Department of Microbiology

M.Sc. Microbiology

Programme outcomes

PO1: Research aptitude will be developed in students.

PO2: Students will carry out literature survey, design experiments, collect, interpret, analyse and represent data and will learn communication and soft skills.

PO3: Students will become employable; they will be eligible for career opportunities in Industry, Research or will be able to opt for entrepreneurship.

PO4: Students will acquire advanced knowledge in the subject of specialization at under-graduate level required for higher studies.

PO5: Students will develop solution oriented approach towards various Social issues.

Programme Specific Outcomes

Students will be able to-

PSO1: Isolate and characterize microbes belonging to different taxonomic groups and ecological niches.

PSO2: Develop the expertise to use and handle various instruments used in Microbiology laboratory as per SOPs.

PSO3: Perform Molecular biology and immunological techniques

PSO4: Carry out Literature survey, design and execution of plans and protocols for experimentation, data analysis and interpretation, scientific communication as part of dissertation.

PSO5: Know and Apply Basic statistics and bioinformatics required for life sciences.

PSO6: Develop Presentation skills and Team work

Course outcomes

M.Sc. Part I (Semester I)

MB 501: Microbial Diversity and Taxonomy

CO1: Explain Concept of speciation and species evolution
CO2: Explain Microbial diversity
CO3: Explain Taxonomy of Bacteria and Introduction to Bergey's Manuals
CO4: Explain Concept of ‘unculturable’ bacterial diversity.
CO5: Explain Strategies for culture of ‘unculturable’ bacteria.

CO6: Explain Culture independent molecular methods for identifying unculturable bacteria.
CO7: Explain Methods of extracting total bacterial DNA from a habitat and metagenome analysis
CO8: Explain Gene sequencing

MB 502: Quantitative Biology

Students will be able to:

CO1: Calculate Measures of central tendency, Measures of dispersion – Mean deviation Standard deviation and Variance, Measures of skewness; Measures of kurtosis, Regression and correlation
CO2: Explain the concepts of null hypothesis, alternate hypothesis, significance level, type I and type II errors, p-value, one tailed and two tailed tests
CO3: Calculate Distribution of sample means, standard error and confidence interval, Degrees of freedom
CO4: Calculate Equality of two population means, proportions by t-tests and z test
CO5: Perform chi square test - test for goodness of fit, independence and homogeneity;
CO6: Perform Non-parametric tests
CO7: Calculate Probability and describe Probability Distributions
CO8: Explain Modeling in Biology

MB 503: Cell Organization and Biochemistry

Students will be able to:

CO1: Describe Structural features of amino acids, classify amino acids based on structure and explain their use as buffers.
CO2: Describe steps involved in determination of primary structure of polypeptide use of MALDI-TOF and MS in protein sequencing and solve problems on primary structure determination.
CO3: Describe structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins with specific examples.
CO4: Describe Structure of Nucleic acid bases, nucleosides, nucleotides, phosphodiester linkages, 5' phosphate, 3'hydroxyl polarity of nucleic acids, tautomeric forms of bases and their implication in pairing of bases.
CO5: Describe structure of DNA (A, B and Z forms), t-RNA, r-RNA, and m-RNA and other RNAs
CO6: Describe Tm value and its application to plot Cot curves
CO7: Describe Structural organization and function of: Cytoskeleton, Endoplasmic Reticulum, Golgi apparatus.
CO8: Describe Protein trafficking among various cellular compartments.
CO9: Describe Events in cell cycle, Regulation of cell cycle, mechanism and significance of apoptosis.
CO10: Describe application electron microcopy, Immunoelectron microscopy, and Confocal microscopy for Localization of macromolecules.
CO11: Describe Concepts of commitment, determination and differentiation.

CO12: Describe Morphogen gradients in developmental regulation, pattern formation in body axis, Hox code, MPF.
CO13: Describe steps of embryogenesis, Organizer and its importance in *Drosophilla* and *Xenopus*) model systems
CO14: Describe Life cycle of *Dyctiostellium discoideum* and myxobacteria.
CO15: Describe Molecular mechanism of quorum sensing in slime moulds, myxobacteria and specific examples of Gram positive and Gram negative bacteria
CO16: Describe Biofilms, their organization, signals involved in their formation and dispersal, applications of study on biofilms in pathogenic and non-pathogenic environments.
CO17: Describe the chemical structure and functions of hormones produced by different endocrine glands.

MB 511: Cell Organization and Biochemistry

Students will be able to:

CO1: Isolate, characterize and identify eubacteria, extremophiles, cyanobacteria and Actinomycetes using Bergey's Manual of Determinative Bacteriology

CO2: Isolate, characterize and identify molds and yeasts

CO3: Isolate purify and check purity of isolated chromosomal DNA of bacteria

CO4: Perform BLAST analysis and draw phylogenetic trees using standard software as a part of molecular characterization of bacteria.

