Orientation of courses in different semesters for M.Sc. in Microbiology

1st Semester

CORE COURSES	Theoretical	Practical	15 credits
Micro C11: Biomolecular Structures & Their Interactions	30	-	3 + 0
Micro C12: Microbial Cell Biology	30	20	3 + 1
Micro C13: Molecular Biology	30	-	3 + 0
Micro C14: Biophysical Methods & Instrumentation	30	20	2 + 1
Micro C15: Microbial Metabolism	30	-	2 + 0
SUPPORTIVE COURSES			**3 credits**
Micro S11: Enzymes and Reaction Kinetics	30	30	2 + 1

2nd Semester

CORE COURSES			16 credits
Micro C21: Biostatistics	30	-	2 + 0
Micro C22: Evolutionary Biology and Biodiversity	30	-	2 + 0
Micro C23: Recombinant DNA Technology	30	20	3 + 1
Micro C24: Environmental Microbiology	30	20	2 + 1
Micro C25: Genetics (Prokaryotes & Eukaryotes)	30	-	3 + 0
Micro C26: Antibiotics	30	-	2 + 0
SUPPORTIVE COURSES			**2 credits**
Micro S21: Eukaryotic Microbiology	30	-	2 + 0

3rd Semester

CORE COURSES			14 credits
Micro C31: Structural Variations in Bacteria	30	-	2 + 0
Micro C32: Fermentation and Bioprocess Engineering	30	-	2 + 1
Micro C33: Proteomics and Genomics	30	-	3 + 0
Micro C34: Computer Application and Bioinformatics	30	20	2 + 1
Micro C35: Regulation of Eukaryotic Gene Expression	30	-	3+0
SUPPORTIVE COURSES			**2 credits**
Optional course I	50	-	2+0
Summer project and Seminar	-	30	0 + 2

4th Semester

CORE COURSES			11 credits
Micro C41: Virology	30	-	2+ 0
Micro C42: Immunology	30	20	3 + 1
Micro C43: Medical Biotechnology and Gene Therapy	30	-	3 + 0
Micro C44: Host-microbe interactions	30	-	2 + 0
SUPPORTIVE COURSES			**2 credits**
Optional course II	50	-	2+0
Dissertation	-	30	0 + 3
Grand Viva	-	30	0 + 2

Duration of theoretical examinations in different semesters for M.Sc. in Microbiology

All theoretical papers of 30 marks will be of 1hour 30 minutes duration. The optional papers of 50 marks will be of 2 hours duration.

Optional courses to be offered by the department for non-departmental students

3rd Semester: **Fundamentals of Bacteriology: 50 marks** **2+0 credits**

Members of the microbial world, the discovery of microorganisms, the conflict over spontaneous generation, Koch's postulates, an overview of prokaryotic cell structure, cell wall, cell membrane, nucleoid, plasmids, endospore, comparison of prokaryotic and eukaryotic cells.

Microbial nutrition, growth and control: Common nutrient requirements, nutritional types of organisms, growth factors, uptake of nutrient by the cell, culture media, isolation of pure culture, growth, continuous cultures of microorganism, influence of environmental factors on microbial growth in natural environments, control of microorganism by physical and chemical agents.

Microbial diversity: Microbial evolution, introduction to microbial classification and taxonomy.

Microbial disease and their control: Host parasite relationship, human disease caused by bacteria, virus, fungi, antimicrobial chemotherapy, drug resistance.

