SCHOOL OF BIOTECHNOLOGY & GENETIC ENGINEERING
DEPARTMENT OF MICROBIAL BIOTECHNOLOGY

Syllabus
M.Sc., Microbiology (CBCS –UD)
2018-2020 BATCH & ONWARDS

Bharathiar University
Coimbatore-46

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
M.SC., MICROBIOLOGY (UNIVERSITY)
FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR
2018 – 2020 BATCH & ONWARDS
SCHEME OF EXAMINATION

Semester/ Code No.	Paper	Subject	University examination			Credit
			Internal Mark	External Mark	Total Mark	
SEMESTER I						
18MBTMC01	Paper-I	Fundamentals of Microbiology	25	75	100	4
18MBTMC02	Paper - II	Microbial Physiology and Biochemistry	25	75	100	4
18MBTMC03	Paper - III	Microbial genetics and recombinant DNA technology	25	75	100	4
18MBTMC04	Paper - IV	Agricultural Microbiology	25	75	100	4
18MBTME12A	Elective 1 A	**List Enclosed**	25	75	100	4
18MBTME12B	Elective 1 B	**List Enclosed**				
	Supportive 1	**List Enclosed**	12	38	50	2
18MBTMCP1	Practical - I	Basic Microbiological Techniques	40	60	100	4
SEMESTER II						
18MBTMC05	Paper-V	Immunology and Immunotechniques	25	75	100	4
18MBTMC06	Paper - VI	Medical Microbiology	25	75	100	4
18MBTMC07	Paper - VII	Food Microbiology	25	75	100	4
18MBTMC08	Paper - VIII	Environmental Microbiology	25	75	100	4
18MBTME13A	Elective 2 A	**List Enclosed**	25	75	100	4
18MBTME13B	Elective 2 B	**List Enclosed**				
	Supportive 2	**List Enclosed**	12	38	50	2
18MBTMCP2	Practical - II	Advanced Microbiological Techniques	40	60	100	4
SEMESTER III						
18MBTMC09	Paper-IX	Bioprocess Technology	25	75	100	4
18MBTMC10	Paper – X	Bioinformatics and Nanobiotechnology	25	75	100	4
18MBTMC11	Paper – XI	Biosafety, Bioethics , IPR and Biostatistics	25	75	100	4
18MBTMC12	Paper – XII	Research Techniques	25	75	100	4
18MBTME14A	Elective 3 A	**List Enclosed**	25	75	100	4
18MBTME14B	Elective 3 B	**List Enclosed**				
	Supportive 3	**List Enclosed**	12	38	50	2

18MBTMCP3	Practical - III	Applied Microbiological Techniques	40	60	100	4
SEMESTER IV						
18MBTME15A	Elective 4 A	**List Enclosed**	25	75	100	4
18MBTME15B	Elective 4 B	**List Enclosed**				
		Project viva voce*	60	90	150	6
		Industrial / Institute visit and Summer Training (Viva voce)**	50		50	2
		Grand total			2250	90

* The report should be a bonafide work carried out by the candidate in the department or any other recognized institute or laboratory under the guidance of a faculty/external guide and should be authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as 'Not qualified as per CBCS' must resubmit the project again in the ensuing academic year.

** The Industrial training report should be submitted by the candidate. This report must be presented and defended by the candidate in the department attended by all faculties.

ELECTIVE COURSES OFFERED

Semester/ Code No.	**Paper**	**Subject**	**University examination**			**Credit**
			Internal Mark	**External Mark**	**Total Mark**	
18MBTME12 A	Elective 1A	Molecular Cell Biology	25	75	100	4
18MBTME12B	Elective 1B	Biomolecular Metabolism	25	75	100	4
18MBTME13A	Elective 2A	Plant Biotechnology	25	75	100	4
18MBTME13B	Elective 2B	Animal Biotechnology	25	75	100	4
18MBTME14 A	Elective 3A	Pharmaceutical Chemistry	25	75	100	4
18MBTME14B	Elective 3B	Good Manufacturing Practices and Quality Assurance	25	75	100	4
FINISHING SCHOOL PAPER						
18MBTME15A	Elective 4A	Hospital Management and Entrepreneurship development	25	75	100	4
18MBTME15B	Elective 4B	Teaching Techniques in Sciences	25	75	100	4

SUPPORTIVE COURSES OFFERED

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
SEMESTER I	10MBT	Microbial Biotechnology	2	3	50	2
SEMESTER II	09MBTD	Food Biotechnology	2	3	50	2
SEMESTER III	09MBT	Clinical Microbiology	2	3	50	2

SEMESTER I
PAPER I: 18MBTMC01 FUNDAMENTALS OF MICROBIOLOGY

Course objectives:

- Recalling the history and theories in microbiological research.
- Gaining information on staining and sterilization techniques.
- Understanding the ultrastructure and function of prokaryotic and eukaryotic organisms.
- Learning various aspects of microbial nutrition and reproduction.

Unit- I

Early history & scope of Microbiology: Spontaneous generation conflict- Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Winogradsky, Paul Ehrlich, Lederberg and Zinder, Lwoff, Arber and Smith, Temin and Baltimore.

Microscopic techniques: Principles, working mechanism and application-simple, compound, dark field and phase contrast microscope, fluorescence, SEM & TEM.

Unit II

Methods of sterilization: physical methods-Dry heat, moist heat, radiation methods, filtration methods, chemical methods & their application. Preservation and maintenance of Microbial cultures- Lyophilizers, Deep freezer.

