Programme Outcomes, Programme Specific Outcomes and Course Outcomes For PG Programmes

ProgrammeName: M.Sc. in Microbiology

Number of Semesters: 04

Name of the Department
University of North Bengal
West Bengal, INDIA

Programme Outcomes

- Basic knowledge about microbiology, biophysical techniques, biochemistry, cell biology, molecular biology, cancer biology, metabolic disorders etc.

- To create awareness to become conscious citizens with a sense of responsibilty towards their surrounding irrespective of any man made differences.

Programme Specific Outcomes

- Both theoretical and practical knowledge about general microbiology, molecular biology and biochemical techniques, which is the base for gaining scientific knowledge and insight about the subject.

- To expose students to the field of microbiology and other allied life science subjects and prepare them for promising career options in research, industries and academics

Course Outcomes

SEMESTER—I		
Course Code	Course Name	Course Outcomes
MICR-CT-101A	Thermodynamics in Biology	• **Understanding the law's of thermodynamics** • **Knowledge of membrane transport, osmotic pressure, Donan equilibrium etc.** • **Concept building about bonds and interactions, important equations and biological buffers**
MICR-CT-101B	Biomolecues and Enzymology	• **Knowledge about biomolecules like protein, nucleic acids, lipids.** • **Concept building about enzyme mediated catalysis, structure, function etc.** • **Understanding steady state kinetics, deviations, ligand binding studies etc.**
MICR-CT-102A	Diversity of prokaryotic and eukaryotic microbes	• **Concept building about the relevance of biodiversity of microbial world** • **Knowledge of classification, life cycle and structure of prokaryotes and eukaryotes** • **Understanding speciation and extinction**
MICR-CT-102B	Cell biology	• **Relevance of cell being small, its structure, function and intracellular organelles, protein sorting and trafficking, cell membrane and cell wall structure** • **Knowledge of cell signaling by receptors like GPCR, RTK etc., cell cycle**

		regulation • **Understanding the processes of chemotaxis by cilia and flagella**
MICR-CT-103A	Microbial metabolism and Growth	• **Knowledge of microbial growth kinetics, quorum sensing, influence of environmental factors and effect of nutrients** • **Different culture media and its use** • **Understanding the metabolic pathways of biomolecules like carbohydrate, lipid, amino acids and nucleic acid**
MICR-CT-103B	Molecular biology	• **Knowledge of organization of genomes** • **Concept of central dogma of molecular biology including replication, transcription and translation** • **Understanding the processes of mutation and cellular repair**
MICR-CP-104	Biochemistry and analytical techniques	• **Gaining knowledge and hands on experience on Biochemistry and analytical techniques including chromatography, microscopy, enzymology, electrophoresis etc.**
MICR-CP-105	General microbiology	• **Gaining knowledge and hands on experience on general microbiological concepts like staining, enrichment and isolation of microbes**
MICR-CP-106	Microbial metabolism and molecular biology	• **Gaining knowledge and hands on experience on Microbial metabolism and molecular biology like microbial growth kinetics, isolation of genomic and plasmid DNA, Induction of mutation etc.**
MICR-ET-107 A	Instrumentation and biotechniques	• **Understanding the principle and uses of microscope, spectroscopy and chromatography** • **Knowledge about electrophoretic separation of bio molecules, centrifugation and radioactive measurement**
MICR-ET-107 B	Microbiological analysis of water and air	• **Knowledge of air and water borne diseases, bioaerosol control and enumeration of microbes** • **Concept of potable water, standards for drinking water, risk assessment, water safety plans, IMViC and MPN determination**
MICR-ET-107 C	Cancer Biology	• **Knowledge about different types of cancer and their causes** • **Concept of therapeutic intervention in controlling cancer**
MICR-ET-107 D	Metabolic disorder	• **Understanding the abnormalities in different biochemical pathways** • **Knowledge of drugs used for treatment of metabolic disorders, drug management**
MICR-CP-108	Class test/assingment/ seminar	• **Mode of continuous assessment for judging the progress of a student throughout the semester** • **Seminar presentation helps in inculcation of scientific knowledge, oratorship and selfconfidance buildup of a student**

