UNIVERSITY OF CALICUT

(Abstract)

M.Sc. Programme in Microbiology under Credit Semester System (PG) Scheme and Syllabus – implemented - with effect from 2010 admission onwards - orders issued.

GENERAL & ACADEMIC BRANCH-IV 'J' SECTION

No. GA IV/J1/2838/07 Dated, Calicut University PO, 20.09.2010.

Read: 1. U.O.GAIV/J1/1373/08 dated 23.07.2010.
2. Item No.1 of the minutes of the meeting of the Board of Studies in Microbiology (Single board) held on 28.07.2010.
3. Orders of Vice-Chancellor dated 18.09.2010.

O R D E R

As per order read as (1) above Credit Semester System was implemented to Post Graduate programmes in the affiliated Arts and Science Colleges and Self-Financing Centres of the University with effect from 2010 admission onwards.

The Board of Studies in Microbiology vide paper read as second above restructured the syllabus of M.Sc Microbiology in tune with the Credit Semester System PG-2010 and decided to implement the same with effect from 2010 admission onwards.

The Vice-Chancellor approved the minutes subject to ratification by the Academic council vide paper read as third above.

Sanction has therefore been accorded for implementing the Scheme and Syllabus of M.Sc.Programme in Microbiology under Credit Semester System for affiliated colleges with effect from 2010 admission onwards.

Orders are issued accordingly. Scheme and Syllabus appended.

Sd/-
DEPUTY REGISTRAR(GA IV)
For **REGISTRAR**

To

The Principals of affiliated colleges offering
M.Sc Programme in Microbiology

Copy to:
PS to VC/PA to Registrar/ Chairman Board of Studies in Microbiology /CE/ EX section /DR III Exams/DR PG/EG I/Enquiry/Information centres/ System Administrator (with a request to upload in the University website)/GA1 'F' 'G' sections/ /GAII/GAIII

Forwarded/By Order

Sd/-
SECTION OFFICER

Detailed Scheme for the M. Sc. Microbiology (CSS) course 2010

		Course	Contact Hours	Credit	Exam Duration	Weightage	
						Ext	Int
Semester I	1.	MBIC01. General Biocehmistry	75	3	3 Hours	3	1
	2.	MBIC02. Microbial Metabolism	75	3	3 Hours	3	1
	3.	MBIC03. Environmental and Sanitation Microbiology	75	3	3 Hours	3	1
	4.	MBIC04. Industrial Microbiology	75	3	3 Hours	3	1
	5.	MBIP01. (MBIC01 and MBIC02)	120	3	1 day x 5 Hours	3	1
	6.	MBIP02. (MBIC03 & MB1C04)	120	3	2 days x 5 hours	3	1
		Total	**540**	**18**			
Semester II	5.	MB2C05. Microbial Genetics	100	3	3 Hours	3	1
	6.	MB2C06. Immunology	100	4	3 Hours	3	1
	7.	MB2C07. Food and Agricultural Microbiology	100	4	3 Hours	3	1
	8.	MB2C08. Mycology and Parasitology	100	3	3 Hours	3	1
	9.	MB2P03. (MB2C07)	140	3	2 days x 5 hours	3	1
		Total	**540**	**17**			
Semester III	10.	MB3C09. Medical Microbiology	100	4	3 Hours	3	1
	11.	MB3C10. Molecular biology	100	4	3 Hours	3	1
	12.	MB3E01. Viruses and virus related diseases	100	4	3 Hours	3	1
	13.	MB3E02. Diagnostic Microbiology					1
	14.	MB3E03. Microbial Taxonomy					1
	15.	MB3P04 (MB2C06, MB2C08 &MB3C09)[1]	120	3	2 days x 5 hours[1]	3	1
	16.	MB3P05. (MB2C05 & MB3C10)[2]	120	3	2 days x 5 hours[2]	3	1
		Total	**540**	**18**			
Semester IV	17.	MB4C11. Biostatistics and Bioinformatics	100	4	3 Hours	3	1
	18.	MB4E04. Microbial Biotechnology	100	4	3 Hours	3	1
	19.	MB4E05. Genetic engineering					1
	20.	MB4E06. Biosafety, Bioethics and IPR					1
	21	MB4P06. (MB4C11)	120	3	1 day x 5 Hours	3	1
	22	MB4Pr. Dissertation	220	8	1 day x 5 Hours	External only	
		Total	**540**	**19**			
		Grand Total	**2160**	**72**			

[1] and [2] can be conducted simultaneously

WEIGHTAGE DISTRIBUTION OF EXAMINATIONS AND PROJECT WORK

Theory examination (Internal)

	Weightage
Test paper	2
Seminar	1
Assignment	1
Attendance	1

Practical examination (External)

	Weightage
Experiment	4
Record	1
Viva	1

Practical examination (Internal)

	Weightage
Continuous assessment	4
Attendance	1

Dissertation (External only)