Microbial cultures: Methods of pure culture technique- Serial Dilution, Pour Plate, Spread Plate and Streaking methods. Microbiological Media- Types and composition of media.

Staining Techniques: Simple, Differential (Gram's AFB), special- capsular staining (negative), spore, Acid Fast Staning, Fungal Staning - LPCB.

Unit- III

Microbial Taxonomy: Domains and Kingdoms of Life- Bacterial Nomenclature- Classification of Bacteria by Physiological, Metabolic, Serological and Molecular methods- Bergey's Manual of Systematic Bacteriology with general characteristics of each division- Numerical Taxonomy- 16S rRNA based classification. Archeabacterium, Actinomycetes- Structure and Classification.

Unit – IV

General Characteristics and Classification of Algae (Fritsch Method). General Characteristics and Classification of Fungi (Alexopolus). General Characteristics and Classification of Protozoa. Structure and Reproduction of *Paramecium* sp.

Unit – V

General Properties and Classification of Viruses. Cultivation of Plant and Animal Viruses- Characterization and Enumeration of Viruses- Quantitative assay. Genome replication, Protein synthesis and assembly of DNA containing Plant Viruses- CaMV and Gemini Virus- RNA containing Plant Viruses- TMV, Cowpea Mosaic Viruses.

Reference Books

- Prescott L M, J P Harley and D A Klein (2005). Microbiology.Sixth edition, International edition, McGraw Hill.
- PelczarTR M J Chan ECS and Kreig N R (2006). Microbiology.Fifth edition, Tata McGraw-Hill INC. New York.
- Hans G. Schlegel. General microbiology. 7th edition. Cambridge university press (1993).
- Dubey RC and Maheswari DK (2012). A text of Microbiology (Revised edition). S. Chand and Company Ltd., New Delhi.
- GeetaSumbali and Mehrotra RS (2009). Principles of Microbiology.First edition, Tata McGraw Hill P. Ltd., New Delhi.

Course Outcomes:

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

CO 1 - Gain a strong foundation on basic microbiological practices

CO 2 - Understand nature of microbial cell structure, function and nutrition

PAPER II: 18MBTMC02 MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Course objectives:

- To recall the bioenergetics' process of the microbe.
- To describe the mechanism of microbial fermentation process.
- To provide the information about the nutritional uptake of microbial cells.
- To familiarize the energy driven process of the microbes from inorganic substances.
- To know the regulatory responses of the environmental stress and changes in microbes.

UNIT I

Modes of nutritional uptake - Entry of nutrition in the cell, passive diffusion, facilitated diffusion and different mechanisms of active diffusion (Proton Motive Force, PTS, role of permeases in transport, different permeases in E. coli. Transport of aminoacids and inorganic ions in microorganisms and their mechanisms. Utilization of nutrients that cannot enter the cell

UNIT II

Principles of microbial metabolism: Methods used to study, microbial metabolism – nutrient balance, metabolically blocked microbes; radiolabelled compounds.

Bioenergetics: **Energy yielding metabolism** – Energy from organic compounds – carbohydrates – aerobic (EMP, HMP, ED, TCA, ET) in prokaryotes and eukaryotes; complete oxidation.

Energy from visible radiation – photosynthesis in eukaryotes, blue-green algae, bacteria.

UNIT III

Anaerobic fermentation – alcoholic fermentation, propionic acid fermentation, formic acid fermentation**. Energy from inorganic compounds** - ET in chemolithotrophs - ammonia oxidation by members of Genus Nitroso group, nitrite oxidation by Nitro group of genera., production of reducing power in chemolithotrophs - Oxidation of molecular hydrogen by Hydrogenomonas species Ferrous and sulfur/sulfide oxidation by Thiobacillus species**.**

UNIT IV

Stress physiology --- effect of oxygen toxicity ,pH, osmotic pressure, heat shock etc on bacteria Adaptations in thermophiles, halophiles ,alkaliphiles ,acidophiles , Extremophiles – adaptations & significance in biotechnology

UNIT V

Enzymes and co –enzymes: IUBMB classification and nomenclature of enzymes, active site, Lock and key Machanism and induced fir hypothesis, Enzyme kinetics- enzyme inhibition: Reversible – Competitive, Noncompetitive, uncompetitive, Irreversible inhibition.

Reference Books:

- Brock Biology of Microorganisms (14thEdition) Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley,David A. Stahl, January 12, 2014; ISBN-10:0321897390; ISBN-13:978-0321897398
- Microbial Physiology, 4thEdition Michael P. Sector),Albert G. Moat(Editor),John W. Foster(Editor),Michael P. Spector
- Chemical microbiology –An introduction to microbial physiology –AH Rose, Butterworth, London
- The Physiology and Biochemistry of Prokaryotes-4thEdition David White,James Drummond,Clay Fuqua,December 2011
- Chemical microbiology –An introduction to microbial physiology –AH Rose, Butterworth, London
- The Physiology and Biochemistry of Prokaryotes-4thEdition David White, James Drummond,Clay Fuqua,December 2011

Course Outcome

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

CO 1 - Describe the types of the growth factors involved in the microbial communities.

CO 2 - Apply the theoretical knowledge to solve the problems in microbial metabolic engineering.

CO 3 - Describe how the microbes can regulate their structure and metabolism in response to environmental stimuli.

CO 4 - Design, carry out, and report on lab experiments in microbial metabolism and microbial regulation.