CO5: Understand research methodology and scientific communication

MB 512: Cell Organization and Biochemistry

Students will be able to:

CO1: Understand and follow GLP

CO2: Prepare buffers for biochemistry

CO3: Separate sugars and amino acids using chromatographic methods

CO4: Estimate carbohydrate and proteins using colorimetric and spectrophotometric methods

CO5: Study cell division by observing various stages of mitosis

CO6: Isolate and quantify bacterial components such as DNA, Pigments etc.

CO7: Observe and identify various developmental stages of frog and fruit fly embryo

CO8: Use Microsoft Excel for data analysis

M.Sc. Part I (Semester II)

MB 601: Instrumentation and Molecular Biophysics

Students will be able to:
CO1: Explain biomolecular separation and detection by chromatography, electrophoresis and centrifugation
CO2: Explain principles of operation, instrumentation of UV/Visible spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy Circular Dichroism (CD) Mass spectroscopy
CO3: Explain principles of operation, instrumentation of X-ray crystallography
CO4: Explain principles of operation, instrumentation of NMR spectroscopy
CO5: Explain protein structure and folding
CO6: Explain various tools of bioinformatics

MB 602: Virology

Students will be able to:
CO1: Explain structure and replication of viruses
CO2: Explain cultivation and detection methods for viruses
CO3: Explain nomenclature & classification systems of viruses
CO4: Explain bacteriophage ecology
CO5: Explain bacteriophage therapy for control of bacterial poultry diseases
CO6: Explain morphology, genome organization and life cycles of DNA and RNA viruses
CO7: Explain effects of viruses on plants
CO8: Explain behavior of viruses in plants
CO9: Explain methods for detection of plant viruses
CO10: Explain transmission of plant viruses
CO11: Explain prevention of crop losses due to virus infection

MB 603: Microbial metabolism

Students will be able to:

CO1: Describe Purifications of enzyme, purification chart
CO2: Describe kinetics of and derive kinetic equations for single substrate enzyme catalyzed reaction, reversible inhibitions of enzymes and allosteric inhibition. Solve Problems to Dermine kinetic constants Km, Vmax and Ki.
CO3: Describe use of King Altman approach to derive – two substrate enzyme catalyzed reactions, types of two substrate enzyme catalyzed reactions,
CO4: Describe models of allosteric enzymes (Monod, Wyamann and Changuax model, Koshland, Nemethy and Filmer model), examples of allosteric enzymes and their significance in allosteric regulation.
CO5: Describe Laws of thermodynamics, entropy, enthalpy, free energy, free energy and equilibrium constant
CO6: Describe Gibbs free energy equation, solve problems for determination of free energy of hydrolytic and biological oxidation reduction reactions, under standard and non-standard conditions, determination of feasibility of reactions.
CO7: Describe high energy compounds with specific examples and their application in coupled reactions.

CO8: Describe Structure of mitochondria, electron transport chain, ATPase, generation and maintenance of proton motive force and mechanism of oxidative phosphorylation.
CO9: Describe inhibitors and un-couplers of electron transport chain and oxidative phosphorylation.
CO10: Describe Concept of anaerobic respiration, components of electron transfer system and energy generation of bacteria where nitrate, sulfate and carbonate acts as terminal electron acceptors
CO11: Describe the composition and architecture of membranes, Membrane dynamics, structure and significance of liposomes and model membranes.
CO12: Describe Solute transport across membranes: Passive diffusion, facilitated transport, primary and secondary active transport using P , V and F type ATPases, Ionophores, gated channels.
CO13: Describe Structure of chloroplast, electron carriers in photosynthesis, Organization of photosystem I and II, light and dark reaction.
CO14: Describe the features of photosynthesis in C3, C4, CAM plants, photorespiration, Regulation of photosynthesis.
CO15: Describe Bacterial photosynthesis with respect to scope, electron carriers, Photosynthetic reaction center, cyclic flow of electrons, bacterial photophosphorylation in various groups of phototrophic bacteria, electron donors other than water in anoxygenic photosynthetic bacteria.

MB 611: Biophysics & Virology

Students will be able to:
CO1: Calibrate analytical instruments like Colorimeter, Spectrophotometer etc.

CO2: Explain the concept of Molar extinction coefficient and determine the same for given biological molecule

CO3: Use the knowledge of ion exchange chromatography for separation/purification of analytes using anionic resins.

CO4: Carry out synthesis of nanoparticles using microbial cells and characterize them with the help of UV/Vis spectrophotometer.

CO5: Use molecular graphics Tools and interpretation of plots like Ramachandran plot

CO6: Collect information about various viral diseases of plants through sample collection and preparation of herbarium.

CO7: Learn cultivation of animal viruses using embryonated eggs

CO8: Describe various qualitative and quantitative methods to detect virus/ viral titre

CO9: Learn various Dissertation techniques like Selection of Topic, experimental planning, standard protocols, data representation and interpretation, use of statistical tools for data analysis, thesis writing etc.