	Weightage
Project work	4
Project Defense	1

Question paper

	Number of questions	Answering Time	Weightage	Total
Short Answer	14	5	1	14
Paragraph questions	7	10	2	14
Essays	2	20	4	8
			Total	36

UNIVERSITY OF CALICUT

M.Sc. Microbiology (CSS) Syllabus
For affiliated colleges

2010 Admission onwards

M.SC. MICROBIOLOGY (CSS)
SYLLABUS 2010

Semester I

1. MB1C01. General Biochemistry
2. MB1C02. Microbial Metabolism
3. MB1C03. Environmental and Sanitation Microbiology
4. MB1C04. Industrial Microbiology
5. MB1P01. (MBIC01 and MBIC02)
6. MP1P02. (MBIC03 and MBIC04)

Semester II

7. MB2C05. Microbial Genetics
8. MB2C06. Immunology
9. MB2C07. Food and Agricultural Microbiology
10. MB2C08. Mycology and Parasitology
11. MB2P03. (MB2C07)

Semester III

12. MB3C09. Medical Microbiology
13. MB3C10. Molecular biology
14. MB3E01. Viruses and Virus related Diseases
15. MB3E02. Diagnostic microbiology
16. MB3E03. Microbial Taxonomy
17. MB3P04 (MB2C06, MB2C08 & MB3C09)
18. MB3P05. (MB2C05 & MB3C10)

Semester IV

19. MB4C11. Biostatistics and Bioinformatics
20. MB4E04. Microbial Biotechnology
21. MB4E05. Genetic engineering
22. MB4E06. Biosafety, Bioethics & IPR
23. MB4P06. (MB4C11)
24. MB4Pr. Dissertation

SEMESTER I

MB1C01. General Biochemistry

Unit I. Structure and functions of Biomolecules: - Structure, classifications and functions of carbohydrates- Monosaccharides; Disaccharides and polysaccharides. Glycosidic linkages; amino sugars, sugar derivatives, glycosides and their functions. Heteropolysaccharides, Glycosaminoglycans and Glycoproteins.

Unit II. Structure and functions of amino acids and proteins: - Chemical structures and classifications of amino acids. Chemical properties of amino acids; Amino acid derivatives, biological amines and their functions. Proteins - different types of classifications; chemical properties of proteins; Structural organization of proteins; primary, secondary, tertiary and quaternary structures. Ramachandran's plot and protein conformation. Super secondary structures, motifs, and domains in protein structures. Non- protein amino acids, biologically important amines and peptides.

Unit III. Lipids –structure, properties and classification. Fatty acid classification- Saturated, unsaturated and poly- unsaturated fatty acids (PUFA); Short chain, medium chain and long chain fatty acids. Tri glycerides, phospholipids, prostaglandins, prostacyclins and leukotriens; Sphingolipids and glycolipids. Structure and functioning of cell membranes.

Unit IV. Structure and properties of nucleic acids: -Purine and Pyrimidine bases; Nucleosides, nucleotides, nucleoside analogues. DNA-structure, Watson and Crick structure; Different forms of DNA –A, B and Z types; Structure properties and functions of different forms of RNA's. Hormones: - Chemical structure, properties and functions of different types of hormones. Classification- based on chemical nature and mechanism of action. Vitamins: - classification, structures, properties and functions Deficiency diseases.

Unit V. Principles and applications of Centrifugation; Electrophoretic techniques Chromatographic techniques-different types. HPLC; GC. Colorimetry, spectrophotometry, Flourimetry and Flame photometry; PH- meter and Rotary evaporator. Spectroscopy – Mass- spectroscopy; NMR; Atomic absorption and Emission Spectroscopy ; ORD and CD; Electron spray. Lyophilization Techniques -Principles and applications, Biphasic separation; Colloids – properties, Solutions –properties; Osmosis, Diffusion; Dialysis, Polar and Non-polar solvents. Principles and applications of tracer techniques in Biology; Radioactive isotopes- applications in biological research; Effect of radiations on Biological systems. Auto radiography and its applications; Geiger – Muller counter.

MB1C02. Microbial Metabolism

Unit I. Basic Principles of Thermodynamics –Laws of Thermodynamics; concepts of Free energy and entropy Enzymology- Enzyme–IUB-Nomenclature; Classification; Enzyme active sites; coenzymes and co-factors; Enzyme kinetics; Michaelis-Menton equation; Factors affecting enzyme activity Multi-subunit enzymes; isozymes; allosteric enzymes; enzyme regulation; Enzyme inhibition; Mechanism of Enzyme action; Enzyme purification techniques. Enzyme immobilization.

Unit II. Glycolysis- aerobic and anaerobic types; alcoholic fermentation; regulation of glycolysis. Pyruvate dehydrogenase complex; Krebs cycle; Glyoxylate cycle-significance, regulation; Substrate- level phosphorylation; Electron transport chain- component structure; oxidative phosphorylation and mechanism of ATP formation; Chemi-osmotic coupling hypothesis. Gluconeogenesis; Glycogenesis and glycogenolysis. Starch synthesis; HMP- shunt and its significance.