PAPER III: 18MBTMC03 MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

COURSE OBJECTIVES:

- To improve the knowledge on genomic structure of microbes
- Recalling the molecular genetics concepts and genetic transformation.
- To familiarize recombinant DNA technology
- To learn gene cloning strategiesand expression analysis
- Applications of recombinant DNA technology in various fields

UNIT I

Origin of Molecular Genetics-Structure of DNA-Mutations-Luria and Delbruck's Fluctuation Test-Spontaneous mutations-nonsense, missense, frame-shift mutations-Induced mutagenesis-Physical agents-UV,X-Rays-Chemical agents-NTG, Base Analogues etc., Reversion-AMES Test-DNA Replication-Messelson and Stahl's Experiment-Okazaki's fragment-DNA polymerases-DNA damage-SOS response-DNA repair.

UNIT II

Gene transfer in bacteria-Transformation-discovery and its significance-competence and factors involved-joint transformation and its uses-Conjugation-F+ and F^- nature of *E.coli*-Origin of Hfr and F' strains-Zygotic induction -Chromosome transfer by Hfr - circular nature of *E.coli* DNA -Use of Hfr strains in genetic mapping-Transduction - λ phage and specialized transduction - Generalised transduction-P1 phage-origin of transducing particles-pre zygotic and post zygotic exclusion-Co-transduction-fine structure mapping of genes by P1 transduction-Wu's Formula-Ratio Test, C-value paradox.

UNIT III

Elucidation of genetic code- Benzer, Khorana and Crick's contributions-Triplet nature of the Genetic code and Adaptor hypothesis-Wobble hypothesis- Bacterial translation, Suppression of nonsense, missense and frame-shift mutations-Intragenic and extragenic suppressions of mutations-modern aspects-structure and function relationship-Gene expression-RNA polymerase-σ factors-other accessory transcription factors-small RNAs'-Concept of Gene and operon-Regulation of gene expression- well studied operon models-*lac*, *trp* and *ara* operon

UNIT IV

Birth of r-DNA technology- Restriction enzymes and their role in r-DNA technology-Restriction-modification system methylase,ligase, adaptors, linkers, homopolymer tailing, *E.coli*-Types of restriction enzymes - Plasmid vectors as cloning vehicles-Vectors for protein over expression, protein secretion and controlled expression-Bacteriophages as cloning vehicles-λ mediated vectors-M13 phage and its use, Cosmids, Phagemids, plasmids, BACS.

UNIT V

Gene Cloning -Purpose – Genomic Library construction-Polymerase chain Reaction (PCR)-Cloning into gram negative, gram positive bacteria and Yeast-Screening of recombinants- α complementation and blue-white selection - Construction of cDNA Library - use of phagemids and Cosmids-DNA sequencing- DNA and RNA hybridization- Southern and Northern blotting-DNA sequencing- Sangers method-Basics of pyrosequencing, next generation sequencing strategies-western blotting for proteins-Semi-quantitative and Real time PCR to quantify gene expression-Yeast two hybrid system-Application of r-DNA technology in human genetics and forensic science-RAPD, RFLP, AFLP, SSCP, Dot and colony blotting.

TEXT BOOKS

1. Principles of Gene Manipulation and Genomics-S.B.Primrose and R.M.Twyman, 2006.John Wiley & Sons Ltd.
2. Molecular Genetics: An introductory narrative, Second Edition - Gunther.S.Stent and Richard Calendar, 2002. CBS Publishers and distributors.

REFERENCE BOOKS

1. A Short Course in Bacterial Genetics: A Laboratory Manual and Handbook for Escherichia coli and Related Bacteria- Jeffrey. H. Miller, 1992.CSHL Press.
2. Fundamental Bacterial Genetics - Nancy Trun and Janine Trempy, 2004. Blackwell publishing
3. From Genes to Genomes: Concepts and Applications of DNA Technology, Second Edition-Jeremy.W.Dale and Malcolm Von Schantz, 2007. John Wiley & Sons Ltd.

COURSE OUTCOMES:

CO 1 - After completing the course, the student should be able to explain the processes mutations and other genetic changes
CO 2 - Identify and distinguish genetic regulatory mechanisms at different levels
CO 3 - Solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction
CO 4 - plan basic experiments in microbial genetics concerned with recombinant DNA technology
CO 5 - Perform gene cloning and their expression studies using various advance techniques

PAPER IV: 18MBTMC04 AGRICULTURAL MICROBIOLOGY

Course objectives:

- To gain knowledge about fundamentals of Agriculture Microbiology.
- To understand the concept of microbial interactions with plants and diseases caused by microbes.
- To learn about biopesticides, bioherbicides and biofertilizers.
- To learn about floriculture techniques.

Unit I:

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, Iron cycles and its importance.

Unit II:

Microbial interaction-among microbes- Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competetion. With plants- Phyllosphere, Rhizosphere, Mycorhizzae - vesicular arbuscular mycorrhizae -VAM) - ecto, endo, ectendomycorrhizae .

Symbiotic and free-living nitrogen fixers (*Rhizobium*, *Azotobacter*, *Azospirillum*, *Frankia*, *BGA* and *Azolla* -Phosphate solubilizers (*Phosphobacterium* and *Aspergillus*) Interrelationships between soil microbes and plants, Rhizosphere concept, R:S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types, Rumen flora, Insects microbial interactions.

UNIT III :

Phytopathology – Classification of plant diseases, signs, and related terminology. Bacterial disease – Citrus canker, Blight of paddy, Fungal Disease- Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease. Principles and methods of plant disease management, integrated plant disease management.

