNA and RNA / Genetic Material DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology – linking number, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA - mitochondria and chloroplast DNA. Replication of DNA (Prokaryotes and Eukaryotes). Various models of DNA replication including rolling circle, D- loop (mitochondrial), Θ (theta) mode of replication and other accessory protein, Mismatch and excision repair.

Unit IV

Transcription in Prokaryotes and Eukaryotes - Post-Transcriptional Processing - Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA, RNA interference: si RNA, miRNA and its significance. Translation (Prokaryotes and Eukaryotes) - Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation,elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote

Unit V

Regulation of gene Expression in Prokaryotes and Eukaryotes - Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons, Sporulation in Bacillus,Yeast mating type switching , Changes in Chromatin Structure - DNA methylation and Histone Acetylation mechanisms.

Reference

1. Gene IX Lewin, Oxford University Press.
2. Molecular Biology – Watson.
3. DNA replication – Arthur Kornberg.
4. Molecular Cell Biology (W.H Freeman) Lodish, Berk, Zippursky.
5. Molecular Biology – Freifelder, Narosa Publishing Co., 2nd Edition.

CORE V-MICROBIAL GENETICS-PMBT25

Credits :5 **Hours :5**

Objectives

- To learn the Molecular nature of mutations in cell
- To learn the molecular genetics of types of phages
- To understand Transposable elements in Prokaryotic and Eukaryotic transposable elements
- Ability to understand the genetic materials revolutionize and its role in living organisms

Gene as unit of mutation and recombination. Molecular nature of mutations; mutagens. Spontaneous mutations – origin. DNA Damage and Repair: type of DNA damage (deamination, oxidative damage, alkylation, pyrimidine – dimers) Repair mechanisms – methyl directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination, repair, SOS system. Auxotrophic Mutants.

Unit II

Biochemical genetics - Fungal genetics: Tetrad analysis and parasexual cycle - Viral genetics: Bacteriophages – T – series, l - biology. Miniphages – M 13, f X 174, Mu. Phage Genetics - Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda.

Unit III

Plasmids - Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

Unit IV

Mechanisms of Genetic Exchange - Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F’ strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction,

specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers.

Unit V

Transposable elements - Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon. Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds). Uses of transposons and transposition.

Reference

1) Microbial Genetics. Maloy et. al. 1994. Jones & Barlett Publishers.

2) Molecular genetics of bacteria. J. W. Dale 1994. John Wiley & Sons.

3) Modern microbial genetics. 1991. Streips & Yasbin. Niley. Ltd.

CORE VI-rDNA TECHNOLOGY-PMBT26

Credits :5 **Hours :5**

Objectives

- To understand the Molecular Cloning- Tools and Strategies and Methods in Molecular Cloning
- To learn the methods of DNA sequencing in prokaryotic and eukaryotic genomes
- To learn the Construction and Screening of Genomic libraries
- To gain theoretical knowledge in rDNA technology tools to apply practical to solve research problems

Unit I

Molecular Cloning- Tools and Strategies - Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases. Cloning Vectors: Definition and Properties. Plasmid vectors: pBR and pUC series. Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs. Use of linkers and adaptors. Expression vectors: E.coli lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors

Unit II

Methods in Molecular Cloning - Transformation of DNA: Chemical method, Electroporation,

Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral mediated delivery, Agrobacterium - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern – blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

Unit III

DNA Amplification and DNA sequencing - PCR: Basics of PCR, RT-PCR, Real-Time PCR

Sanger's method of DNA Sequencing: traditional and automated sequencing. Primer walking and shotgun sequencing

Unit IV

Construction and Screening of Genomic and cDNA libraries - Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping

Unit V

Applications of Recombinant DNA Technology - Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis.

Reference

1. Old R.W and Primrose S.B. 2001. Principles of Gene Manipulation, 6th edition
2. Winnacker E.L. 1987. From genes to Clone.
3. Watson et al, 1991. Recombinant DNA. Molecular Biology of the Gene, 5th Edition.
4. Brown T.A. 1996. Gene Cloning – An Introduction.
5. Glick B.R and Pasternak J.J. 2007. Molecular Biotechnology, 3rd edition.
6. Weaver R.F and Hedrick P.W. 1992. Genetics.
7. Sambrook. Molecular Cloning. Volume I, II, III, 3rd edition, 2001.

