DEPARTMENT OF MICROBIOLOGY

B.Sc. Microbiology

Programme outcomes
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PO1: Scientific temper will be developed in Students.

PO2: Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the science stream.

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

PO4: Students will possess basic subject knowledge required for higher studies, professional and applied courses like Management Studies, Law etc.

PO5: Students will be aware of and able to develop solution oriented approach towards various Social and Environmental issues.

Programme Specific Outcomes (UG)

Students will be able to-

PSO1: Perform Aseptic techniques

PSO2: Prepare reagents and nutrient media

PSO3: Isolate, characterize and maintain bacterial cultures

PSO4: Carry out Production of biofertilizers

PSO5: Perform Microbial analysis/ Quality Control testing of samples such as soil, water, milk and injectibles.

PSO6: Do Biochemical and molecular biology techniques, enzyme assays, chromatography, electrophoresis.

PSO7: Perform Antibiotic sensitivity testing and hematological techniques.

PSO8: Gain Basic computer literacy

Course outcomes

First Year (2019 pattern)

Course - MB 111: Introduction to Microbial World and MB 121 Bacterial Cell and Biochemistry

Students will be able to

CO1: Describe History of Microbiology including discovery of microscope, Theory of Abiogenesis verses Biogenesis, experiments carried out by various scientists etc.

CO2: Contribution of different scientists in Microbiology .Explain Germ Theory

CO3: State Koch's and River's Postulates to explain Germ Theory of Diseases

CO4: Know contribution of several Nobel Laureates in the field of immunology, molecular biology and biotechnology

CO5: Understand the concepts of Vaccination and Chemotherapy and their applications

CO6: Study characteristics of different microbial types like Bacteria, Fungi, Algae, Viruses etc

CO7: Explain beneficial and harmful effects of microorganisms in different areas of Microbiology.

CO8: Describe types of bonds present in biomolecules, structures and roles of biomolecules like Carbohydrates, Proteins, Lipids, Nucleic acids etc.

CO9: Know and explain structure, composition and functions of different bacterial cell components

CO10: Understand introduction to bacterial classification based on 16s RNA sequencing.

CO11: Learn significance and applications of Human Microbiome.

CO12: Learn basics of Nano Biotechnology and Space Microbiology

CO13: Learn basics of bacterial cytology and structures, functions and chemical composition of bacterial cell components.

Course- MB 112: Basic Techniques in Microbiology and MB 122 Microbial cultivation and growth

Students will be able to

CO1: Understand Microscopy-Bright field microscopy, structure and working of compound light microscope, Phase Contrast Microscope, Electron Microscopes, Fluorescent Microscope

CO2: Know concept of Magnification, Resolving power and Numerical Aperture

CO3: Describe aberrations in lenses

CO4: Describe properties and role of Fixatives, Mordant, Decolorisers and Accentuators

CO5: Know concept of Stain and types of Stain.

CO6: Understand Principles of Monochrome staining, Negative Staining.

CO7: Understand Differential Staining techniques-Gram Staining and acid fast staining. Learn special staining techniques for different components of bacterial cell

CO8: Describe Sterilization and disinfection by Physical Agents and by Chemical Agents and their mode of action.

CO9: Describe checking of efficiency of sterilization by using Biological and Chemical Indicators.

CO10: Describe Phenol Coefficient

CO11: Learn Cultivation of Microorganisms, Nutritional requirements and nutritional classification, bacterial media preparation

CO12: Learn Methods for cultivation of different types of microorganisms

CO13: Understand Concept of Enrichment, Pure Culture, Isolation and Maintenance of Microbial Cultures.

CO14: Understand Role of Culture collection centers.

CO15: Requirements and guidelines of National Biodiversity Authority for culture collection centers

CO16: Learn Kinetics of bacterial growth, Growth curve and Generation time, Diauxic growth
CO17: Measurement of bacterial growth by different Methods

CO18: Learn Factors affecting bacterial growth

Course- **Practical Course**

Students will be able to-

CO1: Describe construction and Working of common instruments used in Microbiology laboratory

CO2: Explain use of various glassware used in microbiology experiments

CO3: Handle and use compound microscope to observe microorganisms

CO4: Prepare and stain the smear and focus the slide to observe bacterial/ fungal specimens or their specific cellular components

CO5: Study effect of physical & chemical agents like pH, temperature, Salt concentrations, heavy metals etc. on growth of bacteria

CO6: Prepare growth medium for cultivation of bacteria

CO7: Use inoculation and isolation techniques for isolation of bacteria from given samples

CO8: Observe and record colony characteristics of bacterial isolates

CO9: Evaluate disinfectant by determining its Phenol Coefficient.