Unit IV:

Interaction of pesticides with soil microorganisms. Biopesticides- *Bacillus thuringiensis*, *B. Sphaericus*, *B. Popilliae*, *Psuedomonas syringae*. Microbial control of plant pathogens- Trichoderma, Use of Baculovirus, NPV virus, Protozoa & Fungi in biological control. Microbial herbicides-Useful genes from microorganisms for agriculture (Herbicide resistant, Bt, Viral). Agricultural antibiotics.

Unit V:

Floriculture – orchids and Bonzai techniques; Production, formulation, packing and marketing of single cell proteins (mushrooms, spirullina and yeast); Biofertilizers- Introduction, biofertilizers using nitrogen fixing microbes- phosphate solubilisation- Rhizobium, Azospirillum, Azolla; Anabaena symbiosis, Blue green algae and Ecto and Endomychorizae. Cultivation, mass production and inoculation of Rhizobium, Azobacter, Azospirillum, Azolla and Cyanobacteria, Carrier- based inoculants, methods of application, quality control and agronomic importance. Application methods. Microorganisms for Bioassay and Biological warfare.

Reference:

1. Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Modern Soil Microbiology, Marcel Dekker INC, New York.
2. Agricultural Microbiology by G.Rangaswamy and D.J.Bagyaraj, Prentice Hall India.
3. Bio-fertilizers in Agriculture and Forestry, 1995, by N.S. Subba Rao.
4. Microbes for Sustainable Agriculture by K.V.B.R. Tilak, K.K. Pal, Rinku Dey
5. Soil Microbiology and Plant Growth, 1995, by N.S. Subba Rao.
6. Plant Growth and Health Promoting Bacteria by Dinesh K. Maheshwari
7. Plant-microbe interactions, Volume 1 by Gary Stacey and Noel T. Keen 8. Biological control of crop diseases Volume 89 of Books in soils, plants, and the environment by S. S. Gnanamanickam
8. Plant-microbe interactions and biological control Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall
9. Plants, genes and agriculture by M.J. Chrispeels and D.F. Sadava.2000.The American Scientific Publishers, USA.
10. Practical Application of Plant Molecular Biology by R.J. Henry.1997. Chapmans and Hall.
11. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-Marja Oksman-Caldentey and Wolfgang H. Barz. 2002, Marcel Dekker, Inc. New York.

Course Outcomes:

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

CO 1 - Gain wide information about agricultural microbiology.

CO 2 – Able to guide the usage of biopesticides, bioherbicides and biofertilizers.

CO3 –Able to start floriculture and small scale industries on spirullina and mushroom cultivation.

PRACTICAL I – 18MBTMCP1 BASIC MICROBIOLOGICAL TECHNIQUES

1. Media preparation – Liquid and Solid media, Agar deep, slant and plate.
2. Pure culture techniques – Streak plate, pour plate, spread plate, decimal dilution.
3. Motility determination- soft agar inoculation.
4. Enumeration of microorganisms from soil: Bacteria, Fungi and Actinomycetes.
5. Staining: Smear fixation, Simple, Gram, Spore, Capsule and Negative and LPCB
6. Growth curve and Effect of various intrinsic factors such as pH, Temperature on the growth of bacterium-Spectroscopic method
7. Anaerobic culture techniques; Mc Intosh Fildes anaerobic jar, Wright's tube method.
8. IMVIC test
9. Hydrogen sulphite test
10. Oxidase test
11. Catalase test
12. Urease test
13. Nitrate reduction test
14. Polymer degradation – Starch, Gelatin, Casein.
15. Carbohydrate fermentation.
16. Observation of mitotic cell division using onion root tips -Demo

SEMESTER II
PAPER V: 18MBTMC05 IMMUNOLOGY AND IMMUNOTECHNIQUES

Course Objective

- Provide knowledge on the mechanism of action of immune system
- Understanding principle and methodology of various immunological techniques
- Learning the fundamental mechanism behind autoimmune disorders
- Perceiving information on different types of hypersensitive reactions

Scope: This paper imparts information about the structure and function of immune system and the related immunological techniques.

UNIT -1

History and scope of Immunology, Lymphoid organs and tissues. Immunity- types-innate and acquire, active and passive, Cell mediated and Humoral Immunity. Hematopoiesis- origin, development and differentiation of immune cells.

UNIT-2

Cells of the immune system: Macrophages, B and T lymphocytes- Activation and types, Dendritic cells, Natural Killer cells, lymphokine activated killer cells, Eosinophils, Neutrophils, Mast cells. Antibody; Production, Primary and Secondary antibody response. Immunoglobulin structure, types and functions. Antigen- types.Haptens, adjuvants, carriers, Bacterial, Viral and Tumour antigens, autoantigens, blood group antigens and Rh factors.

UNIT-3

Antigen-Antibody reactions.Factors governing antigens-antibody interactions; affinity, avidity, valency, cross reactivity.Applications of Immunologicaltechniques- Immunoflourescence, RIA, RAST, ELISA and Flowcytometry. Structure and functions of MHC molecules. Response of B cell to antigen, T cell products.

UNIT-4

The complement systems: Mode of activation and pathways. Transplantation immunology: MLR, HLA Typing. Bone marrow transplantation, organ transplants. Tumor immunology. Cancer of the immune system. Autoimmune disorders and Immunology of infectious diseases – viral, Bacterial and protozoan and Immunodeficiencies.

UNIT-5

Hypersensitivity reactions and types. Immune tolerance and suppression. Immunotheraphy. Hybridoma technology- Monoclonal Antibody production and applications in diagnosis and theraphy.Catalytic antibodies.FACs. Vaccination methods, Vaccine Technology and recombinant vacccines- DNA vaccines and Edible vaccines.