PRACTICAL II-LAB IN MICROBIAL GENETICS & MOLECULAR BIOLOGY-

PMBP22

Credits :5 **Hours :5**

Objectives

- To learn the methods of Gene transfer in bacteria in laboratory
- To learn the Electrophoretic Techniques for separation of DNA and protein
- To learn the PCR technique and Immunological techniques in laboratory
- To gain knowledge and understand the isolation, separation and interpretation of samples using different techniques

1) Gene transfer in bacteria – Transformation, Conjugation, Transduction
2) Isolation and separation of genomic DNA and plasmid DNA by Electrophoretic Techniques.
3) Immunoelectrophoresis
4) Double Diffusion (Ouchterlony)
5) Bacteriophage Isolation and Clear plaque observation.
6) PCR - RAPD
7) SDS - PAGE
8) Spontaneous and induced mutation – isolation of antibiotic resistant and auxotrophic mutants.
9) Determination of antibiotic resistance of given bacterial culture
10) Determination of lethal death time of UV mutation
11) Auxotrophic mutant and drug resistant mutant
12) Transformation in E.coli with plasmid
13) Replica plating method
14) Gradient Plate technique.
15) Conjugation.

Reference

1. Hudson and Hay Practical Immunology.
2. Cappuccino, G. James and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 4th edition.
3. Atlas, M. Ronald, Alfred E. Brown and Lawrence C. Parks, Gram stain, Experimental Microbiology.
4. Handbook of Microbiological Media – HiMedia.

ELECTIVE II-CHOICE 1:BIOSTATISTICS-PMBE22

Credits :5 **Hours :5**

Objectives

- To explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations.
- To learn descriptive statistics, elements of experimental design, probability, hypothesis testing and statistical inference, analysis of variance, correlation, regression techniques, and non-parametric statistical methods.
- To know and understand the general principles of study design; hypothesis testing; review of methods for comparison of discrete and continuous data including ANOVA, t-test, correlation, and regression.
- To understand the application of statistical techniques within a biological context will be emphasized, using data from laboratory and field studies.

Unit I

Statistics –Definition – kinds of biological data. Collection and organization of data. Representation of data. Sampling and Sampling Design. Tabulation, Diagrammatic and graphical representation.

Unit II

Measures of Central Tendency – Mean, Median, Mode. Measures of Dispersion – Range, Mean Deviation, Standard Deviation and Variance – Problems and explanation. Probability – Distribution – Binomial, Poison and normal.

Unit III

Measures of symmetry – Explanation and definition, Explanation of Skewness; Kurtosis of different types, Tests of Skewness, Measures of Skewness and Kurtosis. (problems not necessary).

Unit IV

Correlation and regression – Explanation – Types of correlation – Positive and negative correlation – Simple partial and multiple correlation –Linear and non-linear correlation – Methods of studying Correlation using Karl Pearsons Coefficient of correlation (Simple problems related to correlation and regression).

Unit V

Tests of statistical significance – Analysis of Variance – Chi square test – Student T test – Goodness of Fit. Problems in D/L method.

Reference

1. Gupta SP. 1997. Statistical Methods, Sultan Chad & Sons, 40th edition, 2011.
2. Bhaskar Rai T. 2001. Methods of Biostatistics.
3. Bliss C.I.K. Statistics in Biology. Vol I. McGraw Hill, New York.
4. Campbell R.C. Statistics for Biologists, Cambridge University Press.

ELECTIVE II-CHOICE 2: RESEARCH METHODOLOGY-PMBE22

Credits :5 **Hours :5**

Objectives

- To develop understanding of the basic instruments for biological research & various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of an overview to the fields of bioinformatics.
- To acquire knowledge in the application of research theory and methods, and develop skills required in writing research proposals, reports, and dissertation

Unit I

Research-Definition, Importance and Meaning of research, Characteristics of research, Types of Research, Steps in research- Identification, Selection and formulation of research problem, Research questions, Research design, Formulation of Hypothesis, Review of Literature. Sampling techniques: Sampling theory, types of sampling, Steps in sampling-Sampling and Non-sampling error -Sample size- Advantages and limitations of sampling. Collection of Data: Primary Data- Meaning- Data Collection methods -Secondary data - Meaning -Relevance, limitations and cautions. Research Report: Types of reports - contents - styles of reporting - Steps in drafting reports- Editing the final draft evaluating the final draft.