Second Year (Semester I) (2013 pattern)

Course- MB 211: Bacterial Systematics and Physiology (Paper I)

Students will be able to-

CO1: Describe concept of bacterial species
CO2: Describe with suitable examples application of chemotaxonomy and nucleic acids in bacterial classification
CO3: Describe steps involved in numerical taxonomy
CO4: Decribe with example use of radioisotopes in studying metabolic pathways using techniques such as Autoradiography, Phospher imaging and pulse chase.
CO5: Write down following pathways with details such as structures and names of metabolites, names of enzymes and cofactors: EMP, HMP, ED, Phosphoketolase, Glyoxylate, TCA, Homofermentative and heterofermentative lactic acid pathways.
CO6: Describe various electron carriers of electron transport chain and high energy compounds with specific examples.
CO7: Write with examples mechanism of Oxidative phosphorylation, Substrate level Phosphorylation
CO8: Describe chemiosmotic hypothesis, Concept of Standard redox potential and Nernst Equation.
CO9: Describe with examples coenzymes, prosthetic group and cofactors.
CO10: Describe nature of enzyme active site with names of common amino acids at active site.
CO11: Describe Models for catalysis – i. Lock and key ii. Induced fit iii. Transition state.
CO12: Describe with suitable examples of catalytic groups the mechanism of Acid-base catalysis, metal ion catalysis, covalent catalysis.
CO13: Describe the effect of pH & temperature, substrate concentration & enzyme concentration, activators and inhibitors of enzyme.

Course- MB 212: Soil & Industrial Microbiology (Paper II)

Students will be able to-

CO1: Describe industrially important microorganisms

CO2: Desirable characteristics of industrial strain and Principles of primary and secondary screening

CO3: Definitions of Master, working and seed culture

CO4: Development of inoculum

CO5: Describe parts of a Fermenter and their operation.

CO6: Process Control and Monitoring of different fermentation parameters (temperature, pH, aeration, agitation, foam)

CO7: Describe Types of fermentations: Batch, continuous, dual

CO8: Explain Constituents of industrial fermentations media

CO9: Contamination: Sources, precautions, and consequences

CO10: Know the composition and types of soils along with soil microorganisms.

CO11: Describe the Rhizosphere microflora and its role

CO12: Understand Role of microorganisms in composting and humus formation.

CO13: Knows the large scale production of Biofertilizers: Bacterial, Cyanobacterial, fungal

CO14: Describe various Biocontrol agents: Bacterial, Viral, Fungal and their large scale production

CO15: Understand the Role of microorganisms elemental cycles in nature (Carbon, Nitrogen, Sulphur, Phosphorous.)

CO16: Understands microbial interactions like Symbiosis, Neutralism, Commensalism, Competition, commensalism, Synergism, Parasitism, and Predation

Second Year (Semester II)

Course- MB 221: Bacterial Genetics (Paper I)

Students will be able to-

CO1: Describe the experiments underlying the Discovery of transforming material (Griffith's experiment),evidence for nucleic acid as genetic material (Avery and MacLeod experiment) Gierer and Schramm / Fraenkel-Conrat& Singer experiment. Hershay& Chase experiment

CO2: Understand Prokaryotic genome organization and concept of Gene, basic structure ofDNA and its forms.

CO3: Know the process of DNA replication (Messelson and Stahl's experiment),Theta model (semi-discontinuous), J Cairn's experiment, rolling circle model (plasmid DNA,λphage DNA)

CO4: Describe Gene organization and expression with respect to genetic code, mechanism of transcription and translation

CO5: Describe Occurrence and Mechanisms of Spontaneous mutations

CO6: Mechanisms of induced mutations and Frame shift mutations using Physical Chemical and Biological Agents.

CO7: Describe Types of mutations: Nonsense, Missense, Silent, Null, Conditional lethal temperature sensitive, amber, leaky& non leaky

CO8: Understand and experimentally carry out Isolation of Mutants by Replica plate technique

CO9: Describe Reversion and Suppression mutation

CO10: Describe Structure and Properties of plasmids and Types of plasmids

CO11: Describe Plasmid replication, incompatibility , curing ,and plasmid amplification .

Course- MB 222: Air & water Microbiology (Paper II)

Students will be able to-

CO1: Know meaning of Droplet, droplet nuclei, and aerosols, and transient nature of air flora.

CO2: Describe Chemical pollutants, their sources in air and effects on human health.

CO3: Describe with the help of diagram construction and working of various air samplers.

CO4: Describe air bone infections caused by bacteria, fungi and viruses.

CO5: Describe Physical and chemical methods of air sanitation.

CO6: Define types of water: surface, ground, stored, distilled, mineral and de-mineralized water.

CO7: Describe steps in Water purification, Bacteriological standards of potable water. Functions of regulatory bodies such as CPCB, MPCB, BIS, WHO.