Unit III. De-amination; Trans- amination trans- methylation and decarboxylation reactions of amino acids. Synthesis and degradation of various amino acids; essential, semi-essential and non-essential amino acids. Fatty acid oxidation; alpha, beta, and omega oxidations; Fatty acid synthesis; synthesis of unsaturated

and long chain fatty acids. Fatty acid biosynthesis. Purine and pyrimidine-biosynthesis and degradation.

Unit IV. Peptido-glycan biosynthesis. Antibiotics- Structure, classification, and functions of different types of antibiotics. Mechanism of action of different antibiotics. Bacterial toxins - chemistry, properties and mechanism of toxigenicity. Fungal toxins: - aflatoxins and ochratoxins- toxic effects and Mechanism of toxigenicity. Alcoholic fermentation; energy production in anaerobic microbes; Biochemistry of methanogenesis. Biochemistry of Bioluminescence; Bioluminescent bacteria, Biochemistry of rancidity development and microbial lipolysis; Chemical nature and ultra structure of storage granules in Bacterial cell; PHB- synthesis; Volutine- synthesis; Alginates and Siderophores-their structure and functions. Microbial metabolism of Xenobiotics. Co-metabolism and steroid transformations.

MB1C03. Environmental and Sanitation Microbiology

Unit I. Soil microflora, microbial interactions -competition, succession, symbiosis, parasitism, synergism and antagonism. Soil as source of industrial strains. Biodegradation of recalcitrants by soil microbes. Concept of microbial infallibility. Geocycles of C, N, S, P. iron and sulphur oxidation. N_2 fixation. Mycorrhiza, rhizosphere and phylloplane microflora.

Unit II. Air microbiology: Source of microbes and their quantitation techniques. Factors affecting the extent and type of air microflora. Room sanitation in hospitals, industries and pharmaceuticals etc. Air sanitation in cinema and metro tunnels. Early warning of animal, human and plant diseases by air monitoring. Biological weapons, their regulation and precautions.

Unit III. Water microbiology – Source of water microflora and their quantitaion techniques. Water purity in industries, irrigation, potable and recreational waters. Indicator organisms, like *E.coli* and their detection. Bacteriological analysis of drinking water. Water purification and various steps involved.

Unit IV. Pollution and environment. Biosensors and Biological indicators, Waste water management and sewage treatment; industrial, municipal and house hold wastes, BOD concepts, treatment of tannery and slaughter house waste. Solid waste management and land filling. Treatment of petroleum wastes and xenobiotics - General account. Marine pollution, oil spills, tar ball pollution, beach pollution.

MB1C04. Industrial Microbiology

Unit I. Isolation and screening of industrially important microbes. Strain selection and improvement. Bioprocesses- concepts and design. Continuous and batch fermentations. Types of bioreactors. Bioreactor design and control. Kinetics of fermentation process. Transport phenomena in bioprocess such as mass transport coefficients for gases and liquids and oxygen transfer coefficients, heat transfer.

Unit II. Principles of bioprocess media formulations. Sterilization systems. Concepts of inoculum development. Monitoring and control of variables such as temperature, agitation, pressure and pH.

Unit III. Down stream processing – filtration, centrifugation, precipitation, salting out, crystallization and biphasic separation. Bioassays, Standardization, formulations and packaging. Shelf life consideration.

Unit IV. Manufacture of the following: penicillin, streptomycin, tetracycline, Vit. B -12. Citric acid by surface and submerged process. Ethanol fermentation from molasses. Industrial fermentation of wine and beer. Acetone - butanol fermentation. Bakers yeast. Lactic acid from whey, amylases by fungi, mono - sodium glutamate. Importance of fermentations in ayurvedic medicines. Importance and production of Single cell protein (SCP).

MB1P01. (MB1C01 and MB1C02)

1. Preparation buffers.
2. Protein Estimation using Lowry's method
3. Folin - Ciocalteau estimation of unknown protein using Std. graph
4. Carbohydrate estimation
5. Dissolved O2 estimation
6. Estimation of ascorbic acid in plant matter
7. Citric acid estimation
8. PHB Synthesis
9. Visualization of PDB files using rasmol.
10. SDS PAGE using protein Standards
11. Gel filtration chromatography
12. Dialysis of proteins
13. Paper chromatography
14. TLC
15. Column separation of plant pigments

MP1P02. (MB1C03 and MB1C04)

1. Growth curve of bacteria using breeds count, CFU, turbidimetry and PCV
2. Anaerobic culturing by liquid paraffin overlay and pyrogallol.
3. Anaerobic enrichment of cellulose digesters.
4. Demonstration of mutation in bacteria,
5. Phage cultivation.
6. Demonstration of Microbial Bioluminescence.
7. Efficiency testing of bacteria proof filters and autoclave.
8. Study of air microflora by plate exposure and liquid entrapment.
9. Winogradsky column.
10. Water portability testing using indicator organisms.
11. Use of biofilms in sewage treatment.