4th Semester: **Initiation to Bioinformatics: 50 marks** **2+0 credits**

Comparison of sequences of biological macromolecules – Pairwise alignment: local and global alignment; Concept of indel, affine gap penalty; Database search algorithm, significance of hits, Karlin Altschul equation; Multiple sequence alignment, concept of consensus, interpretation with regular expression, concept of protein profile and PSSM, algorithm of PSI-BLAST

1st Semester

CORE COURSES

Micro C11: Biomolecular Structures & Their Interactions Theoretical : 30 3 + 0 credits

General structure of proteins in relation to biological function; chemistry of amino acids, polypeptides; four levels of protein structure, shape of protein molecules; there-dimensional protein structure determination; concept of protein structure motif, idea of prosthetic groups, chemical modification of proteins, protein splicing, unfolding of protein structure, effect of heat, pH and chemicals, denaturation and refolding of proteins, in vivo protein folding: concept of chaperones.
Structure of DNA, (A,B, Z), supercoiling, nucleosomes, RNA, lipids, fatty acids and carbohydrates

Micro C12: Microbial Cell Biology Theoretical: 30, Practical: 20 3 + 1 credits

Cell as a basic unit of living systems; precellular evolution of cell; the evolution of cell from prokaryotes to eukaryotes and from single cells to multicellular organisms; structure of the cell; isolation and fractionation of cells; internal organization of the cell; membrane structure; membrane constituents; phospholopids, glycolipids, cholesterol, membrane proteins, receptors and phospholipases; bilayer structure, asymmetry, fluid mosaic model of random diffusion of membrane components, domains in membrane- natural and artificial membranes; General strategies of the cell division: bacteria and yeast, molecular genetics of cell cycle control;

cellular structure and function; flagella, pili, capsules, cell wall, cell membrane of bacteria; specialized features of higher bacteria like budding, gliding bacteria etc.; fruiting body formation in myxobacteria.
Practical: Subcellular fractionation of nucleus, cell membrane and cytoplasm by differential centrifugation , nuclear staining by DAPI, subcellular localization of proteins: immunostaining methods and GFP-tagging.

Micro C13: Molecular Biology Theoretical: 30 3 + 0 Credits

DNA replication in prokaryotes and eukaryotes: General features and enzymology; detailed mechanisms of initiation, elongation and termination; experiments underlying each step and role of individual factors; telomerases: mechanism of replication, maintenance of integrity and role in cancer; Transcription: RNA polymerase subunits, different sigma factors- related to stress, viral infections etc., initiation, elongation and termination (rho- dependent and independent) of RNA synthesis; antitermination, attenuation and other influences of translational apparatus on the process of transcription; various protein motifs involved in DNA-protein interactions during transcription; translation: in prokaryotes and eukaryotes, processing of mRNA for translation and involvement of different translational factors at different stages of the process.

Micro C14: Biophysical Methods & Instrumentation Theoretical: 30, Practical: 20 2 + 1 Credits

Thermodynamics: extensive and intensive variables; mathematical description of a system with two or more variables, exact and partial differential; first law of thermodynamics, isothermal process, entropy and second law of thermodynamics, reversible and irreversible process, free energy and chemical potential; Gibb's free energy; potentiometric determination of pK's of amino acids. Free energy of charged macro-ions; Debye-Huckel theory; Hydration, solvation number.

Instrumentaion: Principles of light absorption, extinction coefficient, ultraviolet, visible and infrared absorption spectrophotometer and their working principles; molecular vibrations, normal modes and group vibrations- hydrogen bonding effect on vibrational spectra; resonance Raman spectroscopy and its biological applications; Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD) and their application in the study of macromolecules; fluorescence and phosphorescence. Introduction to Mass Spectrometry, MALDI-TOF, ESI.

Practical: General laboratory practices and handling of instruments; training on centrifugation, microscopy and spectroscopy.