SEMESTER—II		
Course Code	Course Name	Course Outcomes
MICR-CT-201A	Genetic Engineering	• **Knowledge regarding basic concepts of Restriction enzymes and other important enzymes like DNA ligase, Klenow enzyme, T4 DNA ligase, Polynucleotide kinase, Alkaline phosphatase.** • **Labelling of DNA - Nick translation, Random priming, Radioactive and non-radioactive probes** • **DNA sequencing methods Cloning vectors:**
MICR-CT-201B	GENETICS	• **Basic concepts like: DNA as genetic material; Physical basis of heredity; Chromosomes; Cell division, Gene transfer mechanisms., mendelian genetics** • **Regulation of gene expression in prokaryotes and eukaryotes:**

		Operon concept-lac, ara and trp operons, nif regulon; • **Environmental factors of gene regulation; Chromosome remodeling;RNA editing; SiRNA and RNA Interference**
MICR-CT-202A	Agricultural Microbiology	• **Concept on microbial communities; Soil microbial diversity- Significance and conservation;** • **Knowledge of Biological Nitrogen fixation:** • **Understanding Biodegradation of Herbicides and Pesticides., Biofertilizer: PGPR, Disease forecasting and assessment of losses; Prevention of epidemics and disease control**
MICR-CT-202B	ENVIRONMENTAL MICROBIOLOGY	• **Basic concepts of Microbiome: Microbes in terrestrial, aquatic, atmospheric and biological environments;** • **Study the Significance of bioflim reactor, biotransformation, bioremediation, bioaugmentation, bioleaching etc.** • **Knowledge on Microbe-microbe interactions Microorganism and pollution**
MICR-CT-203A	Bioprocess Engineering and Industrial Microbiology	• **Microbiology Suitability of microbes in industrial processes and their source; Types of fermentations and bioreactors;** • **Strain improvement, Methods for the recovery and purification of fermentation products (downstream processing)** • **Economic aspects of fermentation processes Product optimization, and Applications) of the following: Industrial alcohol and alcoholic beverages and glycerol; Organic acids- Enzymes- extracellular amylases and proteases; VitaminsAntibiotics- β-lactam, Microbial insecticides Biogas from wastes etc.**
MICR-CT-203B	Food Microbiology	• **Factors affecting the growth and survival of microorganisms in foods** • **Methods for studying microbes and their products in food stuffs Spoilage, food preservation with chemicals, irradiation, low and high temperatures, high pressure, modified atmosphere, low humidity and drying** • **Manufacture of fermented foods: Dairy products,Meat and fishery products; Plant products, Breads, Beverages, The hazard analysis and critical control point (HACCP) concept in controlling microbiological quality of foods; Predictive models**
MICR-CP-204	Genetic Engineering and Genetics	• **Gaining knowledge and hands on experience on Pedigree analysis PCR and TA Cloning, Bacterial expression of proteins, Restriction enzyme digestion of DNA, RT-PCR etc.**
MICR-CP-205	Agricultural and Environmental Microbiology	• **Gaining knowledge and hands on experience on isolation of actinomycetes, ceelulose decomposer, soil texture analysis, Physico chemical properties of water analysis, e.g .COD, BOD etc.**
MICR-CP-206	Bioprocess Engineering and Food Microbiology	• **Gaining knowledge and hands on experience on isolation of microbes from processing plants and equipments, D value, z value determination, bioassay of vit b12 etc.**