12. Cultivation of fungi - Slide culture technique.
13. Isolation of amylase producers.
14. Isolation of cellulase producers.
15. Strain development
16. Scale up of inoculum.
17. Cell disruption techniques
18. Downstream processing - Salting out
19. Bioassay.
20. Citric acid production.
21. Alcohol fermentation

SEMESTER II

MB2C05. Microbial Genetics

Unit V. Introduction to microbial genetics. Organization of prokaryotic genome. DNA as genetic materials. DNA replication, DNA damage and repair .Genetic system in yeast and Neurospora.

Unit VI. Mutation; Types and molecular mechanisms of mutation, mutagens, Ames test for mutagenesis. Genetics of bacteriophage and phage induced mutation.

Unit VII. Gene expression and regulation. Regulation of mRNA synthesis, Operon concept, Attenuation, Catabolic repression and autoregulation. Gene transfer mechanisms in prokaryotes: Transformation, Conjugation and Transduction. Construction of genetic map in bacteria. Recombination.

Unit VIII. Introduction to DNA technology. Cloning vectors, Restriction enzymes, Plasmids, Transposons types and mechanisms. Techniques-RAPD, RFLP, PCR, DNA fingerprinting etc.

MB2C06. Immunology

Unit I. Specific immune response. Humeral and cell mediated immune system. Immunoglobulin structure & classes. Isotypes, allotypes and idiotypes. Genetic basis for immunological diversity.

Unit II. Hematopoesis – Cells of immune system, lymphoid organs, lymphocyte traffic, T and B cells – Structure, function, maturation and development. Lymphokines and cytokines. Processing and presentation of intracellular and extracelluar antigens. Primary and secondary immune response. Immune response to T-dependant and T independent antigens. Major histocompatibility complex.

Unit III. Antigen-antibody reactions and their applications in immunodiagnosis. Monoclonal antibodies and hybridoma technology. Complement system, Immunological tolerence.

Unit IV. A brief account of; dysfuntional immunity – autoimmune diseases, hypersensitivity reactions, blood compatibility, Rh. incompatibility, transplantation immunology, immunosuppression, tumor immunology and immunodeficiency diseases.

MB2C07. Food and Agricultural Microbiology

Unit I. Factors predisposing to food spoilage at different levels – intrinsic and extrinsic factors, Spoilage of meat fish, milk, vegetables, fruits and stored grains. Spoilage at low temperature. Food preservation by physical and chemical means: irradiation, drying, heat processing, chilling, freezing, high pressure and food preservatives. Modern techniques like high electronic field pulses, oscillating magnetic fields – pulses, intense light pulses and ultra high hydrostatic pressure. Class I and class II preservatives. Effect of self generated preservatives like organic acids. Preservation of meat as corned beef, sausages, fish fillets, vegetables in brine and as pickles, fruits as cut-fruits, jams, pasteurized milk.

Unit II. Fermented dairy products microbes involved in fermentation -starter lactic acid cultures - yoghurt, and cheese production and its types. Fermented food by microbes; fish, meat products, Importance of Bifidobacterium. Nisin manufacture, whey utilisation eg:- alcohol, lactic acid and SCP fermentations. Delactosing milk enzymatically. Idli, soyasauce and Indian pickle fermentations. Yeast role in bread making. Food hygiene and control - food sanitation in food manufacture and in the retail trade. Food control agencies and their regulations.

HACCP. Food poisoning, intoxications like botulism and aflatoxins. Infections like *Salmonella, Staphylococcus, Listeria etc.*

Unit III. Microbial interactions between plants rhizosphere -phyllosphere - mycorrhizae - symbiotic association in root nodules. Fixation of molecular nitrogen. Biofertilizers VAM, *Rhizobium, Frankia, Azospirillum, Azotobacter* cyanobacteria. Ti plasmid and its importance. Microbes in Coca and Coffee fermentations, Husk retting, biogas from agro waste, rumen digestion, and termite nutrition.

Unit IV. Factors predisposing plants to microbial infections. Mycoplasma and coconut wilt. Brief account of plant diseases caused by microbes. Plant – pathogen interactions, plant defences, endophytic microbes, use of tissue sap as a culture medium. Plant disease control strategies. Biological warefare of plants-precautions. Factors predisposing animals to microbial diseases, epizootic ulcerative syndrome of fish.

Unit V. Biological insect control using microbial insecticides -viral bacterial and fungal. Advantages and disadvantages of biopesticides, qualities of an ideal microbial pesticide. Factors affecting its efficiency. Mass production of bacterial, viral and fungal pesticides. Bioassays, quality control. Success stories – bacterial – Bacillus thuringensis, B. Sphericus, B. popillae against insects and pasturia penetrans against nematodes. Viruses – baculovirus – NPV, CPV, nematodes like Neoplactana carpocapsae. Fungi – Entomophthora and muscardine fungus.