Micro C15: Microbial Metabolism Theoretical: 30 2 + 0 Credits

Bacterial photosynthesis (different types of photosynthetic bacteria, photopigments, paths of carbon and electron in bacterial photosynthesis); metabolism of energy reserve compounds (polyglycans, poly- and β-hydroxybutyrate); metabolic energetics: basic differences in anaerobic and respiratory kinds of energy metabolism; electron transport system; basic mechanisms of ATP synthesis; energy conservation in chemolithotrophic bacteria (*Nitrobacter*, *Nitrosomonas*, *Thiobacilli* including *Thiobacillus ferrooxidans*, methanogens, hydrogen oxidizing bacteria); respiratory metabolism- Embden-Meyerhoff pathway, Entner-Doudroff pathway, phosphoketolase pathway, glyoxalate pathway, Krebs' cycle, oxidative and substrate level phosphorylation, reverse TCA cycle, gluconeogenesis- Pasteur effect; energy metabolism and microbial growth; growth yield coefficients, theoretical growth yield; fermentation of carbohydrates-homo and heterolactic ferementations- mixed acid, propionic acid, butyric acid, acetone-butanol etc. fermentations, substrate level phosphorylation in anaerobic energy metabolism; transport processes

SUPPORTIVE COURSES

Micro S11: Enzymes and Reaction Kinetics Theoretical: 30, Practical: 30 2 + 1 credits

Definition of enzymes; active site, substrate, coenzyme, cofactor and different kinds of enzyme inhibitors; enzyme kinetics, two substrate kinetics, three substrate kinetics, deviation from linear kinetics; ligand binding studies; rapid kinetics; association and dissociation constants; use of isotopes in enzyme kinetics mechanism analysis; effect of pH, temperature and isotopically labeled substrates on enzyme activity; allosteric model of enzyme regulation; substrate induced conformational change in enzyme; techniques for purifying and characterizing proteins and enzymes; idea of all analytical techniques like electrophoresis, liquid chromatography, crystallography, column chromatography for enzyme protein analysis.

Practical: Estimation of proteins, enzyme kinetics, effects of pH and temperature on enzyme, use of inhibitors for active site determination, chromatographic techniques, purification of enzymes, chemical estimation of vitamins, minerals like calcium, iron etc, separation of biomolecules by electrophoresis, determination of molecular weight by gel filtration.

2nd Semester

CORE COURSES

Micro C21: Biostatistics Theoretical: 30 2 + 0 Credits

Probability and statistics; population, variables, collection, tabulation and graphical representation of data, frequency distribution, central tendency and skewness, binomial, Poisson and Gaussian distributions, additive and multiplicative laws of probability, concept and correlation; regression; methods of least squares; chi-square tests, random number generation- testing and use; probability density and cumulative distribution function; systematic and random sampling.

Micro C22: Evolutionary Biology and Biodiversity Theoretical: 30 2 + 0 Credits

Origin of life (including aspects of prebiotic environment and molecular evolution); concepts of evolution, theories of organic evolution; mechanisms of speciation; Hardy-Weinberg genetic equilibrium; genetic polymorphisms and selection; origin and evolution of economically important microbes; interactions between environment and biota, types of ecosystems, population ecology and biological control; community structure and organization, 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; ecosystem dynamics and management, stability and complexity of ecosystems, speciation and extinctions, environmental impact assessment; principles of conservation; conservation strategies; sustainable development.

Micro C23: Recombinant DNA Technology Theoretical: 30, Practical: 20 3 + 1 Credits

Principles and methods of recombinant DNA technology- hybridization, cloning, sequencing, polymerase chain reaction, genome projects; gene manipulations; cloning in *E.coli*, plasmids, bacteriophages and cosmid vectors, cloning strategies, genomic and cDNA library; expression of cloned genes in *E. coli*, products made in *E. coli* by genetic engineering; cloning in yeast: transformation in yeast, yeast vector development: Yep, YRp, YCp and YIp, 2μ plasmid, yeast artificial chromosome (YAC), expression of proteins in yeast; yeast 2-hybrid system. Genetic engineering of plants: transformation of plants, manipulating gene expression in plants,

selectable markers and reporter genes, *Agrobacterium tumefaciens*; Genetic elements present on the Ti plasmid, genetic engineering of the Ti plasmid, vectors used to introduce foreign DNA into plant cells- binary cloning vector, disarmed Ti plasmid, cointegrate cloning vector; comparison of methods for transfer of DNA to plants, manipulation of gene expression in plants; production of transgenic plants without reporter or marker genes.