CO8: Describe Escherichia coli, Bifidobacterium, Streptococcus faecalis, Clostridium perfringens, Campylobacter and Pseudomonas as indicators of faecal contamination.

CO9: Describe Water borne Infections caused by bacteria and viruses.

CO10: Describe tests for Bacteriological analysis of water for potability.

CO11: Describe physical and chemical parameters used for waste water analysis.

CO12: Describe Biomagnification and eutrophication.

CO13: Describe Methods of effluent treatment – Primary, secondary, tertiary treatment methods.

CO14: Describe Recycling of waste water and sludge.

CO15: Solid waste management: Types of anaerobic digesters, raw material and organisms used for biogas production.

Course- MB 223: Practical Course

Students will be able to-

CO1: Learn to measure the dimensions of microorganisms

CO2: Learn to isolate, identify and biochemically characterize microorganisms from soil and air.

CO3: Can determine air flora and find the diversity of microorganism using statistical analysis

CO4: Can determine potability of drinking water using MPN test and interpretation of results

CO5: Understands concept of Mutations in bacteria and its isolation methods.

Third Year (Semester I)

Course- MB 331: Medical Microbiology (Paper I)

Students will be able to-

CO1: Study human infectious diseases of respiratory system, Gastro-intestinal syatem, Kudney & Liver, Genital system and CNS.

CO2: Understand the term 'Epidemiology" and explain its various aspects like Incidence & prevalence of disease, Mortality, Morbidity, Disease distribution etc.

CO3: Describe reservoirs of diseases, modes of disease transmission and prevention or control of diseases.

CO4: Know common bacterial pathogens along with their pathogenicity, symptoms caused, lab diagnosis, prophylaxis and chemotherapy.

Course- MB 332: Genetics & Molecular biology (Paper II)

Students will be able to-

CO1: Students will understand Mendel's laws of inheritance, genetic recombination and linkage, gene mapping by tetrad analysis in the case of *N. crassa* and parasexual cycle with specific reference to *A. nidulans*.
CO2: Students will understand molecular mechanisms of prokaryotic DNA replication.
CO3: Students will understand molecular mechanisms of prokaryotic and eukaryotic transcription and its regulation.
CO4: Students will understand molecular mechanisms of prokaryotic and eukaryotic translation and its regulation.
CO5: Students will have learnt history of Recombinant DNA Technology (RDT), potential uses and biohazards of RDT and safety guidelines for set up of a laboratory involved in RDT.
CO6: Students will have learnt details of techniques used in RDT such as isolation and purification of genomic DNA, Agarose gel electrophoresis, Southern, Northern and Western blotting and hybridization.

Course- MB 333: Enzymology (Paper III)

Students will be able to-

CO1: Explain the role of cofactors in metabolism

CO2: Explain principles and methos of enzyme purification

CO3: Understand enzyme kinetics

CO4: Understand and describe metabolic regulation

CO5: Learn and explain concept of enzyme immobilization and its applications.

Course- MB 334: Immunology (Paper IV)

Students will be able to-

CO1: Understand immunity and formation of blood cells
CO2: Knows different functions and structure of immune organs
CO3: Describe three lines of defence mechanisms with non specific and specific immune responses
CO4: Can describe antigen and antibody structure and properties
CO5: understand humoral and cell mediated immune responses.
CO6: Know the activation maturation and differenciation of T and B cells at genetic and molecular level.
CO7:.Understand what is transplantation immunity with types of grafts and prevention and rejection of grafts

Course- MB 335: Fermentation Technology (Paper V)

Students will be able to-

CO1: Describe objectives and methods for strain improvement
CO2: Describe various methods of media optimization and sterilization.
CO3: Understand Concept of Plackett-Burman Design and Del factor
CO4: Know objectives and methods for scale-up and scale-down in fermentation technology
CO5: Describe principles and methods of Downstream processing.
CO6: Describe various methods for Quality Assurance (QA) of fermentation product
CO7: Describe fermentation economics-Recurring and Non-recurring expenses
CO8: Know IPR and its types.

Course- MB 336: Food & dairy Microbiology (Paper VI)

Students will be able to-

CO1: Student will have learnt about dairy development in India

CO2: Student will understand milk chemistry and constituents

CO3: Student will understand microbiology of milk

CO4: Student will have leant preservation of milk by pasteurization and its storage

CO5: Student will have learnt microbial analysis of milk

CO6: Student will classify foods based on stability

CO7: Student will aware about spoilage of meat and poultry products, bread, fruits and vegetables, eggs, sea foods and canned foods.

CO8: Student will understand principle and methods of food preservation.
CO9: Student will understand microbial food poisoning and food infection.
CO10: Student will explain significance and describe fermented foods.
CO11: Student will have learnt applications of genetically modified microorganisms.
CO12: Student will have learnt food sanitation and regulation.