MB2C08. Mycology and Parasitology

UNIT I. Characteristic features of fungi. Classification based on Morphology and Reproduction. Cultivation of fungi in detail.

UNIT II. Fungal diseases-Superficial (Piedra and Pityriasis), Cutaneous (Dermatophytoses, Subcutaneous (Mycetoma), Deep (Histoplasmosis) and Opportunistic (Candidiasis,Cryptococcosis and Aspergillosis). Mycotoxicoses and Mycetismus.

UNIT III. Protozoan parasites- *Entamoeba histolytica, Toxoplasma gondii, Leishmanis donovnii, Plasmodium falciparum* and *Trichomonas vaginalis-*

Epidemiology, Life cycle and pathogenesis. Helminth larva- Microfilariae of different filarial worms- Structure, Pathogenesis and Epidemiology.

UNIT IV. Laboratory diagnosis of fungal and parasitic diseases-Routine methods.

UNIT V. Control of mycoses-Antifungal agents- types, mode of action. Treatment of parasitic diseases mentioned in Unit III.

MB2P03. (MB2C07)

1. Effect of O_2 depletion on food storage.
2. Survival of added test microbes in pickles and curd
3. Brine storage of foods
4. Whey fermentation to alcohol
5. Study of microflora in idli, soya-sauce, chilli sauce, palm toddy.
6. Milk microbiology - direct microscopic count and standard plate count
7. Methylene blue reductase test
8. Isolation of microbes from yoghurt, curd.
9. Microflora of termite gut
10. Demonsration of microbial succession
11. Demonstration of microbial antagonism
12. Bioassay of Bti and Bt
13. Comparison of microflora in Bt-treated and chemical pesticide-treated soils
14. Microbial analysis of food products – bacterial and fungal
15. Microbial spoilage of refrigerated food
16. Extracellular enzyme activities – cellulase, protease, lipase and phosphatase
17. Microbial flora from different soil types and habitats
18. Isolation of nitrogen fixing bacteria
19. Isolation of phosphate solubilizing organisms
20. Degradation of phenols
21. Phosphate, nitrogen and metal removal by microbes

SEMESTER III

MB3C09. Medical Microbiology

Unit I. Epidemiology, pathogenicity and treatment of diseases caused by Haem. influenzae, C. diphtheriae, E. coli, Pseudomonas, Bacillus anthracis, Cl. tetani, Cl. walchi, Leptospira icterohaemmorhagiae, N. gonorrhea, Mycoplasma, compylobacter. Rickettsia -cox, burneti, Chlamidiae -trachoma, New Bacterial diseases- Helicobacter, Lyme diseases, Legionella.

Unit II. Epstein Barr virus, Influenza virus, Rubella (German measles). Slow virus diseases. AIDS, Hepatitis virus, Viral hemmoragic fevers - Ebola. Blastomycetes dermatitidis, Cryptococcus neoformans, Aspergillus fumigatus and A.flavus. Trypanosoma - Giarida lambia, Malaria, Cryptosporidium, Encephalitis virus. Japanese encephalitis virus.

Unit III. Infections in Vulnerable hosts, antimicrobial drugs, Bauer Kirby test, Broth dilution test, minimum inhibitory and lethal concentrations. Mechanism of action and activity spectrum of penicillin, streptomycin, tetracycline, sulfonamides, rifampicin, polymixin - B, Amphotericin – B. Drug resistance.

Unit IV. Conventional and rapid microbiological methods for identification of bacteria. Automation in microbiology - Culturing advances. Spiral plating, Oxyferm, mycotube, enterotube etc. Molecular diagnosis.

MB3C10. Molecular biology

Unit I. Nucleic acid chemistry, properties of nucleic acids, Watson & Crick model of DNA, the law of DNA constancy & C-value paradox, eukaryotic genome organization, repetitive DNA, selfish DNA. DNA replication in prokaryotes & eukaryotes, models of DNA replication-rolling circle & D-loop, reverse transcription.

Unit II. Prokaryotic & eukaryotic transcription, transcription factors, regulatory elements, operon concept,-Lac & Trp operons, post transcriptional modifications.

The genetic code, Translation in prokaryotes & eukaryotes, regulation of translation, post translational modifications of proteins.

Unit III. DNA damage & repair, DNA recombination, transposons, DNA amplification, regulation of gene expression, oncogenes & tumour suppressor genes, viral & cellular oncogenes, tumour suppressor genes from humans, pRb &p53 tumour suppressor proteins.

Unit IV. Bacterial transformation, transduction & conjugation, interrupted mating techniques & gene mapping, lytic & lysogenic phages, episomes, plasmids.

