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) (2019 pattern)

MB 501: **Microbial systematics**

CO1: Explain Concept of speciation and species evolution
CO2: Explain Microbial diversity
CO3: Explain Taxonomy of Bacteria and classification of bacteria by 3 kingdom and 5 domain system, the phonetic and phylogenetic approach for classification.

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 the concept of evolution, kin selection, game theory, coevolution, molecular evolution, r and k selection.

MB 502: Quantitative Biology

Students will be able to:
CO1: Define and explain the fundamental concepts like variable, data, sample, population etc.
CO2: Statistically analyze and measure central tendency & dispersion for the given/experimental data
CO3: Present the data using appropriate method amongst frequency distribution table, Bar diagram, histogram, pie chart, scatter diagram etc.
CO4: Understand and apply the concepts of null hypothesis, Test statistics, P-value significance level, type I and type II errors, one tailed and two tailed tests, degrees of freedom, Parametric and nonparametric test
CO5: Perform Test of Significance, ANOVA One way and two way, Post Hoc test, Sign test, Wilcoxon's signed rank test and Mann-Whitney U test, for the data provided.

MB 503: Biochemistry and Metabolism
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 and solve problems on primary structure determination.
CO3: Describe structural classification of proteins, primary, secondary, super secondary, tertiary, quaternary structures of proteins with specific examples.
CO4: Explain biochemistry and molecular biology techniques such as chromatography, electrophoresis, PCR reaction and sequencing of DNA and RNA.
CO5: Explain basic concepts n developmental biology such as commitment, determination, differentiation, pattern formation in body axis, Hox code, MPF.

CO6: Describe Morphogen gradients in developmental regulation, steps of embryogenesis in *Drosophilla* and *Xenopus* model systems.
CO7: Describe morphogenesis and organogenesis in plants
CO8: Describe Structural organization and function of: eukaryotic cell organelles and protein trafficking among various cellular compartments.
CO9: Describe Events in cell cycle, Regulation of cell cycle, mechanism and significance of apoptosis.

MBTE 13 Microbial communication, Membrane transport and signal transduction

CO1: Describe Life cycle of *Dyctiostellium discoideum* and myxobacteria.
CO2: Describe Molecular mechanism of quorum sensing in slime moulds, myxobacteria and specific examples of Gram positive and Gram negative bacteria
CO3: Describe Biofilms, their organization, signals involved in their formation and dispersal, applications of study on biofilms in pathogenic and non-pathogenic environments.
CO4: Describe the chemical structure and functions of hormones produced by different endocrine glands.
CO5: Describe the composition and architecture of membranes, Membrane dynamics, structure and significance of liposomes and model membranes.
CO6: Describe Solute transport across membranes: Passive diffusion, facilitated transport, primary and secondary active transport using P , V and F type ATPases, Ionophores, gated channels.

MBPE 13 Practicals Based on Microbial communication, Membrane transport and signal transduction

After completion of the course based on Quantitative Biology, students will be able to
CO1: Study and estimate development of biofilm
CO2: Design an experiment to study the mechanism of quorum sensing in bacteria.
CO3: Perform various methods to study chemotactic response of bacteria to various chemical stimuli
CO4: Carry out cell disruption using different methods
CO5: Explain and study the principle of osmosis and diffusion with the help of artificial membranes

MBCP 1: Biochemical Techniques (Practicals Based on Compulsory Courses)

After completion of the course based on Quantitative Biology, students will be able to

CO1: Follow necessary safety rules while working in the laboratory and Do standardization of procedures, calibration and maintenance of the instruments and Design SOPs for the same

CO2: Prepare and use stock solution and buffers of different types

CO3: Use Microsoft excel for preparation of data sheets, handling experimental/ scientific data, presentation of data and statistical analysis of data

CO4: Enrich, isolate and identify extremophiles from various samples

CO5: Learn the role of chemical treatments in the procedure to study mitosis and to observe the stages of mitosis and polyploidy in onion root tips

CO6: Extract proteins and EPS from bacterial cultures and Estimate them using colorimetric and spectrophotometric methods

CO7: Separate proteins using Chromatographic and electrophoretic techniques

CO8: Interpret Ramchandran plot for study of protein conformation

M.Sc. Part I (Semester II) (2019 pattern)

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 the use of radioisotopes in biology

CO6: Explain construction and working and applications of confocal microscope.