UNIT-II

Biostatistics: Definition, Principles of experimental design, collection, assembly, analysis and interpretation of experimental data. Data presentation - Tabular, graphical and diagrammatic representation of data. Measures of Central Tendency, standard deviation, standard error, analysis of variance, regression, coefficient of variation. Levels of significance, Chisquare test, students test (t), ANOVA.

Unit III

Techniques separation techniques: Chromatography: adsorption, partition, paper,thin layer, paper, cellulose derivatives affinity. Electrophoresis: Moving boundary, zone, starch gel, paper, cellulose derivatives Isotachophoresis, Isoelectro focusing, high voltage

electrophoresis. PAGE: Preparation of native & denaturing polyacrylamide gels and separation of proteins. Preparation of PAGE gels for DNA sequencing. Preparation of DNA fragments. Maxam and Gilbert and Sangers DNA sequencing methods. Generation of DNA sequence.

Unit IV

Biological Databases and Data Retrieval: Nucleotide (Genbank- EMBL- DDBJ)- Sequence submission Methods and tools (Sequin, Sakura, Bankit)- Sequence retrieval. Biological Databases and Data Retrieval: Nucleotide (Genbank- EMBL- DDBJ) - Sequence submission Methods and tools (Sequin, Sakura, Bankit). Protein (Swiss-prot, PIR, Expasy)- Structural Databanks (PDB and NDB)- Protein structure classification(SCOP, CATH and ESSP)- Metabolic pathway db(KEGG)- Specialised -db(imgt, Rebase, COG).

Unit V

Molecular sequence alignment- Global Alignment-Local alignment- Visual alignment- Dynamic Programming- Heuristic approach- scoring matrices and affine gap costs- Database search methods-Multiple Sequence Alignment methods. Gene prediction and phylogentic analysis: gene structure in prokaryotes and eukaryotes- Gene prediction methods- construction of phylogenetic trees- Distance methods- Maximum parsimony method- Maximum likelihood method. Molecular modelling and drug designing: introduction to protein structure prediction- rational drug discovery- recent advances in drug design methodologies- structure based drug design- Drug receptor N interactions- structure- activity relationships.

References

1.Microbiology (2005), Sixth edition by L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill, Boston.

2. Keith Wilson& John Walker (2003). Bioinstrumentation. John Wiley &sons, Ltd

3.Khan and Khan- Fundamentals of Biostatistics (1999). Bsp Books Pvt. Ltd.

5.S.P.Guptha-Statistical Methods (1969). Published by Sultan Chand & Sons.

6.Arora PN &Malhon PK, (1996) Biostatistics. Imalaya Publishing House, Mumbai.

7. C.R.Kothari (2004) Research Methodology. New Age International(P) Limited Publishers.

8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd Edition. Andreas D. Baxevanis , B. F. Francis Ouellette . Wiley, John & Sons.2004.

9. Bioionformastics 2001. D. Mount. Cold Spring. Harbor Press.

SEMESTER III

CORE VII-ENVIRONMENTAL MICROBIOLOGY-PMBT37

Credits :5 **Hours :5**

Objectives

- To understand the microorganisms and and their Habitats
- To introduce microbial processes of environmental and geochemical significance provide detailed information on the most up to date methods for the study of microbial communities
- To develop knowledge on Solid Waste management
- To know the exploration of microbes' interactions with their biotic and abiotic environments.

Unit I

Microorganisms and their Habitats - Structure and function of ecosystems - Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats. Atmosphere: Aeromicroflora and dispersal of microbes. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

Unit II

Microbial Interactions - Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

Unit III

Biogeochemical Cycling - Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle. Other elemental cycles: Iron and manganese

Unit IV

Waste Management - Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary. Sewage treatment. Water Potability - Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit V

Microbial Bioremediation - Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.