MB3E01. Viruses and Virus related Diseases

Unit I. General properties of viruses- Structure and Morphology, Principles of viral classification. Methods used for viral quantification and enumeration. Electron-microscopic studies. Different methods of cultivation and isolation of viruses. - Laboratory requirements for cultivation. Embryonated egg inoculation, Animal inoculation, Permissive and non-permissive hosts or cells. Tissue - Types of celllines used for the study Detection of virus growth in cell culture

Unit II. Viral Tropism, Factors responsible for viral tropism. Replication of DNA viruses and RNA viruses, effects of viruses on the host cells – cyto-pathic effect. Immune aversion mechanism of viruses, Emerging viral diseases. Virus Host interaction- Acute infection, chronic/persistent infection latent infection and slowly progressive virus infection Viral inclusion bodies - methods of staining and demonstration.

Unit III. Knowledge of medically important DNA and RNA viruses - Pathogenicity, Host range, epidemiology, prophylaxis and antiviral agents used, interferons. Poxviruses, Papilloma Viruses, Human Herpes Viruses, Adenoviruses, Picornaviruses, Myxoviruses, Arboviruses, Rotaviruses, Paramyxoviruses and Rhabdoviruses, Reoviruses, Retroviruses Flaviviruses, Coronaviruses Human Swine fever virus Cancer causing RNA and DNA Viruses. Viral arthritis.

Unit IV. Collections, preservations, Transportation, Processing, Isolation and identification of specimens for viral diagnosis. Metabolic inhibition,

Haemadsorption, Immunofluorescence Serological diagnosis of viral infection, Paul Bunnel test, Haemagglutionation and Haemagglutination inhibition test, viral neutralization tests, Immunofluroscence Principles of immunoblotting techniques, Southern blotting, Northern blotting, Principles of Luminescence Assay, P.C.R and its applications. Immunoelectron microscopy. Molecular diagnostic methods. Types of viral vaccines. Role of genetic engineering in vaccine developments.

MB3E02. Diagnostic microbiology

Unit I. Automated Blood Cultures. Rapid Antigen Tests.- Advanced Antibody Detection.- Phenotypic Testing of Bacterial Antimicrobial Susceptibility.- Biochemical Profile-Based Microbial Identification Systems.

Unit II. Probe-Based Microbial Detection and Identification.- Pulsed Field Gel Electrophoresis.- In Vitro Nucleic Acid Amplification: An Introduction.- PCR and It's Variations.- Non-Polymerase Chain Reaction Mediated Target Amplification Techniques.- Recent Advances in Probe Amplification Technologies.- Signal Amplification Techniques: bDNA, hybrid capture.

Unit III. Detection and Characterization of Molecular Amplification Products: Agarose Gel Electrophoresis, Southern Blot Hybridization, Restriction Enzyme Digest Analysis and Enzyme-Linked Immunoassay.- Direct Nucleotide Sequencing for Amplification Product Identification.- Microarray-Based Microbial Identification and Characterization.- Diagnostic Microbiology Using Real-time PCR Based on FRET Technology.

Unit IV. Bacterial Identification Based on 16S Ribosomal RNA Gene Sequence Analysis. Advance in the Diagnosis of Mycobacterium tuberculosis and Detection of Drug Resistance. Molecular Strain Typing Using Repetitive Sequence –Based PCR.

MB3E03. Microbial Taxonomy

Unit I. Contributions of Pioneers in the field-Von Nageli, Chatton, Whittaker and Woese. Phylogenetic relationships. Brief outline of 5 kingdom classification. Three domain system- characteristics of the Domains: Bacteria, Archaea, Eukarya.Approaches in classification-Natural, Phenetic and Phylogenetic classification. Molecular or genetic approaches in classification. Numerical taxonomy.

Unit II. Criteria used in classification-Morphological, cultural, biochemical, nutritional, ecological, serological characteristics. Principles and procedures of important tests (based on the characteristics) used in classification. Agglutination, Precipitation, ELISA, Western blotting, Phage typing, Fatty acid profile, Flow cytometry.

Unit III. Molecular techniques: DNA base composition, DNA finger printing, Aminoacid sequencing, PCR, Nucleic acid hybridisation, Southern blotting, DNA chips, Nucleic acid sequencing, Ribotyping and rRNA sequencing. Flourescent In Situ Hybridisation (FISH).

Unit IV. Bergey's Mannual of Systematic Bacteriology: Brief outline. Distingushing features of Prokaryotes-Archae and Bacteria. Characteristic features of the important groups under- Archae: Crenarchaeota (Hyperthermophile) and Euarchaeota (Methanobacteriales and Halobacteriales). Bacteria: Proteobacteria (Alpha, Beta, Gamma, Delta and Epsilon), Nonproteobacteria (Deinococcus, Photosynthetic bacteria, Planctomycetes, Chlamydiae, Spirochetes and bacteroidetes), Gram positives -Low G+C gram positive bacteria (Firmicutes- Mycoplasma, Closrtidia and Bacilli) and High G+C gram positive bacteria (Actinomycetes-Corynebacterium, Mycobacterium, Streotomyces).