Practical: Isolation of bacterial genome and plasmid DNA, restriction enzyme digestion, restriction mapping and cloning, Southern blotting, RT-PCR.

Micro C24: Environmental Microbiology Theoretical: 30, Practical: 20 2 + 1 Credits

Microbiology of the hydrosphere: Major environmental conditions influencing microflora; distribution of microorganisms in the aquatic environments- freshwater, estuarine and marine environment. Microbiology of the lithosphere: General description of soil as culture media for microbes; soil as a habitat for microorganisms; methods of studying microorganisms and their activities in soil; biology and biochemistry of nitrogen fixation; biochemical transformation of inorganic and organic nitrogen compounds; microbial degradation of cellulose, hemicellulose, lignin, xylans, starch and pectin; biodegradation of petroleum hydrocarbons, pesticides, herbicides and xenobiotics; biofertilizers. Microbiology of extreme environments: General account of thermophilic, halophilic, acidophilic and alkaliphilic microorganisms; metal-microbe interactions; microbial control of heavy-metal pollution.

Practical: Isolation of heavy metal resistant bacteria, Metabolic fingerprinting of microbes by BIOLOG, isolation of cellulolytic bacteria from soil sample, preparation of total DNA from soil and water, amplification of 16S rDNA and DGGE electrophoresis.

Micro C25: Genetics (Prokaryotes & Eukaryotes) Theoretical: 30 3 + 0 Credits

Prokaryotic

DNA damage and repair: factors affecting DNA bases, identification and molecular characterization of repair enzymes in photoreactivation, excision, recombination, and SOS pathways; recombination and transposition: models for homologous recombination- the Holliday, Meselson-Radding and RecBCD pathways and their experimental supports; meiotic recombination- mechanism, the double-stranded DNA breaks; site-specific recombination and transposition: lambda phage integration and excision, bacterial use of site-specific recombination, eukaryotic (yeast, maize, fruitfly) and prokaryotic transposons.

Genetic recombination in Bacteria: Identification and selection of mutants; transformation: natural transformation systems, mechanism, gene mapping by transformation; chemical and electrotransformation. Conjugation: discovery, nature of donor strains and compatibility, interrupted mating and temporal mapping, Hfr, F12 heteroduplex analysis, chromosome transfer in other bacteria, Transduction: Generalized and specialized transduction; gene mapping by specialized transduction, mechanism of generalized transduction, abortive transduction.

Techniques of studying Bacteriophages-virulent phage(T4) and Temperate phage(phage lambda). Important aspects of life cycles; phage genome and gene mapping; host parasite relationship, immunity and repression; site specific recombination (lambda and PI), Transposable phage (Phage Mu), genetic organization and transposition , Phase variation in Salmonella and others.

Eukaryotic

Physical basis of Heredity: Cells, chromosomes, cell division, Mendel's laws, gametogenesis, life cycle (yeast, *C.elegans*); Single gene inheritance, terminology, allelic releationship, single gene crosses, Pedigree analysis;

Two or more genes: Independent assortment, dihybrid cross, Genetic interactions: Two factor interaction, epistatic interaction, non-epistatic interaction, interactions with three or more factors. Linkage and Chromosome mapping: Linkage, cross over, chi square test for linkage, recombination frequency and map construction, tetrad analysis in yeast and recombination mapping with tetrad, mapping with molecular markers.
Yeast genetics: isolation and characterization of auxotrophic and temperature sensitive mutants, synthetic lethality, meiotic mapping, multicopy suppression.