REFEENCES:

1. Kubey, J. 1993. Immunology Freeman and company.

2. Janeway, C.A., Immuno-biology Paul Travers1994.
3. SeemiFarhatBasir., Text Book of Immunology by. First edition. PHI LrarningPvt Ltd, New Delhi.
4. MadhaveeLatha, P., A Text Book of Immunology, First Edition. S.Chand& Company Ltd, New Delhi

Course Outcomes

CO 1 - Able to understand the structure, function, principles and practices outlining various key concepts in immunology.

CO 2 - Equipped to perform various immunological assays

PAPER VI: 18MBTMC07 MEDICAL MICROBIOLOGY

Course Objectives

- To understand basic information on bacterial, fungal and viral diseases.
- Impart a knowledge on parasites
- Create an awareness on the infection caused by the organisms

UNIT I

Milestones in Medical Microbiology - Infectious Diseases process – Diagnosis – Process of sample collection, transport, examinations and discarding of clinical specimens. Antibiogram and serological test. Virulence factors of bacteria – Host parasite relationship.

UNIT II

Bacteriology: Gram positive organisms - Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of Staphylococcus aureus, Streptococccus pyogenes, Pneumococcus, Bacillus anthracis, Corynebacterium diphteriae, Mycobacterium tuberculosis, Mycobacterium leprae. Spirochaetes – Treponema pallidum. Gram negative organisms:- Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of E. coli, Klebsiella pneumoniae, Salmonella typhi, Shigella dysentriae, Pseudomonas aeruginosa, Vibrio cholerae, Bordetella pertusis, Neiserria gonorrhoeae, and Neiserria meningitidis.

UNIT III

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

UNIT IV

Parasitology: Life cycle, Pathogenicity and laboratory diagnosis of Entamoeba histolytica, Trichomonas vaginalis, Plasmodium vivax, Leishmania donovani, Taenia solium, Ascaris lumbricoides, Enterobious vermicularis and Wucheraria bancrofti.

UNIT V

Virology: Pathogenesis and laboratory diagnosis of: DNA containing animal viruses - Adeno viruses, Herpes viruses-type-I and type-II, Pox viruses – Variola virus. RNA containing animal viruses: Picorna virus, Rhabdo virus, Hepatitis viruses -A, B and C, Orthomyxo virus – Influenza H1N1, Paramyxovirus, Retroviruses - HIV and Rubella virus. Arbo virus – Dengue virus, Ebola virus, Prions.

References

1. Textbook of Microbiology – Ananthanarayanan and Jayaram Panicker.
2. Essentials of Diagnostic Microbiology – Lisa Anne Shimeld, Anne T. Rodgers,
3. Manual of Clinical Microbiology – Lenetle, E, Balows H.A.

4. Textbook of Medical Parasitology – Subash. C. Parija.
5. Medical Microbiology - Geo. F. Brooks. S
6. Medical Mycology – Jagadesh Chander.
7. Laboratory Manual in Microbiology-T. Sundararaj
8. Luria. S.E. Darnall. J.E. Baltimore. D. and Compare. A. 1978. General Virology, 3ed.
9. Freidfelder ,D. 1995. Microbial genetics.
10. Hayes. W. 1968. The Genetics of Bacteria and their Viruses.

Course Outcomes:

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

CO 1-Gain wide information regarding various types of bacterial and viral infections.

CO 2- Enables proper diagnosis and treatment of various infections caused by virus and bacteria.

CO 3-Understand of medical mycology and parasitology to make appropriate and effective on-the-job professional decisions.

CO 4- Apply parasitology/mycology laboratory techniques, methodologies, instruments and equipment; and accurately identify, record, and report results to improve patient care.

CO 5- Adapt parasitology and mycology laboratory techniques/procedures when errors and discrepancies in results are obtained to effect resolution in a professional and timely manner.

PAPER VII: 18MBTMC07 FOOD MICROBIOLOGY

Objectives

To impart knowledge about the various areas related to food science as a discipline

To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways

To develop an understanding of food composition,principles of preservation, new product development, food quality and analysis and food safety laws.

UNIT I

Fermentation products: Dairy products: - Production of starter cultures; Cheese - principles of cheese making. Cheddar Cheese, Swiss Cheese, Surface ripened Cheeses; Mold ripened Cheeses. General principles of manufacture of Yogurt, acidophilus milk, Kefir, Koumiss. Fermented foods: Soy sauce, Miso, Sufu, Natto, Idli, fermented fish products. Fermented vegetables: Sauer kraut, pickles, Olives. Fermented sausages.

UNIT II

Distilled beverages: Alcohol, wine, brandy and beer.

Food additives: Production of additives - organic acid (acetic acid, lactic acid and citric acid), amino acids (glutamic acid, lysine, threonine, arginine and histidine), food flavourants and pigments.

UNIT III

Food spoilage and public health: *Staphylococcal, Salmonellosis, E.coli,* Botulism, aflatoxin and amine production; food spoiling enzymes; Deterioration of foods- vegetables, meat, poultry, sea food and fruits.

Food preservation: Principles of food preservation – methods of preservation: Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere); Chemical (Sodium benzoate Class I & II); Biological: Probiotics and bacteriocins.

UNIT IV

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 V

Food process technology: Packaging and canning of foods – preparation for packaging, thermal processing of foods: Microwave heating, thermal inactivation of microorganisms, thermal process, evaluations, freezing and thawing of foods. Food process operations: Evaporation - single and multi effect evaporation, dehydration, psychomatric

charts, drying-tunnel, tray, spray, drum, freeze, distillation; food processing aid through biotechnology.

