

UNIVERSITY OF KALYANI



SYLLABUS FOR MICROBIOLOGY (MINOR)

UNDER

CURRICULUM AND CREDIT FRAMEWORK

FOR

UNDERGRADUATE PROGRAM

(WITH EFFECT FROM THE SESSION 2023-24)

Course-wise Content of the Syllabus
University of Kalyani
UG Minor in Microbiology

SEMESTER-I OR SEMESTER -II	
COURSE CODE	MB-MI-T-01
COURSE TITLE	FUNDAMENTALS AND TECHNIQUES IN MICROBIOLOGY (THEORY)
CREDIT	3
FULL MARKS	35
COURSE OUTCOME	• Basic introduction to the subject is provided to students • Students will learn basic terminology related to microbiology • Students will get conceptual understanding of Microbiological world • Foundation for microbiological laboratory practice will be given to students
CONTENT	Unit 1: Introduction, History and Scope of Microbiology- General concept of microbes, their distribution and dimension. History and Scope of microbiology as a modern science. Branches of Microbiology. Contribution of Scientists to the field of Microbiology - Antony Von Leewenhoek, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Fleming and Iwanovsky. Theories of origin of life. Unit 2: Microbial growth requirements and culture techniques- Nutritional requirements of microorganisms -Macronutrients, micronutrients and growth factors. Nutritional types of microorganisms: Autotrophs and heterotrophs, phototrophs and chemotrophs. Physical factors affecting growth of microorganisms: Temperature, pH and Oxygen. Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media. Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, cultivation of anaerobic bacteria; Growth: concept of growth of microorganisms; measurement of growth; Culture system: concept of batch and continuous culture, growth kinetics in batch system emphasizing different phases of bacterial growth, specific growth rate, growth curve, diauxic growth. Counting of bacteria - Viable count, Total count and turbidimetric estimation. Unit 3: Stains and Staining Techniques- Nature of dyes. Physical and chemical theories of staining- Staining techniques; principle, procedure and applications of i) Simple staining- negative staining, ii) Differential staining - Grams and acid fast staining, iii) Structural staining- cell wall, endospore, flagella and capsular staining. Unit 4: Sterilization and aseptic Techniques- Definition of terms -sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agents and antimicrobial agent. Evaluation of antimicrobial chemical agents- Tube dilution and agar plate techniques- well method and disk plate method. Physical methods of control- Principle, construction and application of moist heat sterilization- Boiling, Pasteurization, Fractional

	sterilization- Tyndallization and Moist heat under pressure- autoclave. Dry heat sterilization- Incineration and hot air oven, Filtration -membrane filter and laminar air flows, Radiation -Ionizing radiation– γ rays and non-ionizing radiation- UV-rays. Chemical methods: Alcohol, aldehydes, phenols, halogen, metallic salts, quaternary ammonium compounds and sterilizing gases as antimicrobial agents. Selection of a chemical agent for practical applications.
COURSE CODE	MB-MI-P-01
COURSE TITLE	FUNDAMENTALS AND TECHNIQUES IN MICROBIOLOGY (PRACTICAL)
CREDIT	1
FULL MARKS	15
CONTENT	1. Safety measures in Laboratory. 2. Study of student microscope and research microscope - Construction, working principle, care to be taken while using the microscope. Use of oil immersion objective 3. Study of instruments - Autoclave, hot air oven, Laminar air flow bench, Inoculation chamber, inoculation loop and needle, Incubator, centrifuge, pH meter, seitz filter, colony counter, membrane filter and colorimeter/spectrophotometer. 4. Cleaning and sterilization of glassware. 5. Study of aseptic techniques -preparation of cotton plugs for test tubes and pipettes, wrapping of petriplates and pipettes. 6. Staining of bacteria - Simple staining -methylene blue staining; Gram staining
SEMESTER III OR SEMESTER IV	
COURSE CODE	MB-MI-T-02
COURSE TITLE	MICROBIAL SYSTEMATICS AND DIVERSITY (THEORY)
CREDIT	3
FULL MARKS	35
COURSE OUTCOME	• Student will be able to describe the fundamental concepts and terminology of taxonomic organization and parameters used in classifying bacteria, and the molecular analytic approaches used to classify diverse bacteria. • Student will be able to discuss about the use of rRNA analysis as a means of developing phylogenetic relationships. • Student will be able to describe the major groups of archaea, their stand-out physiological and structural features, as well as their ecological niches and economic significance. • Students will visualize through microscope different types of bacteria, fungi, algae • Students will learn isolation of single cell of bacteria and know preservation techniques for microbes in