Third Year (Semester II)

Course- MB 341: Medical Microbiology (Paper I)

Students will be able to-

CO1: Understand characteristics of virion

CO2: Know production of antibiotics and explain their modes of action

CO3: Describe laboratory diagnosis for various infections

CO4: Learn life cycles of different parasites

CO5: Study pathogenesis of *Candida* and non- *Candida* fungal pathogens

Course- MB 342: Genetics & Molecular biology (Paper II)

Students will be able to-

CO1: Students will have learnt the details of the process of transformation in Gram positive and Gram negative bacteria and how gene mapping is done by co-transformation.
CO2: Students will have learnt the details of the process of generalized and specialized transduction and how gene mapping is done by co- transduction.
CO3: Students will have learnt the details of the process of conjugation and how gene mapping is done by interrupted mating technique.
CO4: Students will understand how DNA is damaged by hydrolysis, deamination, alkylation oxidation and radiation. They will have learnt details about various DNA repair mechanisms such as Base excision repair, nucleotide excision repair, Recombinational repair, Photoreactivation and Translesion DNA synthesis.
CO5: Students will have learnt about various types of bacteriophage mutants, cis-trans test/ genetic complementation test and fine structure mapping of phage genes by deletion mapping.
CO6: Students will have learnt details about the Generation of a recombinant DNA molecule such as vectors used in RDT, molecular tools used for cutting and joining the DNA molecules, methods used to transfer recombinant DNA into host cells, methods of screening the cells containing the recombinant DNA and identification of clones using probes.

Course- MB 343: Enzymology (Paper III)

Students will be able to-

CO1: Describe different mechanisms of membrane transport

CO2: Understand laws of Thermodynamics

CO3: Learn the process of bacterial photosynthesis

CO4: Explain the pathways for biosynthesis and degradation of biomolecules

Course- MB 344: Immunology (Paper IV)

Students will be able to-

CO1: Understand structure and function of MHC in man and mouse
CO2: Know polymorphism of MHC molecules and MHC typing
CO3: Describe cytokines and its role in immune system activation.
CO4: Principles of Antigen Antibody reactions and vizualiztion (ELISA,RIA etc)
CO5: Describe ABO blood group system Rh system and blood banking practices.
CO6 Know Medico legal applications of blood groups.
CO7: Describe types of vaccines and immunization schedules.
CO8: Describe various Hypersensitivity reactionsand autoimmunity.
CO9: Know monoclonal antibody technique and its application.Course

Course- MB 345: Fermentation Technology (Paper V)

Students will be able to-

CO1: Explain solid state fermentation and submerged fermentation
CO2: Explain large scale production of primary metabolites, secondary metabolites, enzymes, biomass based products, milk products, vaccines, immune sera.

Course- MB 346: Agriculture and Environmental Microbiology (Paper VI)

Students will be able to-

CO1: Describe methods for plant disease control

CO2: Explain biochemistry of different biofertilizers

CO3: Learn concept of Bioremediation and Bioaugmentation

CO4: Explain the concept and examples of bioleaching

CO5: Understand the concepts of Bioterrorism, Biofuel cells and bio degradable plastic

Course- MB 347: Practical Course I

Students will be able to-

CO1: Learn Process of fermentation and product recovery

CO2: Isolation, identification and use of different bacteria from natural samples such as Nitrogen fixers, plant pathogens, lactic acid bacteria etc.

CO3: Learn bioassay technique and its application

CO4: Know importance of and application of Quality control techniques

Course- MB 348: Practical Course II- Biochemistry and Molecular Biology

Students will be able to-

CO1: Determine absorption spectra and molar extinction coefficient using colorimeter

CO2: Estimate sugar, urea, cholesterol, proteins and albumin from human blood samples

CO3: Carry out qualitative and quantitative estimation of carbohydrates and proteins

CO4: Prepare buffers

CO5: Perform Paper chromatography for separation of amino acids

CO6: Isolate amylase producing microorganisms and carry out production and purification of amylase

CO7: Isolate and enumerate bacteriophages

CO8: Isolate bacterial plasmid and genomic DNA and carry out transformation of *E. coli*

Course- MB 349: Practical Course III

Students will be able to-

CO1: Isolate and identify pathogens from various clinical samples like Urine, Stool, Sputum etc.

CO2: Carry out epidemiological survey of diseases

CO3: Study various hematological parameters like haemoglobin, ESR, PCV, Differential WBC count, total WBC & RBC count etc

CO4: Detect blood group of unknown blood samples and study blood group compatibility of donor & recipient

CO5: Study immunological tests and apply them for diagnosis such as Agglutination- Widal test, Precipitation-Ouchterlony method etc.

CO6: Learn collection and storage of blood samples, separation of blood components and their preservation, through visit to Blood bank.

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