Food sanitation: Good manufacturing practices – Hazard analysis, Critical control points, Personnel hygiene

TEXT BOOKS

1. Industrial Microbiology, 1983, 4th Edition, Prescott and Dunn's, Gerald Reed, AVI Publishing Company Inc. Conneticut.
2. Food Microbiology- Frazier, 1987, Tata McGraw-Hill Education.

REFERENCES

1. Food Biotechnology. 1982. by Knorr, D. Marcel Dekker, New York
2. Biotechnology, 1983, VI-VIII, Rehm, H.J. and Reed,G, Verlag Chemie,Wainheim.
3. Genetic Engineering Applications for Industry, 1981, Paul,J.K.,Noyer Corporation, New Jersey.
4. Fundamentals of Food Process Engineering, 1980, Toledo,R.T., AVI Publishing Co., USA.
5. Food Engineering Operations, 1979, 2nd Edition, Brennan,J.G., Bulters,J.R., Gowelx,N.D and Lilly, A.E.V., Applied Science Publishers.
6. Food Process Engineering, 1977, 2nd Edition, Heldman, D.R., AVI Publishing

Course Outcome

CO 1 - Explain importance of different types of food in balanced diet and diet planning
CO 2 - Differentiate between different nutrient components in food and their role in processing and consumption.
CO 3 - Correlate basic food microbiology with food safety laws and standards.
CO 4 - Apply traditional methods for food preservation in developing a new food product.
CO 5 - Determine food quality by food analysis as per food laws and the their importance in food industry.

PAPER VIII: 18MBTMC08 ENVIRONMENTAL MICROBIOLOGY

COURSE OBJECTIVES

- To give information about various pollution sources and preventive measures to control pollution.
- To learn intensive process in various pollution treatments
- Applications of Environmental biotechnology in various industries

UNIT I

Basic concepts ecology: Interaction between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession

UNIT II

Aerobiology-Microbial contamination of air-Sources of contamination-Biological indicators of air pollution. Enumeration of bacteria from air, Air sampling devices. Significance of air Microflora, Outline of Airborne diseases (Bacterial - Whooping cough, Diphtheria, Pneumonia; Fungal - Aspergillosis, Cryptococcosis; Viral – Chickenpox, Influenza, Measles), Air sanitation. Air pollution : Types, source, method of sampling, measurement, impact on ecosystem and control. Control of noise and air pollution by biotechnological methods. Gaseous pollutants and odours: General sources, methods of control; fundamentals of adsorption, mechanism of adsorption.Application of adsorption for control of gaseous and odour emission. Noise pollution: Source, measurement, impact on ecosystem and control.

UNIT III

Aquatic Microbiology-Microbiology of water (Aquatic environment-Fresh and Marine)- Water pollution: Impurities in water, water pollution by industrial waste, examination of water, collection of water samples, water analysis – physical, chemical and biological. Assessment of water quality (Chemical and Microbial-indicator organisms) Water treatment processes: Primary treatment, screening, skimming with coagulants, flocculation, filteration, aeration and disinfection; Secondary treatment: Aerobic processes – activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors; Tertiary treatment: Activated carbon treatment, reverse osmosis and electro dialysis. Water borne pathogens.

UNIT IV

Solid waste management: sewage sludge treatment and utilization, refuse disposal, excreta disposal in unsewered area; composting and vermiculture.; biodegradation of

cellulosic and noncellulosic wastes for environmental conservation and fuel; bioaugmentation and biostimulation,bioconversion of cellulosic wastes into protein and fuel; biodegradation of xenobiotics; bioremediation of contaminated soils and waste lands; radioactive product waste disposal.

UNIT V

Effluent treatment – Case studies: Sources of pollution, impact on ecosystem and treatment of following industrial effluents: starch, paper and pulp, tannery, dairy, distillery, oil refineries and pharmaceutical.

Microbes in mining, ore leaching, oil recovery, biopolymers, biosurfactants.

TEXT BOOKS

1. Environmental Biotechnology by Alan Scragg.(2005). IInd edition. Pearson Education Limited, England.
2. Environmental Biotechnology by S.N. Jogdand. (1995). Ist edition. Himalaya Publishing House.Bombay.

REFERENCES

1. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata McGraw Hill, NewDelhi
2. Environmental chemistry by A.K. De Wiley Eastern Ltd. NewDelhi.
3. Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

COURSE OUTCOMES:

After completing the course, the student should be able to

CO 1 - Students will be able to understand use of basic microbiological, molecular and analytical methods, which are extensively used in environmental biotechnology.

CO 2 -To combat any pollution problems arising from industries.

PRACTICAL II: 18MBTMCP2 ADVANCED MICROBIOLOGICAL TECHNIQUES

1. Wine production
2. Organic acid production – Citric acid – Solid state and submerged fermentation.
3. Isolation of nitrogen fixers – free living, symbiotic, ammonification, nitrification, denitrification.
4. Isolation of Phosphate solubilizers.
5. Isolation of Coliphage.
6. Isolation of Plasmids and chromosomal DNA from microbes.
7. Restriction digestion and ligation of bacterial DNA
8. Preparation of competent cells
9. Gene transfer in bacteria by calcium mediated method and identification of recombinants by antibiotic marker
10. Size determination and fractionation of nucleic acids and proteins – Agarose gel electrophoresis, SDS – PAGE.
11. Identification of food pathogen
12. Estimation of coliforms by MPN in water
13. Determination of BOD of effluent
14. Determination of COD of effluent

ELECTIVE
ELECTIVE PAPER I: 18MBTME12A MOLECULAR CELL BIOLOGY

COURSE OBJECTIVES:

- Recalling the structural organization of organelles in both prokaryotic and eukaryotic cells
- Providing information on the functional aspects of the cellular organelles
- Understanding the molecular interaction of cells with regard to metabolism and cell cycle
- Perceiving the molecular interactions in terms of regulation of cell cycle

UNIT I

Cell architecture: Structure of cells – structure of prokaryotic and eukaryotic cells; Surface appendages – Cilia and Flagella, Capsules, Pili, Fimbriae and slime layers; Cell walls – Algae, fungi, bacteria ; Membranes of Gram positive, Gram negative bacteria and acid fast bacteria; protoplast, spheroplast and endospores; Transport across membrane – active and passive transport, transport channels and pumps, transport across nuclear membrane; Neurotransmission, neuromuscular junction.