Micro C26: Antibiotics **Theoretical: 30** **2 + 0 Credits**

Definition, phenomenon of antibiotics, concept of secondary metabolites. Role of antibiotics in the producer organism. Assay of antibiotics: chemical versus microbiological assay system, different methods of antibiotic assays (serial dilution, photometric and agar-diffusion methods) - theory and practice; Chemical and biochemical modification of antibiotic structures: development of antibiotics (different generations of antibiotics) taking penicillins and chloramphenicols as parent compounds. Phenomenon of antibiotic resistance. Different biochemical mechanisms of resistance development, multiple-drug resistance, its genetics and chemical significance. Biochemical modes of action of antibiotics acting as inhibitors of ribosomal function (as for example aminoglycosides, tetracyclines, puromycin, choloramphenicol, microlides etc.), inhibitors of nucleic acid metabolism (actinomycin D, mitomycin C etc.), inhibitors of cell wall biosynthesis (penicilline, bacitracins etc.) and inhibitors of membrane function (polyenes, tunicamycin, ionophores etc.).

SUPPORTIVE COURSES
Micro S21: Eukaryotic Microbiology **Theoretical: 30** **2 + 0 Credits**

Important human and veterinary parasites, life cycle and biology of *Plasmodium*, *Entamoeba*, *Leishmania*, *Wuchereria*, *Fasciola*, *Schistosoma*, host parasite interaction. Protozoa: Classification of Protozoa, general biology of protozoal cell, process of reproduction in common protozoal classes, importance of protozoa in soil and water eco-system.
Elements of mycology: General classification of fungi, fungal cell structure, structure and biology of fungal spores of different kinds, reproduction in fungi, mycotoxins.

3rd Semester
CORE COURSES
Micro C31: Structural Variations in Bacteria **Theoretical: 30** **2 + 0 Credits**

Bacterial Cell wall: structures, diversities and biosynthesis, different cell wall hydrolyzing enzymes; bacterial endospores: structure, formation and germination; uncommon bacterial genera: Rickettsia, Chlamydia, Mycoplasma, sheathed bacteria, stalked and budding bacteria, gliding bacteria including Myxobacteria.

Micro C32: Fermentation and Bioprocess Engineering **Theoretical: 30** **2 + 1 Credits**

Introduction to Bioprocess Engineering, Bioreactors, and Membrane Bio reactors, Isolation, preservation, and Maintenance of Industrialn Microorganisms, Kinetics of microbial growth and death, Media and medial sterilization for industrial Fermentation. Air quality Management and air sterilization. Types of Fermentation processes: Analysis of batch, Fed-batch and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.); Fermentation kinetic and monitoring; Measurements and control of bioprocess parameters.

Downstream processing: Introduction, removal of microbial cells and solid matter, foam preparation, precipitation, filtration, centrifugation, cell disruptions, liquid liquid extraction, chromatography, Membrane process, Drying and Crystaliztion, Effluent treatment: D.O.C. and C.O.D. treatment and disposal of effluents. Whole cell immobilization and their industrial applications: Immobilized enzymes, enzymes in aqueous and nonaqueous media, Bioconversion and biotransformation. Industrial production of chemicals: alcohol (ethanol), Acids (citric, acetic, and gluconic), solvents (glycerol, acetone, and butanol) antibiotics (ampicillin, streptomycin and tetracyclin), microlodes, anticancer antibiotics, aminoacids (lysine, glutamic acids), single cell protein, single cell lipids. Use of microbes in mineral beneficiation and oil recovery. Introduction to food technology: Elementary idea of canning and packing– fat based edible products, sterilization and pasteurization of food products, fat-based nutraceuticals technology of typical food/food products (bread, cheese, idli, agro-products (oilseeds), food preservation, food colors, flavors, and antioxidants. Introduction to Bioprocesses technology: Hydrogenation, oxidation, esterification.