Reference

1. Ronald M. Atlas & Richard Bartha. 1991. Microbial Ecology, Fundamentals and application.
2. Thomas D. Brock and M.T Madigan. 1991. Biology of Microorganisms.
3. Alexander 1977. Introduction to soil microorganisms and plant growth.
4. N.S. Subba Rao – Soil Microorganisms and Plant growth.
5. N.S. Subba Rao – Biofertilizers.
6. Dasgupta R.S – Plant Pathology.
7. George N. Agriosis – Plant diseases.

CORE VIII-INDUSTRIAL MICROBIOLOGY-PMBT38

Credits :5 **Hours :5**

Objectives

- Demonstrate an understanding of the basic principles of microbiology associated with the production and recovery of important bioproducts used in industry today
- Demonstrate an understanding of fundamental quality control techniques conducted on raw materials and finished products
- To know the principles and practices in the main applications of micro-organisms to the industrial production of foods, pure chemicals, proteins and other useful products, including the use of genetically modified organisms.
- Ability to apply the techniques used in the different phases of industrial microbiology: discovery, production (including fermentation and scale-up),bioprocessing and cell banking.

Unit I

Isolation of industrially important microbial strains and fermentation media - Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates.

Unit II

Types of fermentation processes, bio-reactors and measurement of fermentation parameters - Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations. Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and

production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

Unit III

Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) Citric acid, ethanol, penicillin, glutamic acid, Vitamin B_{12}, Enzymes (amylase, protease, lipase), Wine, beer.

Unit IV

Control of process parameters: Instrumentation for monitoring bioreactor and fermentation processes, microprocessor based control systems, data analysis, dynamic modelling of fermentation processes. Down-stream processing - Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

Unit V

Enzyme immobilization - Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose, isomerase and penicillin acylase)

Reference

1. Stanbury PF., Whittakar A., and Hall SJ. Principles of Fermentation Technology, 2nd edition.
2. Casida L.E 1989. Industrial Microbiology.
3. Wulf Cruger, Biotechnology: A textbook of Industrial Microbiology, 2nd edition.
4. McNeil and Harvey. 1990. Fermentation – A practical approach.
5. Arnold L. Dermain and Nadine A .Solomon. 1986. Industrial Microbiology and Biotechnology.

CORE IX-FOOD & DAIRY MICROBIOLOGY-PMBT39

Credits :5 **Hours :5**

Objectives

- To Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
- To understand the role and significance of intrinsic and extrinsic factors on growth and response of microorganisms in foods. Identify ways to control microorganisms in foods.
- To identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods. Describe the beneficial role of microorganisms in fermented foods and in food processing.
- To understand the foodborne diseases, effects of food processing on the microflora of foods, principles of food preservation, food spoilage, and foods produced by microorganisms

Unit I

Foods as a substrate for microorganisms - Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Food sanitation and control - HACCP, Indices of food sanitary quality and sanitizers

Unit II

Microbial spoilage of various foods - Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit III

Principles and methods of food preservation - Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

Unit IV

Fermented foods - Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit V

Food borne diseases (causative agents, foods involved, symptoms and preventive measures) Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni.

Reference

1. Adams M.R and Moss M.O. Food Microbiology. Royal Society of Chemistry Publication, Cambridge.
2. Frazier WG and Westhoff Dc. Food Microbiology. Tat McGraw Hill Publishing Company, 4th ediiotn, 2012.
3. Stanbury PF., Whittakar A., and Hall SJ. 1995. Principles of Fermentation Technology.
4. Bandwart GJ. Basic Food Microbiology, SK Jain for CBS Publishers & Distribution.
5. Hobbs BC and Robert SD. Food Poisoning and Food Hygiene.
6. Robinson R.K. Dairy Microbiology.

PRACTICAL III-LAB IN APPLIED MICROBIOLOGY – PMBP33

Credits :5 **Hours :5**

Objectives

- To develop isolation and identification of beneficial plant growth organisms
- To develop skills in testing milk quality
- Utilize laboratory techniques to detect, quantify, and identify microorganisms in foods
- Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.

1) Antibiotic sensitivity test.
2) Clinical analysis of the following bacteria – Staphylococcus, Streptococcus, Salmonella and Pseudomonas.
3) Immobilization Principle and Methods
4) Wine production – Alcohol Estimation and Sugar Estimation.
5) Isolation of Rhizobium.
6) Isolation of Azotobacter.
7) Isolation of Azospirillum.
8) Identification of VAM.
9) Microbial growth measurement – cell count – turbidity measurement – OD – Calculation of generation time.
10) Standard graph preparation of DNA, BSA and Glucose.
11) Monitoring of Milk quality by Dye reduction method
12) Enumeration of microbial population in fruits, vegetables, meat, soft drinks and any preserved food.