	laboratory
CONTENT	Unit 1: Microbial Systematics- General account of systematics, classification and nomenclature; Classification systems- artificial or phonetic, natural and phylogenetic; Species concept in microbiology, monophyletic, paraphyletic, polyphyletic; Newer approaches for exploring unculturable bacteria-molecular taxonomy, molecular phylogeny, molecular chronometers; Chemotaxonomy; Polyphasic taxonomy, Unit 2: Phylogeny of prokaryons- Diversity of more complex unicellular complex microorganisms: Monera (Prokaryote), Protista. Five kingdom domains in Whittaker's system of classification and Archaea, Bacteria and Eukarya, RNA world. Theory of endosymbiogenesis. Unit 3: An account of prokaryons- Brief accounts of major subgroups of these classes. The thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, Cyanobacteria, Gram positive and Gram negative Eubacteria; including the five classes of Proteobacteria, Spirochetes and Actinomyces. Unit 4: Phycology- General characteristics of algae including occurrence, thallus organization, algal cell ultrastructure, pigments, flagella, eye spot, food reserves and vegetative, asexual and sexual reproduction, General characters of the following classes: Chlorophyta, Xanthophyta, Cyanophyta. Applications of algae in agriculture, industry, environment and food. Unit 5: An account of eukaryotic microbes- Fungi including Zygomycetes, Oomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes (imperfect and perfect stages) and Protozoa (<i>Giardia</i>, <i>Entamoeba</i> and <i>Plasmodium</i>). Unit 6: General Account of Virology- Discovery of viruses, distinctive property of viruses; morphology and ultrastructure, capsids & their arrangements. Types of envelopes and their composition; viral genome – types and structures; nomenclature and classification of virus (Animal, plant, bacterial viruses). Virus related agents – viroids, prions. Structural organization of bacteriophage; Life cycle – lytic & lysogenic,
COURSE CODE	MB-MI-P-02
COURSE TITLE	MICROBIAL SYSTEMATICS AND DIVERSITY (PRACTICAL)
CREDIT	1
FULL MARKS	15
CONTENT	1. Preparation of culture media (Nutrient Broth and Nutrient Agar) for bacterial cultivation 2. Study of <i>Rhizopus</i>, <i>Penicillium</i>, <i>Aspergillus</i> using permanent mounts 3. Study of <i>Spirogyra</i>, <i>Chlamydomonas</i> using permanent Mounts 4. Study of <i>Paramecium</i>, <i>Plasmodium</i> using permanent mounts 5. Isolation of pure cultures of bacteria by streaking method.