MB 602: Molecular Biology

Students will be able to:

CO1: Describe the details of the process of RNA processing in eukaryotes.

CO2: Explain molecular techniques like Chromatin Immuno-precipitation (ChIP), Designing probe, Epitope tagging, expressed sequence tags.

CO3: Explain how to construct cDNA and genomic libraries.

CO4: Explain the importance of enzymes like klenow enzyme, T4 DNA polymerase, polynucleotide kinase in molecular techniques.

CO5: Explain the use of vectors like M13, *Pichia*, Ti in cloning and gene expression.

CO6: Describe the concept of genome project. Students will have learnt the genome projects of *E. coli*, yeast, Plasmodium, Mouse, Drosophila, Rice and human.

CO7: Describe the principle, working and applications of molecular diagnostic techniques like immunoassay, protein arrays.

CO8: Explain various types of diagnostic techniques used for the detection of disease associated changes in gene expression, miRNA in cancers and RNA of antibiotic resistance in Bacteria.

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 and two substrate enzyme catalyzed reactions. Determine kinetic constants Km, Vmax and Ki using provided data.
CO3: Describe models of allosteric enzymes and examples of allosteric enzymes with their significance in allosteric regulation.
CO5: Describe Laws of thermodynamics, and basic concepts in thermodynamics such as entropy, enthalpy, free energy, free energy and equilibrium constant, Gibbs free energy and feasibility of reactions.
CO6: Explain the role of high energy compounds, Atkinson's energy charge.
CO7: Describe classification of lipids and fatty acids.
CO8: Explain structure, function and synthesis of various classes of lipids and role of lipids as signaling molecules.
CO9: Explain classification and structural features of carbohydrates and sugar derivatives and concept of isomerism in sugars.. .
CO 10: Describe synthesis of alginate, synthesis and breakdown of cellulose
CO 11: Explain carbohydrate metabolism and its regulation.

MBTE23: Nitrogen Metabolism, respiration and Photosynthesis (Elective course)
CO1: Describe the process of nitrogen fixation, structure and regulation of nitrogenase enzyme.
CO2: Explain methods of ammonia assimilation observed in bacteria.
CO3: Describe the biosynthesis of amino acids and nucleotides.
CO4: 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
CO5: Organization of photosystem I and II, light and dark reaction, Hill reaction..
CO6: Describe the features of photosynthesis in C3, C4, CAM plants, photorespiration, Regulation of photosynthesis.

MBPE23: Practical based on Nitrogen Metabolism, respiration and Photosynthesis (Elective course)

After completion of the course based on Quantitative Biology, students will be able to

CO1: Enrich and Isolate bacteria producing different plant growth promoting factors like IAA, Siderophores & fixing Nitrogen
CO2: Detect IAA and Siderophores produced by bacteria using appropriate methods
CO3: Extract and Estimate polyphenols & tannins by Folin-Danis method
CO4: Enrich, Isolate and Characterize different groups of bacteria like Lignin degraders, sulphur reducing bacteria, Cyanobacteria
CO5: Detect chlorophyll-a activity of cyanobacteria

MBCP 2: Practical based Molecular Biology, Enzymology and Instrumentation Techniques (Compulsory courses)

After completion of the course based on Quantitative Biology, students will be able to
CO1: Design an experiment to study induction of beta galactosidase enzyme by lactose using colorimetric method and through diauxic growth curve
CO2: Isolate, Quantify, Characterize and Cure plasmid from bacterial cells
CO3: Use various online and off-line tools to annotate genes
CO4: Purify enzyme with salt precipitation, solvent precipitation and gel filtration techniques and Determine Km, Vmax and Kcat values for the same.
CO5: Determine molecular extinction coefficients of various biomolecules
CO6: Isolate Afla toxin producing organism and extract & detect the same from food samples.
CO7: Isolate and characterize lipase/cellulase/chitinases producing microorganisms
CO8: Employ effective presentations skills during Power point presentations, Poster presentation, Oral presentation and Group discussions based on scientific experiments/information
CO9: Use technical writing skills for writing reports & research papers

M.Sc. Part II (Semester I) 2013 pattern

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 (Practical course)

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 (Practical course)

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) 2013 pattern

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

*****