MB 612: Enzymology & Microbial Metabolism

Students will be able to:
CO1: Carry out purification of enzymes from cells using different techniques of precipitation and filtration.
CO2: Study kinetics of enzyme catalyzed reactions by calculating Km and Vmax
CO3: Do electrophoresis i.e. SDS-PAGE for separation of proteins.
CO4: Isolate and characterize anaerobic bacteria from different habitats/ samples
CO5: Isolate *Azospirillum* and detect production of IAA and siderophores
CO6: Isolate and characterize Phosphate solubilizing bacteria, Cellulose, Chitin and pesticide degrading bacteria from suitable samples.
CO7: Isolate Aflatoxin producing organism using specific growth conditions and detect Aflatoxin from food/produced by culture

M.Sc. Part II (Semester I)

MB 701: Immunology-I

Students will be able to:
CO1:Explain structure and function of cell receptors.
CO2: Explain structure and function of signal transduction path way.
CO3: Explain the mechanism of self-tolerance and clonal deletion.
CO4: Explain cytokine families and cytokine mediated cross regulation of T_H sub set.
CO5: Explain different methods of animal cell culture and media used for it.
CO6: Explain cytokine assays.
CO7: Explain uses of different experimental animals.
CO8: Explain types of tumors and tumor surface markers.
CO9: Explain concept of surveillance and escape of tumor cells.
CO10: Explain theory of autoimmunity and pathophysiology, symptoms and treatments for immuno-deficiencies.

MB 702: Molecular biology-I

Students will be able to:
CO1: Explain method and importance of different molecular techniques.
CO2: Explain concept of operon and different levels of controlling gene expression in prokaryotes.
CO3: Explain steps involved and significance of RNA processing in prokaryotes and eukaryotes.
CO4: Explain families of transposable elements and their significance.
CO5: Explain concept of metabolomics and proteomics.
CO6: Explain various molecular diagnostic tools used in the detection of cancer.
Co7: Explain different types of PCR with their applications.

MB 703: Industrial Wastewater Treatment

Students will be able to:
CO1: Describe about principles and consequences of disposal of untreated wastewater in natural water bodies
CO2: Apply different methods for measurement of pollution load of wastewater sample
CO3: Apply their knowledge about measurement of pollution load of wastewater for designing suitable treatment protocol for given wastewater sample
CO4: Understand about mechanism of working of different primary, secondary and tertiary unit processes
CO5: Have an idea about current ongoing treatment methodologies as well as advanced and innovative treatment processes

MB 711: Immunology, Pharmaceutical Microbiology and Environmental Microbiology

Students will be able to:
CO1: Apply various immunological techniques such as immuno-electrophoresis, SRID, agglutination for detection of antigen and antibody titre
CO2: Understand basic concepts of separation and culturing of different cell types eg. Chick embryo fibroblast cell, lymphocytes, etc. and their application in toxicity testing and diagnostic studies
CO3: Apply knowledge about extraction, fractionation, detection, and anti -infective activity of different phytochemicals
CO4: Perform wastewater analysis by estimating parameters such as COD, BOD, TS, TSS, etc. with additional knowledge about setting up of laboratory scale bioreactors for wastewater treatment.
CO5: Understand basics about on-site application of wastewater treatment processes as well as some immunological techniques by visiting respective sites or institutions

MB 712: Molecular Biology (I and II) and Microbial Technology

Students will be able to:
CO1: Understand and perform molecular techniques for plasmid isolation, characterization as well as transformation of bacteria
CO2: Use various software (online as well as offline) for identification of bacterial isolates at molecular level and annotation of unknown nucleotide sequences.
CO3: Know different immobilization techniques and use them for immobilization of microbial cells/ enzymes for their application in substrate to product conversion.
CO4: Learn to design and standardize growth media for cultivation of specific microorganisms or production of particular microbial products.
CO5: Employ microbial biomass for removal of organic or inorganic chemicals such as Dyes, metal ions etc., from effluent samples**.**

M.Sc. Part II (Semester II)

MB 801: Pharmaceutical and Medical Microbiology

Students will be able to:
CO1: Explain steps involved in drug discovery.
CO2: Explain methods for screening of antimicrobial properties of compounds.
CO3: Explain types and mechanisms of bacterial pathogenicity and concept of bacterial resistance.
CO4: Explain quantitative methods for assessment of antimicrobial activity of drugs.
CO5: Explain GMP, GLP and safety measures.
CO6: Explain role of regulatory authorities and importance of pharmacopeia.
CO7: Explain concept of biological warfare.

MB 802: Molecular Biology II

Students will be able to:
CO1: Explain concept of eukaryotic and bacterial SNPs.

CO2: Explain gene cloning strategies and their applications.

CO3: Explain applications of recombinant DNA technology.

CO4: Explain approaches to produce GMOs and their applications in different fields.

CO5: Explain concept and applications of bioremediation.

CO6: Explain concept of genome project and its applications.

MB 803: Microbial Technology

Students will be able to:
CO1: Describe basic operational parameters of different fermenters and reactors design

CO2: Understand about governing and influencing factors for any fermentation process

CO3: Understand about significance and features of batch, continuous and fed-batch operation mechanisms

CO4: Apply knowledge regarding designing part of aeration, agitation assembly as well as designs of fermenter reactors

CO5: Grasp idea of significance of Intellectual property rights (IPR), different types and categorization of IP's as well as pros and cons of legal aspects of IPR