SEMESTER V	
COURSE CODE	MB-MI-T-03
COURSE TITLE	IMMUNOLOGY AND MEDICAL MICROBIOLOGY (THEORY)
CREDIT	3
FULL MARKS	35
COURSE OUTCOME	- Students will know about beneficial and disease-causing microbes - They will have an overview on public health, community health and clinical health system and the terminologies used in these practices (Epidemiology, pandemic, epidemic, endemic etc) - Students will be able to correlate disease symptoms with causative agent, isolate and identify pathogens. - They will gain knowledge of mechanism of action of antimicrobial drugs and prophylaxis. - Students will learn hands-on to identify bacteria by simple testing and qualitative and quantitative method to understand the working of antimicrobials
CONTENT	Unit 1: Human and its defenses against pathogens: Different line of defenses: physical barrier, chemical defense and cellular defense. Components of cellular defense – blood and lymphatics, leukocytes, lymphocytes (B - cell, and Tcells), phagocytes, macrophages. The immune response – non-specific defense, opsonization, phagocytosis; specific immune response and acquired immunity, antigens and antibodies: nature and functions; Immunoglobulins - structure and diversity. Antigen – antibody reactions. Cytokines, T-Cell receptors. Antigen presentation; Major histocompatibility complexes. Blymphocytes and antibody production, memory cells; complement system; Hypersensitivity; Inflammation autoimmune response. Graft rejection. Super antigens, Immunodeficiencies. Unit 2: Immuno-diagnostics: Neutralization, precipitation, agglutination. Complement fixation, immune-diffusion, Enzyme-linked Immunosorbent Assay (ELISA). Immuno-fluorescence. Radioimmunoassay. immunoblotting. Serotyping. Immunization for prevention of diseases: vaccines, toxoids. Immunization programmes – role of WHO. Unit 3: Human and microbes interactions: Normal microbial flora of the human body. Mode of entry, colonization and growth. Damage to host cell, virulence, virulence factors- exotoxins, endotoxins, neurotoxins and enzymes with special reference to Cholera toxin, enterotoxin, diphtheria toxin and tetanospasmin. Pathogens, symptomatology, epidemiology, and measures of AIDS, Cholera, Tuberculosis, Tetanus, Dermatomycosis, Malaria. Unit 4: Antimicrobial agents: General characteristics and mode of action- Naturally produced drugs. Antibiotics produced by bacteria, actinomycetes and fungi used in chemotherapy. Classification of antibiotics on the basis of structure and mode of action. Assay of antibiotics, antibiotic spectrum Semisynthetic antibiotic.

	Sulfa drugs, their use and mechanism of action. Nalidixic acid, nitrofurans, isonicotinic hydrazide, metronidazole; Prophylactic agents. Drug toxicity. Drug resistance
COURSE CODE	MB-MI-P-03
COURSE TITLE	IMMUNOLOGY AND MEDICAL MICROBIOLOGY (PRACTICAL)
CREDIT	1
FULL MARKS	15
CONTENT	1. Identification of human blood groups 2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, TCBS 3. Perform antibacterial sensitivity by Agar cup method
SEMESTER VII	
COURSE CODE	MB-MI-T-04
COURSE TITLE	ENVIRONMENTAL MICROBIOLOGY (THEORY)
CREDIT	3
FULL MARKS	35
COURSE OUTCOME	• The student will be able to recall the importance of microbes in any ecosystem with reference to nutrient cycling/ biogeochemical cycling, and biofuels and the role of microbes in mineral recovery. • The student will be able to describe BOD, COD and various methods of waste treatment (solid and liquid) utilizing diverse microorganisms. • The student will be able to describe microbial bioremediation, including petroleum products, microbial degradation of pesticides, plastics and e-waste management for a cleaner environment. • Students will learn hands-on quality monitoring of different environment and thus understand the basics of environmental sustainability
CONTENT	Unit 1: Microorganisms and their Habitats- Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats, Atmosphere: Aeromicroflora and dispersal of microbes, Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Unit 2: Biogeochemical Cycling- Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction, Phosphorus cycle:

	Phosphate immobilization and solubilization, Sulphur cycle: Microbes involved in Sulphur cycle, Other elemental cycles: Iron. Unit 3: Waste Management- Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment. Unit 4: Microbial Bioremediation- Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants
COURSE CODE	MB-MI-P-04
COURSE TITLE	ENVIRONMENTAL MICROBIOLOGY (PRACTICAL)
CREDIT	1
FULL MARKS	15
CONTENT	1. Analysis of water quality by MPN method 2. Isolation of microbes (bacteria) from soil (28°C & 45°C). 3. Isolation of microbes (bacteria) from rhizosphere and rhizoplane. 4. Determination of BOD of waste water sample.

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