Micro C33: Proteomics and Genomics Theoretical: 30 3 + 0 Credits

Genomics

Genetic and physical maps, physical mapping and map-based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, chromosome microdisection, molecular markers in genome analysis; RAPD and AFLP analysis, molecular markers linked to disease resistant genes, application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, varietal etc. Genome sequencing: genome sizes, organelle genomes, genoimc libraries, strategies for genome sequencing, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes. Pharmacogenetics, genetics of globin triplet repeat disorders, cancer genetics; immunogenetics; mapping of human genome; somatic cell genetics; DNA polymorphism in mapping; structure and function; biochemical genetics; polygenic inheritance, Microarray

Proteomics

Mass spectroscopy, basic principle, MALDI-TOF, ESI; 2-D Gel electrophoresis, Nuclear magnetic resonance spectroscopy (NMR), basic principles, chemical shift, spin-spin interaction, NOE, 2D-NMR**,** NOESY, COSEY.

X-ray Crystallography: Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg's law, special properties of protein crystals, model building, refinement and R-factor.

Micro C34: Computer Application and Bioinformatics Theoretical: 30, Practical: 20 2 + 1 Credits

Computer Application

Basic idea to work on Linux platform – basic concept of OS. Simple shell commands.

Bioinformatics

Concept of homology, paralogy, orthology, analogy and xenology

Comparison of sequences of biological macromolecules – Pairwise alignment: local and global alignment; Concept of indel, affine gap penalty; Database search algorithm, significance of hits, Karlin Altschul equation; Multiple sequence alignment, concept of consensus, interpretation with regular expression, concept of protein profile and PSSM, algorithm of PSI-BLAST. PHI-BLAST and other forms of BLAST.

Concept of tree, reading and interpreting phylogenetic trees, distance-based and character-based methods for the construction of phylogenetic trees, judging strength of clades (with BS or PP values) in a tree.

Kyte-Doolittle plot and Hopp-Woods plot- prediction of localization of a protein, prediction of TMD.
Secondary, tertiary and quaternary structure prediction –concept of propensity in Chou-Fasman method; Homology modeling, threading and ab initio method; Docking – rigid and flexible, protein-protein and protein-ligand.

Practical: Implementation of above components.

Micro C35: Regulation of Eukaryotic Gene Expression Theoretical: 30 3+0 Credits

Chromatin organization, cis- acting sequences in transcriptional regulation, mechanisms of action at a distance, trans- control of transcription, different modes of mRNA, tRNA splicing, general discussion on various snRNPs, capping, polyadenylation and other processing events in eukaryotes, RNA editing; discussion on ribozyme; RNA interference: mechanisms and enzymology; regulation of gene expression by miRNP pathway; regulation of translation, tissue specific regulation of transcription, dissecting eukaryotic regulatory elements.

Summer Project and Seminar: A project performance report based on the summer research training in a reputed laboratory of excellence will have to be submitted. A presentation of the accomplishments will be required before a panel of experts. Evaluation will be based on both the project report and presentation.

4th Semester

CORE COURSES

Micro C41: Virology Theoretical: 30 2+ 0 Credits

Classification and modes of propagation, bacterial, plant and animal viruses: morphology and ultra structure; assay of viral particle, cell culture, viral enzymes, nuclic acids, bacterio phages; lambda, T4, T7, M13, lytic cycle, lysogeny; viral replication, nuclic acid and protein synthesis, viral diseases. Virus host interaction: virus infection, viral diseases and pathogensis: Herpes, adeno, hepatitis, rhabdo, oncogenic viruses etc. DNA viruses: Herpes, hepatitis B, adenovirus; RNA viruses: polio, VSV, influenza, retroviruses: structure and life cycle, transformation; baculovirues.; molecular biology of genetic shift and drift in influenza virus, cellular trophism of HIV; Plant viruses: TMV.

Micro C42: Immunology Theoretical: 30, Practical: 20 3 + 1 Credits

Immunoglobins, organization and expressions of Ig genes; B cell maturation, activation and differentiation; MHC/ HLA; antigen processing and presentation; T-cells, T-cell receptors, T-cell maturation, activation and differentiation; cytokines; cell mediated and humoral effector responses, auto immunity, immunodeficiency diseases, transplantation immunology, cancer and immune system. Monoclonal and polyclonal antibodies, monoclonal antibody technique.