UNIT II

Cellular constituents: Cytoskeleton and structural components – Microfilaments, Intermediate filaments, Microtubules; Mitochondria – structure, biogenesis; Chloroplast – structure, biogenesis; Endoplasmic reticulum and Golgi complex – structure, function, vesicular transport and import into cell organelles; Structure and function of ribosomes, mesosomes, lysosomes, peroxysomes.

UNIT III

Nucleus: Nucleus structure – structural organization, nucleosome, supranucleosomal structures, specialized chromosomes, polytene and lamp brush chromosomes and chromosome banding; Nucleic acid structure: DNA and RNA.

UNIT IV

Cell cycle: Mechanism of cell division – Mitosis, meiosis and genetic recombination; regulation of cell cycle – factors and genes regulating cell cycle (Cyclins, CDK and CDKI). Biochemistry and molecular biology of Cancer – malignant growth, tumour suppressor genes (p53, RB) and oncogenes (Ras), chemical carcinogenesis, hormonal imbalances.

UNIT V

Cellular development: Extracellular matrix – cell to cell and cell-matrix adhesion, cell junctions; Cellular systematic – components of systematic, receptors (cell surface –

GPCR, RTK, TGF-β, Hedgehog, Wnt, Notch-Delta, NF-Kb, ion channels; intracellular – NO, Nuclear receptor), secondary messengers, effectors ; cell differentiation; gametogenesis and fertilization; development of Drosophila and Arabidopsis – spatial and temporal regulation of gene expression.

TEXT BOOKS

1. Molecular Biology of Cell, Alberts, B et al.
2. Molecular cell Biology, Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.

REFERENCES

1. Introduction to genetics: A molecular approach, T.A. Brown, Garland Science, 2011.
2. Molecular Biology of the Gene (7^{th} Edition, J.D.Watson, Tania A. Baker, Stephen P. Bell , Michael Levine, Richard Losick) Benjamin/Cummings Publ. Co., Inc., California, 2013.
3. Genes XI (9^{th} Edition) Benjamin Lewin, Jones & Bartlett Learning, 2008
4. Molecular biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed) Wiley-Blackwell Publishers, 1995

COURSE OUTCOMES:

CO 1 - Able to coordinate structural organization with functions
CO 2 - Abe to differentiate the prokaryotic and eukaryotic cells
CO 3 - Capable of understanding the molecular mechanism of several diseases
CO 3 - Capacity to determine the causes of cancer and drug resistance
CO 4 - Able to understand the molecular mechanisms of body movement
CO 5 - Abe to explain the process of development of organisms to adult

ELECTIVE PAPER II: 18MBTME12B BIOMOLECULAR METABOLISM

Course Objectives:

- To provides information about the significance of biomolecules
- Recalling the fundamental concepts of biochemistry
- To learn the structure and functions of biomolecules

Unit I

Foundations of Biochemistry: Chemical foundations of Biology: pH, pK, acids, bases and buffers, Henderson-Hassel Balch Equation, biological buffer solutions. Concept of free energy:

Unit II

Principles of thermodynamics; Kinetics, dissociation and association constants; energy rich bonds and weak interactions; Coupled reactions; group transfer; biological energy transducers.

Unit III

Aminoacids: Structural features of amino acids, classification of amino acids, peptide linkage, determination of primary structure of polypeptide (N-terminal, C-terminal determination, method of sequencing of peptides), structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins, protein detection and estimation.

Unit IV

Carbohydrates: Monosaccharides, Disaccharides and Polysaccharides, Glycoconjugates: Proteoglycans, Glycoproteins, and Glycolipids. Carbohydrate metabolism: Glycogenolysis, Gluconeogenesis, interconversion of hexoses and pentoses.

Unit V

Lipids: Classification, chemical nature, properties. Biosynthesis of fatty acids. Oxidation of fatty acids. Storage Lipids, Structural Lipids in Membranes, Lipids as Signals, Cofactors, and Pigments.

Reference Books

- Microbial Biochemistry-2nd Edition - Georges N. Cohen Springer, Feb 2, 2011 – SCIENCE
- Lehninger Principles of Biochemistry by Albert L. Lehninger, David L. Nelson, Michael M. Cox

Course Outcomes:

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

CO 1 - Get a distinct idea about structure and function, synthesis and breakdown of Biomolecules.

CO 2 - Understand metabolic events that occur in cells.

CO 3 - Distinguish the mechanism of regulation associated with these metabolic events.

ELECTIVE PAPER IV: 18MBTME13B ANIMAL BIOTECHNOLOGY

Objectives:

1. To impart the theoretical knowledge on animal cell and tissue culture techniques.
2. To give a hands-on practical exposure on explants isolation, cell derivation, culturing and maintenance.
3. To enable the learners explore advancements of the field and recent technical updates.
4. To provide the knowledge on various aspects of applications including therapeutics, diagnostics and cell culture based products.