Reference

1. Experiment in Microbiology, Plant Pathology Tissue Culture and Mushroom Cultivation – K.R Aneja, New Age International Ltd.

2. Cappuccino, G. James. and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 1999.

3. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks, Gram stain, Experimental Microbiology, 1995.
4. Handbook of Microbiological Media – HiMedia

ELECTIVE III-CHOICE 1: BIOINFORMATICS-PMBE33

Credits :5 **Hours :5**

Objectives

- To introduce the most important and basic concepts, methods, and tools used in Bioinformatics
- The application of bioinformatics and biological databases to problem solving in real research problems
- To know the bioinformatics databases, sequence and structure alignment, protein structure prediction, protein folding
- Ability to use the bioinformatics tools to solve the problems on their own research.

Unit I

History, development and types of computers. General awareness of computer systems – hardware and software (CPU and other peripheral devices, computer arithmetic, computer logic, programming languages – machine language, assembly language, higher level languages). Introduction – Email – World Wide Web – Surfing. Search engines.

Unit II

Sequence analysis – need and importance – pairwise alignment – dynamic programming – Global (Needleman – Wunsch) and Local (Smith Waterman) Alignment concepts – Database searching tools – Entrez, BLAST, FASTA – multiple alignment – Clustal – Construction of Phylogenetic trees – Softwares for phylogenetic trees.

Unit III

Structural classification of proteins (SCOP, CATH and other classification) – Structural and functional genomics – Proteomics – Protein sequencing and Protein structure prediction.

Unit IV

Evolutionary analysis; Distance – Clustering methods – Rooted and Unrooted tree representation – Bootstrapping strategies. Neural Networks – Concepts and Secondary Structure Prediction – Hidden Markov Models –Gene Identification and other application.

Unit V

Microarray – types – Stanford Microarray Database –Microarray analysis – Hierarchical clustering and Self organizing Maps.

3D structural analysis of biomolecules – molecular visualization tools – Protein Docking.

Reference

1. Bioinformatics – Principles and potential of a new multidisciplinary tool, TIBITE, 1996.
2. Computing for biologists – A. Fielding. 1985. Benjamin/Cuming Publ.Co.
3. Sequence Analysis in molecular Biology – G.Von Heijne.
4. Sequence analysis – A pioneer – Devereux and Gtribskov.
5. Introduction of Bioinformatics – Attwood T and Parry, D. 2002. Pearson Education Asia, reprinted 2005.

ELECTIVE III-CHOICE 2: INTELLECTUAL PROPERTY, BIOSAFETY & BIOETHICS-PMBE33

Credits :5 **Hours :5**

Objectives

- To learn about the Intellectual Property Rights
- To understand about criteria in applying and maintaining patents.
- To be familiarized with the law and enforcement in Intellectual Property Rights
- To know about IPR and also the importance of protecting their innovation and familiar with international and national law practiced and also recent issues on it.

Unit -I

IPR - Definition - Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies. WTO - Definition - Functions - Forms of IPR Protection.

Unit-II

Types of patent applications: Ordinary,PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Financial assistance for patenting. Patent licensing and agreement. Patent infringement- scope, litigation, case studies.

Unit -III

Biosafety: Definition, concepts and issues. Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

Unit –IV

Biosafety Guidelines: Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO

applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

Unit -V

Bioethics: Definition ethics/bioethics, Principles of bioethics – framework for ethical decision making; biotechnology and ethics –benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare; Animal ethics - Norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects.

Reference

1. Bareact, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co.
Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
3. Singh K. Intellectual Property Rights on Biotechnology, BCIL, and Newdelhi-1993.
4.Shaleesha A. Stanley, Bioethics, Wisdom educational service-2010
5. S. Ignacimuthu. Bioethics.Alpha Science International, 2009.

