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 and explain their use as buffers, determination of primary structure of polypeptide, structural classification of proteins with specific examples.
CO2: Solve problems on primary structure determination, use of amino acids as buffers and behavior of amino acids, peptides and proteins in solutions at different pH values and under effect of electric field.
CO3: Explain biochemistry and molecular biology techniques such as chromatography, electrophoresis, PCR reaction and sequencing of DNA and RNA.
CO4: Explain basic concepts of developmental biology such as commitment, determination, differentiation, pattern formation in body axis, Hox code, MPF.

CO5: Describe morphogen gradients in developmental regulation, steps of embryogenesis in *Drosophilla* and *Xenopus* model systems, morphogenesis and organogenesis in plants
CO6: Describe organization and function of eukaryotic cell organelles and protein trafficking among various cellular compartments, cell cycle and its regulation, mechanism and significance of apoptosis.

MBTE 13 Microbial communication, Membrane transport and signal transduction
CO1: Describe Life cycle of *Dyctiostellium discoideum* and myxobacteria.
CO2: Explain molecular mechanism of quorum sensing in slime moulds, myxobacteria and specific examples of gram positive and gram negative bacteria
CO3: Describe biofilms formation and dispersal, significance of biofilms in pathogenic and non-pathogenic environments.
CO4: Describe the composition and architecture of membranes, membrane dynamics, structure and significance of liposomes and model membranes, various modes of solute transport across membranes
CO5: Explain signal transduction and mechanism of chemotaxis.

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 and two substrate enzyme catalyzed, reversible inhibitions and allosteric inhibition reactions, models of allosteric enzymes and examples of allosteric enzymes with their significance in allosteric regulation.
CO3: Calculate kinetic constants Km, Vmax and Ki, Gibbs free energy using provided data.
CO4: Explain Laws of thermodynamics, and basic concepts in thermodynamics.
CO5: Describe classification structure, function and synthesis of various classes of lipids and carbohydrates
CO6: Explain synthesis of alginate and cellulose, breakdown of cellulose, 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, methods of ammonia assimilation observed in bacteria..
CO2: Describe the biosynthesis of amino acids and nucleotides.
CO3: 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
CO4: Organization of photosystem I and II, light and dark reaction, Hill reaction, 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 III) 2019 pattern

CCTP 7 (MB 701): Immunology

Students will be able to:

CO1:Explain structure and function of cell receptors.

CO2: Explain the mechanism of self-tolerance and clonal deletion.

CO3: Understand the importance of use of experimental animals.

CO4: Understand the approaches in cancer immunotherapy.

CCTP 8 (MB 702): Molecular biology

Students will be able to:

CO1: Understand the concept of gene variation, role of Prokaryotic and eukaryotic SNPs and explain methods/tools for detection of SNPs.

CO2:Explain approaches to produce GMOs and their applications in different fields

CO3: Explain families of transposable elements, their origins, significance and the process of transposition

CO4: Describe various steps involved in Proteomic studies and applications of proteomics

CCTP 9 (MB 703) : Clinical Microbiology

Students will be able to understand and explain:

CO1: Determinants of pathogenicity, modes of action of different bacterial toxins

CO2: Significance of epidemiological modelling, use of mathematical models, modified epidemiological model for COVID 19 pandemic

CO3:Different bacterial, fungal and parasitic infections and their respective epidemiology, pathogenicity, diagnosis, prevention

CO4: Different viral diseases, significance of their study in current situation, epidemiology, pathogenicity mechanism, their laboratory diagnosis, therapeutic agents, prevention

MBTE 32 : Bioremediation and Biomass utilization

Students will be able to understand and explain:

CO1: Concept of bioremediation, different modes of bioremediation

CO2: Use of genetic engineering technology to enhance bioremediation, plasmids useful in development of genetically engineered strains

CO3: Conventional industrial processes of Alcohol, Fructose and Sillage production and the improvements brought in to them

CO4: Structure of Prokaryotic and eukaryotic cellulase genes and their manipulation.

MBCP 3: Practicals based on Compulsory Theory Credits (Immunology, Molecular Biology & Clinical 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: Carryout Plasmid Isolation, Separation using electrophoretic method and design an experiment to study bacterial transformation & conjugation.

CO3: Understand basics about on-site application of wastewater treatment processes as well as some immunological techniques by visiting respective sites or institutions

CO4: Understanding cultural and biochemical characteristics of bacterial and fungal pathogens

MBPE 32 : Practicals based on Bioremediation and Biomass utilization

Students will be able to:

CO1: Learn methodology for microbial degradation of pollutant compound, detection of biodegradation activity using analytical techniques

CO2: Learn importance of plastic degradation, understand biological solutions for plastic degradation, mode and methodology for low density plastic degradation

CO3: Learn methodology and applications of DNA fingerprinting technique

CO4: Learn to design and standardize process for production of biodiesel using microalgal mass

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 IV) 2019 pattern

CCTP 10 (MB 801): Pharmaceutical Microbiology

Students will be able to:

CO1: Explain the concept of Medicinal Chemistry, historical perspectives of drug discovery as well as the modern rational approach along with classification of drugs.

CO2: Give account of the various stages of drug development process and the tools/techniques used at every stage.

CO3: Know the regulatory authorities functional in the drug development process and explain roles of each of them and importance of pharmacopeia with various example of drug formulations.

CO4: Describe the Pharmacokinetics and the mechanism of ADME

CCTP 11 (MB 802): 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

MBTE 43: Industrial Waste Water Treatment and Industrial Production of Vaccines

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

CO6: Acquire the knowledge of industrial production of vaccines.

MBTE 44: Bioethics, Biosafety, Quality Control and Quality Assurance

Students will be able to -

CO1: Explain GMP, GLP and safety measures.

CO2: Explain the principles of Bioethics.

CO3: Understand the importance, role and functions of various regulatory committees on biosafety.

CO4: Understand the importance, role and functions of various regulatory committees on quality control and quality assurance.

MBCP 4 : Dissertation

Students will be able to -

CO1: Identify the problem area to carry out research and state the hypothesis through survey of scientific literature obtained from authentic sources/ means.

CO2: Decide the line of action, describe methodology and accordingly design experimental set up

CO3: **R**ecord observations, statistically analyse the data obtained, effectively represent and interpret the data and finally drawing conclusions.

MBPE 43: Practicals based on Industrial Waste Water Treatment and Industrial Production of Vaccines

Students will be able to -

CO1: 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.

CO2: Define Potency of the vaccine and Assess quality of toxoid type of vaccine using immunological techniques

CO3: Perform the steps for isolation of *Salmonella* H and O antigen.

MBPE 44: Practicals based on Bioethics, Biosafety, Quality Control and Quality Assurance

Students will be able to -

CO1:Understand the NABL norms for calibration of Autoclave and Laminar Air Flow.

CO2: FSSAI manuals, their significance, their application in water and food testing, tests prescribed for different samples for detection of different contaminating pathogens

CO3: Carry out quality assessment of packed foods with respect to pathogens like *L.monocytogenes*.

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