Practical: Immunization with a specific antigen and raising of the antibody, Determination of blood group (ABORL), Bacterial agglutination (raising antibody in rabbit using bacteria as antigen), ODD (Ouchterlony double diffusion), SRID (Mancini's method), Immunoelectrophoresis. Lymphocyte preparation from peripheral blood and separation of macrophages. Antibody producing CFU form mouse spleen.

Micro C43: Medical Biotechnology and Gene Therapy Theoretical: 30 3 + 0 Credits

Disease diagnosis-probe, PCR, LCR immunological assay. Detection of genetic, Neurogenetic disorders involving Metabolic and Movement disorders. Treatment-products from recombinant and non-recombinant organisms, Interferons, Antisense therapy, cell penetrating peptides.

Gene therapy, Types of gene therapy, somatic virus germline gene therapy, mechanism of gene therapy, Immunotherapy, Detection of mutations in neoplastic diseases MCC, SSCP, DGGE, PTTC.

Focusing on emerging infections, viral classifications, transmissions and preventions, viral pathogenesis, mechanisms of viral induced cancer and viral evolution, developmental biology of virally induced birth defects, factors in pathogenesis and transmission of prions. Cell mediated and Gene therapy as a novel form of drug delivery, vectors, cell types. Responses to viral infections; slow and persistent infections, anti viral agents, interferons, equipments and materials for animal cell culture technology. Primary and established cell line cultures. Introduction to the balanced salt solution and the simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Serum and protein free defined media and their applications. Measurements of viability and cytotoxicity. Biology and characterization of the culture cells, measuring parameters of growth. Basic techniques of mammalian cell culture in vitro; desegregation of tissue and primary culture, maintenance of cell culture, cell separation. Scaling up of animal cell culture. Cell synchronization. Cell cloning and micromanipulation. Cell transformation. Application of animal cell culture. Stem cell culture, embryonic stem cells and their applications. Cell culture based vaccines, somatic cell genetics, organ and histotypic cultures.

Micro C44: Host-microbe interactions Theoretical: 30 2 + 0 Credits

Pathogenic bacteria, bacterial diseases, mechanism of pathogenesis, prophylaxis, therapy etc. (*Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, B*
acillus, Closridium,) enterobactriacae (*Shigella, Salmonella, E.coli*), *Vibrio* etc., *Mycobacterium* etc. Accute diarrhoeal diseases, food poisoning , Meningitis, tuberculosis, diptheria, leprosy, urinary tract infection, cystic fibrosis, typhoid, enteritis (in *Helicobacter pylorae*), gastritis, cholera, pneumonia; Bioweapons- infectious agents and their epidemiology. Common mycotic infections in human: superficial, subcutaneous, cutaneous, and systemic mycoses.

Plant-microbe interactions: Rhizosphere and phyllosphere microorganisms and their interactions with plants; Symbiotic vs nonsymbiotic nitrogen fixation, symbionts and their cognate hosts, regulation of nitrogen fixation in a symbiotic vs a non-symbiotic N fixer; mechanism of inception of symbiosis, symbiosis vs pathogenesis. Plant pathogens (bacterial, fungal, algal and mycoplasmal); mechanisms of plant pathogenicity, beneficial association between plant and microorganisms (association of plants with cyanobacteria, actinomycetes and fungi).

Human-microbe mutualism and disease, manipulation of host cell pathways by bacterial and parasitic pathogens.

Dissertation: A grant proposal on any relevant topic in biology will have to be prepared by students following the format of National Institute of Health, USA. The students will also be required to defend the proposal before a panel of experts. Both the written proposal and its defense will be taken into consideration for evaluation.

Grand viva: Students will be evaluated on all the topics discussed in the two years programme by a panel of experts.