SEMESTER IV

CORE X-MEDICAL MICROBIOLOGY-PMBT410

Credits :5 **Hours :5**

Objectives

- To attain knowledge of principles of microbial taxonomy, structure, physiology, genetics, immunology and pathogenesis
- To Develop a knowledge of microbial organisms and their relevance of infectious diseases
- To understand the principles of prevention and treatment of pathogenic microorganism infection in humans.
- To develop both informatic and diagnostic skills in microbiology, the microbial species that cause human disease and the antibiotic resistance, public health threats, and global health.

Unit I

Normal microflora of the human body and host pathogen interaction - Normal microflora of the human body: Importance of normal microflora, normal microflora of skin,throat, gastrointestinal tract, urogenital tract. Host pathogen interaction: Nosocomial infections. Transmission of infection. Sample collection, transport and diagnosis - Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA,Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

Unit II

Bacterial diseases - List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control. Respiratory Diseases: Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis. Gastrointestinal Diseases: Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori. Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum,

Unit III

Viral diseases - List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control - Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

Unit IV

Protozoan diseases - List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar

Fungal diseases - Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot), Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis

Unit V

Antimicrobial agents: General characteristics and mode of action - Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism.

Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin

Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine, Antibiotic resistance, MDR, XDR, MRSA, NDM-1

Reference

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition,

University Press Publication.

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Chatterjee K.D. Parasitology and Helminthology
4. Jawetz and Melnich. 1986. Review of medical Microbiology.
5. Greenwood, A guide of microbial infections, 15th Edition.
6. Textbook of Microbiology – Jeyaram Panicker, 4th Edition, 2000, Orient Longman Publishers.

CORE XI-IMMUNOLOGY-PMBT411

Credits :5 **Hours :5**

Objectives

- To provide students with a foundation in immunological processes
- To provide students with knowledge on how the immune system works and principles of auto immunity and tumuor biology
- To provide a basic knowledge of the immune response and its involvement in health and disease.
- To illustrate the cell types and organs involved in the process of immune system

Unit I

Overview of immunology – cells of immune system, hematopoiesis – mononuclear cells, granulolytic cells, mast cells, dendritic cells – organs of immune system – primary and secondary lymphoid organs – Immunity and types – antigens and haptens – types. Immunoglobulins – structure, types and functions. Antigen Antibody reaction.

Unit II

Cell mediated immune response – Histocompatibility complexes – organization, genes, role in immune response – T cells types, subtypes, surface receptors, structure, T cell accessory membrane molecules – cytokines – classes, functions and receptors – T cells – activation, proliferation and differentiation – Cytotoxic response –types.

Unit III

Humoral Immune response – interaction of T cells, MHC and B cells. B cell activation, proliferation and differentiation – Complement system, Components, Classical and Alternate Pathway – receptors- Consequences of complement activation – phagocytosis – Hypersensitivity – types, components and consequences

Unit IV

Immunization types, modes – adjuvants. Immune regulation. Immune tolerance. Immuno modulation. Autoimmune diseases in human – organ specific, systemic – mechanisms.

Unit V

Transplantation immunology – graft rejection – basic mechanism. Tumor immunology – changes in the surface of the tumor cells – immune response tumors. Immunobiology of AIDS. Lymphocyte Disease.

Reference

1. I.M. Roitt. Essential immunology; Blackwell Scientific Publications, Oxford, 9th edition.
2. R.M Coleman. Fundamentals of Immunology. W.C Brown Publ.
3. Janis Kuby. Immunology. W.H Freeman and Coy, N.Y, 4th edition.
4. Illustrated dictionary of Immunology, Cruse.
5. Cellular and Molecular Immunology, Abbas, 3rd edition.
6. Benjamin Elie – Immunology, 3rd Edition.

MAJOR PROJECT – PMBP44

Semester : IV **Duration: 500 hours**

Sub code : MBTC435 **Credit :5**

Learning outcome: Empowering students to carryout individual research projects.

All the candidates of M.Sc (Biotechnology) are required to undergo a Major project and submit the following:

1. Dissertation/Thesis based on the work done by the student.
2. Soft copy of the project on CD/DVD

Project Evaluation Guidelines.

The project is evaluated on the basis of following heads:

Presentation - 25% of total marks.

Viva - 20% of total marks.

Thesis/ Dissertation - 30% of total marks.