UNIT I

Introduction –Basics of animal cell culture techniques. Types of animal cell/tissue culture. Advantages and limitations of animal cell culture techniques. Aseptic techniques inside the cell culture laboratory. Biology of cultured cells

UNIT II

Basic requirements for animal cell culture - equipments and culture vessels. Media and supplements- physical, chemical and metabolic functions of different constituents of culture medium; Various media- Complete and defined media, serum and protein free media. Antibiotics in culture media. Media preparation and sterilization.

UNIT III

Establishment of primary culture. Methods of cell disaggregation. Subculture and cell line propagation. Cloning and selection of cultured cells. Cell separation techniques. Cell synchronization. Cryopreservation of cultured cells. Contamination in cultured cells. Large scale production of therapeutic proteins, hormones and vaccines from cultured animal cells.

UNIT IV

Stem cell Biology: Introduction, biology and classification-Unipotent, Pluripotent and Totipotent. Sources of stem cells-embryonic stem cells, embryonic germ cells and adult stem cells (Mesenchymal, Hematopietic, Induced pluripotent stem cells (iPS), Umbilical cord blood cells, Adipose tissue). Stem cells characterization-Genetic markers and membrane markers. Therapeutic applications of stem cells.

UNIT V

Tissue Engineering: Principles, tissue engineering triad – Basic Constitutents (Matix molecules, Ligands, Growth factors, Biomaterials). Tissue engineering bioreactors. Biodegradable polymers in tissue engineering. Therapeutic applications of tissue engineering.

Outcome of the course:

CO 1 - Students would understand and appreciate basic and advanced methods of mammalian plant tissue culture techniques.

CO2 - The practical exposure would kindle the ideas of students to come up with novel applications of the field.

CO 3 - The technical details would expand the knowledge on the field that would equip the students to implement their views.

TEXT BOOKS

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition- R. Ian Freshney (Wiley Publishing)
2. Animal Cell Culture: A Practical Approach, 3rd Edition -John R. W. Masters (Oxford University Press)
3. Principles of Tissue Engineering, 4th Edition, Robert Lanza, Robert Langer, Joseph P. Vacanti.(Academic Press)
4. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell science publication.

REFERENCES

1. Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P. Mather, David Barnes, Academic press.
2. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford University press.
3. Stem Cells: Scientific Progress and Future Research Directions (http://stemcells.nih.gov/)
4. Essentials of Stem Cell Biology, 2nd Edition - Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut (Academic Press)

ELECTIVE PAPER III: 18MBTME13A PLANT BIOTECHNOLOGY

COURSE OBJECTIVES:

- To understand the basic and latest techniques for in vitro culture of plants.
- Providing advanced knowledge about use of plant biotechnology in breeding and micropropagation techniques.
- To introduce the students to the theory and practice of plant tissue culture and their role from modifying plants in plant biotechnology to the propagation of endangered plants.

Unit – I

Laboratory organization and Techniques in Plant Tissue Culture. Organ culture, root, shoot tip or meristem, ovary, flower and ovule culture and their importance.

Unit – II

Callus culture-principle, protocol and significance, Cell suspension culture – Principle, protocol and its importance. Totipotency, cytodifferentiation and organogenesis – Principle, factors influencing Organogenesis and applications.

Unit – III

Somatic embryogenesis and synthetic seeds – Principle, protocol and importance. Single cell culture, embryo culture – Principle, protocol and applications.
Anther and Pollen culture – Principle, protocol, and its significance. Protoplast, isolation, fusion and culture somatic hybridization, chemofusion, electrofusion, important properties of protoplast, somatic hybrids, cybrids – Principle, protocol and importance.

Unit – IV

Somaclonal variation – Causes and significance, plant tissue culture in forestry, micro propagation, clonal propagation production of useful biochemicals – Gene conservation bank – plant tissue culture in biotechnology-commercial aspects of plant tissue culture.

Unit – V

Application of transgenic plants for Biotic Stress tolerance: Herbicide resistance: phosphoinothricin and glyphosate; Insect resistance: *Bt* genes and alpha amylase inhibitor. Disease resistance: chitinase and 1,3-beta glucanase; Virus resistance: coat protein mediated, nucleocapsid gene; Nematode resistanc;. **Abiotic stress:** Drought, cold and salt; Post-harvest losses: long shelf life of fruits and flowers, male sterile lines, RNAi and Reverse genetics; Nutritional enhancement- Golden rice; Edible vaccine.

References:

1. Edwin F. George and Paul Sherington, D. 1984. Plant Propagation by Tissue Culture, Exegetics Ltd., Edington, Westbury, England.
2. Indra K. Vasil, 1980. Cell Culture and Somatic Cell Genetics of Plants. Academic Press Inc., New York.
3. Kalyanakumar De. 1997. An Introduction to Plant Tissue Culture, New Central Book Agency, Calcutta.
4. R.L.M. Pierik, 1987. In vitro culture in higher plants.MartinusNijhoff Publishers, Boston.

COURSE OUTCOMES:

Co 1- Capable of understanding the totipotency of plants.
Co 2- Able to identify the cell differentiation.
Co 3- Able to understand cell and tissue culture contributes to global sustainability.
Co 4- Abe to develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell, tissue culture and genetic engineering.
Co 5- It will also develop the practical skills and confidence of students to successfully perform plant cells and tissues culturing.
Co 6- Capacity to establish commercial plant tissue culture lab.