MB3P04 (MB2C04, MB2C08 & MB3C09)

1. Acid fast staining
2. Stool picture of pathogenic protozoa

3. Microscopic examination of pathogenic microbes using permanent slides
4. Preparation of permanent slides
5. Preparation of antibiotic discs
6. Antibiograms of common bacterial pathogens
7. Determination of MIC
8. Demonstration of antifungal activity
9. Insoluble antibacterial sensitivity by ditch plate method
10. Detection of betalactamase production
11. Identification of common bacterial and fungal pathogens using biochemical tests.
12. Gel diffusion test
13. Blood group determination - A, B, O, and Rh.
14. Widal test
15. VDRL test
16. ELISA
17. Immunoelectrophoresis
18. Blood cell count - TC and DC
19. ESR determination
20. Complement fixation test

MB3P05. (MB2C05 & MB3C10)

1. Study of mitotic stages using onion root tip
2. Karyotype preparation
3. DNA isolation
4. Estimation of DNA
5. RNA isolation
6. Estimation of RNA
7. Hyperchromic shift on DNA melting

8. Bacterial conjugation
9. Isolation of plasmids
10. Induction of Beta galactosidase gene in E. coli
11. Expression of cloned gene in *E.coli*
12. Agarose electrophoresis of RE digest of DNA
13. Western Blot

SEMESTER 4

MB4C11. Biostatistics and Bioinformatics

Unit I. Biostatistics – Principles and practice of statistical methods in Biological Research; Basic statistics; Averages; statistics of Dispersion; Coefficient of variations; Standard error; Probability; Distributions; Tests of statistical significance; Students T-test; Basics of correlation and regression. Analysis of variance.

Unit II. Bio-informatics -: Biology in the computer age – Computational Approaches to Biological questions. Basics of computers – servers, workstations, operating systems, Unix, Linux. World Wide Web. A brief account on introduction to biological databases. Search engines, finding scientific articles - Pubmed – public biological databases.

Unit III. Protein Data Bank, Swiss-prot, Genbank Sequence assembling using computational methods – analysis of sequences using computer ORF – finding the structural motifs (protein) - Homology search using BLAST, motifs - Phylogenetic analysis. Sequence analysis and sequence alignment. Structure prediction and protein modelling.

MB4E04. Microbial Biotechnology

Unit I. Production of microbial biofertilizers – cyanobacteria, *Rhizobium*, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and VAM. Extremophiles and their possible uses - Thermophilic organisms. Yeasts and its uses - Brewer's and Baker's yeast - Food and fodder yeasts - yeast products and their uses. Microbes as a health food - Spirulina and its production methods.

Unit II. Petroleum microbiology - Sedimental microbes in petroleum formation - Coal bioprocess to eliminate sulphur. Microbial enhanced oil recovery, oil spills degradation by microorganisms. Microbial production of fuels- H_2 and ethanol. Microbial leaching of ores - oil extraction - metal leaching and biomining. Microbes and bioremediation - role of microbes in herbicides, pesticides and other xenobiotics degradation. Degradation of toxic chemicals by *Pseudomonas*. Biotransformation - useful products obtained in biotransformation. Microbial production of products like Biopolymers and biosurfactants.

Unit III. Immobilization of cells and enzymes. Advantages and disadvantages of immobilized systems. Enzyme based electrodes. ATPase based cell quantitation and Lumac system. Hybridoma technology for monoclonal antibodies, recombinant vaccines, Animal cell culture. Novel bioreactor designs for animal cell culture – hollow fiber, microcarrier and spin bioreactors. Probiotics - use of *Lactobacilli* and *Bifidobacterium* - therapeutic and nutritional value.

Unit IV. Microbial Insecticides, Commercial Products by Recombinant Microbes, Plant and animal Transgenesis, Cloning, Gene Therapy. Vaccine farming. Environmental impact of genetic engineering – problems of GM foods and crops, Bti. Toxin resistance of insects - cotton bollworm, tobacco budworm, use of multiple alleles of Bti toxin genes. Environmental release and monitoring of genetically modified/engineered organisms. Milk flavor manipulation through rumen microflora, mitigating greenhouse gas emission from dairying using biotechnology.

MB4E05. Genetic engineering

Unit I. Restriction digestion of DNA, separation by isopycnic & agarose gel methods. Cloning vectors-plasmids, BACs, PACs & YACs, cutting &joining DNA molecules, linkers, adaptors & homopolymer tailing, DNA libraries-construction of DNA libraries, genomic & cDNA libraries,

Unit II. PCR-different types like RT-PCR, long PCR, inverse PCR, quantitative PCR, differential display PCR, nested PCR, RACE etc., probes- radiolabel led DNA/RNA probes, synthetic oligonucleotide probes, cloning strategies-cloning in E.coli, yeast & gram +ve bacteria.

Unit III. Expression strategies for heterologous genes, vector engineering & codon optimization, screening strategies, screening by hybridization, colony hybridization, plaque lift assay, Northern, southern & western blotting, FISH, reporter assays. (25 Marks)

Unit IV. DNA sequencing, nucleic acid microarrays, site directed mutagenesis & protein engineering, DNA introduction methods like calcium chloride facilitated uptake, microinjection, electroporation, particle bombardment, use of Ti plasmid in generating transgenic plants. Molecular markers in genome analysis: RFLP, RAPD, AFLP analysis. RNA interference. (15 Marks)

MB4E06. Biosafety, Bioethics & IPR

Unit I. Impacts of biotechnology – legal, socioeconomic, public elucidation of process of biotechnology in generating new forms of life. Biosafety in general, Food and feed products containing GMOs, Risk assessment/analysis, Risk management, Ethical aspects of GMOs, policy on the storage of GMOs, Gene technology act, Precautionary principle, Potential environmental risks & benefits, Potential socio-economical risks & benefits.

Unit II. Bioethics: The Nature of Bioethics, Genetic modification/research on plants and animals, therapeutic cloning, human cloning, stem cell research. Federal Laws and the roles of: The Food and Drug Administration, The

Centers for Disease Control and Prevention, The United States Department of Agriculture, The Environmental Protection Agency, State and Local Agencies

Unit III. Patenting research tools and the law: Patents as a Strategy for Protection of Intellectual Property, Benefits and Costs of Patents, Requirements for Patent Protection, patentable subjects and protection in biotechnology, international convention for the protection of new varieties – Strasbourg convention, UPOV convention. Experimental Use Exemption. The patentablility of microorganisms, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology. Patentability of vectors.

Unit IV. Patents on Research Tools. Access to data and intellectual property: scientific exchange in genome research. Patented research tools - Recombinant DNA, PCR, Taq Polymerase, Protein and DNA Sequencing Instruments, Research Tools in Drug Discovery.

MB4P06. (MB4C11)

1. Biological Databanks- Sequence Databases, Structure Databases, Specialized Databases
2. Data retrieval tools and methods
3. Molecular visualization
4. Gene structure and function prediction (using GenScan, GeneMark)
5. Sequence similarity searching using BLAST
6. Protein sequence analysis using ExPASy proteomics tools
7. Multiple sequence alignment (Clustal)
8. Molecular phylogeny (PHYLIP)
9. Sequence analysis using EMBOSS
10. Small molecule building, using ISIS DRAW and CHEM SKETCH
11. Homology Modeling using SPDBV
12. Model structure refinement using SPDBV
13. Model validation using What Check and Pro Check
14. Docking using HEX
15. Biostatistics problems

MB4Pr. Dissertation

A dissertation should be submitted by each student as a part of the curriculum, based on a topic related to the subject area at the end of the forth semester.

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2. A text book of Medical Mycology-J. Chander
3. Advanced Techniques in Diagnostic Microbiology -Tang, Yi-Wei; Stratton, Charles W. (Eds.)2006.
4. Agricultural Microbiology – Rangaswami
5. Agricultural Microbiology – Subha rao
6. Bailey and Scott's Diagnostic microbiology – Baron *et al*
7. Basic food microbiology – Banwart GJ
8. Biochemistry – DM Vasudevan and S Sreekumari
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10. Biochemistry – Voet and Voet
11. Biochemistry – West and Todd
12. Bioethics: An Introduction for the Biosciences - Ben Mepham,
13. Bioinformatics - sequence and genome analysis – Mount
14. Bioinformatics computing – Bergeron
15. Biological fundamentals – Biotechnology – Ed. H.J. Rehm and G. Reid
16. Biopesticides, use and delivery – Hall and Menn
17. Biostatistical analysis - Zar
18. Biotechnology – B.D. Singh
19. Biotechnology of Integrated pest management – Persley
20. Cell & Molecular Biology-Gerald Karp.
21. Comprehensive biotechnology – Murray and Moo Yung
22. Dairy Microbiology – Robinson RK
23. Diagnostic methods in Clinical Virology : N.R. Grist

24. Environmental Biotechnology – Principles and applications –Burce E *et al.*,
25. Environmental biotechnology and cleaner bioprocess
26. Essential Clinical immunology – Helen Chappell and Mansei Haemy
27. Essentials of Diagnostic Virology: G. Storch
28. Food microbiology – Adams MR and Moss MO
29. Food Microbiology – Frazier WC and Westhoff
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32. Fundamental principles of bacteriology – A.J. Salle
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34. Fundamentals of Immunology – Kuby
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36. Fundamentals of Molecular Virology By Nicholas H. Acheson
37. Fundamentals of the Fungi- Moore
38. Fungal infections:Diagnosis and Management-Richardson and Warnock.
39. General Microbiology – Stanier
40. Genes VIII – Benjamin Lewin
41. Immunobiology – Janeway Travers
42. Immunology – Coleman *et al*
43. Immunology –Roitt
44. Industrial microbiology – Prescott and Dunns
45. Introduction to Bioinformatics – Arthur M Lesk
46. Introduction to immunology – John W Kimbal *etal.*,
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49. Medical Microbiology - Macie and Mc. Cartney
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69. Principles of Gene Manipulation – Primrose
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