MICR-ET-207A	Waste water treatment	• **A brief idea of various stage of wastewater treatment, Activated sludge, Anaerobic treatment of waste water and sludge, Methane production, Use of microbes for removing toxic metal ions etc.** • **Recognize the common physical, chemical and biological unit operations encountered in treatment processes,Illustrate the fundamentals of water and wastewater treatment** • **Formulate a preliminary design of a water and/or wastewater treatment plant.**
MICR-ET-207B	Pharmacogenetics and Pharmacogenomics	• **Basic principles of genetic medicine and personalized medicine, Mechanisms of drug metabolism and transport with genetic variation, Clinical response and outcomes. Methods used for standard genotyping assays , VNTR, SNTR, RFLP, AFLP, EST etc.** • **Pharmacogenomics, Pharmacokinetics and pharmacodynamics** • **Case study: Mechanism of action,effect,side effect, drug metabolization with allelic variation: Warfarin ,codeine, thiopurine drugs etc.**
MICR-ET-207C	Value added product from agro-waste	• **Generation of microbial biomass from wastes of cereal, oil crops, fruit wastes, vegetable waste, fermentation waste industry and whey,Baker's yeast production ,Fermented edible products from waste etc.** • **Enzyme production- amylase, lipase, cellulose, pectinase, Bioethanol, Microbial flavours, Microbial pigment ,Microbial gums and polysaccharides** • **Biogas from wastes, Anaerobic digestion and Methanogenesis; Bio-hydrogen, Techno-economics of biogas generation from fruits and vegetable wastes etc.**
MICR-ET-207D	Microbial ecology	• **community structure, benevolent interactions, antagonistic interactions, Rhizosphere, rhizoplane, siderophore, flavonoids from plants, lectines, octapine, nipotine, indole acetic acid etc.** • **Biomagnification; Bioaugmentation, Ecological niche, Bioacclimatization, Mycorrhiza etc.** • **Marine ecosystem**
MICR-CT-208	Class test/assingment/ seminar	• **Mode of continuous assessment for judging the progress of a student throughout the semester** • **Seminar presentation helps in inculcation of scientific knowledge, oratorship and selfconfidance buildup of a student**

SEMESTER—III		
Course Code	Course Name	Course Outcomes
MICR-CT-301A	VIROLOGY	• **knowledge about major families of viruses** • **detailed account of various viral pathogenesis, symptoms, epidemiology, transmission, diagnosis, prevention and control** • **deep insights about plant viruses**
MICR-CT-301B	IMMUNOLOGY	• **basic knowledge about cells and organs of immune system** • **understanding various immunological methods, immunogenetics** • **understanding the concept of tumour immunology and immuno pathology**
MICR-CT-302A	MEDICAL MICROBIOLOGY	• **knowledge about various clinically important disease causing bacteria, virus, protozoa and fungi** • **gaining knowledge about different diagnostic tests in microbial diseases**

		• **studying the microflora in human body in relation to pathogenesis and epidemiology**
MICR-CT-302B	ANTIBIOTICS AND CHEMOTHERAPEUTICS	• **knowledge about different antimicrobials and their mode of action** • **understanding the mechanism of microbial resistance against drug** • **studying various mechanisms to overcome microbial drug resistance**
MICR-CT-303A	BIOSTATISTICS	• **understanding the concept of matrix, frequency and distribution of biological variations** • **studying the classification and identification of probability** • **knowledge about various statistical models , test of hypothesis and tests of significance, correlation and regression**
MICR-CT-303B	COMPUTER APPLICATIONS AND BIOINFORMATICS	• **basics concepts of computers and electronic spreadsheet** • **genomics and proteomics data analysis using various bioinformatics tools** • **structural prediction and homology modelling using various bioinformatics tools**
MICR-CP-304	VIROLOGY AND IMMUNOLOGY	• **hands on knowledge about the following topics:** • **isolation and enumeration of bacteriophages (using double agar layer technique)** • **determination of one-step growth curve of bacteriophage** • **haemagglutination test for presence of antigens (microorganisms)** • **infectivity of plant viruses (using local lesion method)** • **study of cytopathic effect of viruses** • **serological tests of diagnostic importance including complement fixation, precipitin reaction, slide agglutination test, widal test, tuberculin test and elisa** • **counter electrophoresis** • **blood examination for abo groups and rh factors** • **haemagglutination inhibition test** • **to perform western blotting** • **to study morphological and staining characteristics of lymphocytes, neutrophiles, monocytes, eosinophils and basophils**
MICR-CP-305	MEDICAL MICROBIOLOGY	• **hands on knowledge about the following topics:** • **estimation of urine bacteria by calibrated loop-direct streak method and pour plate method** • **urine culture and microbial analysis for antibiotic sensitivity** • **isolation of enteric pathogens from stools by direct plating method** • **study for antimicrobial spectrum of antimicrobials** • **determination of cidal and static activity** • **screening for antibiotic producing microbes** • **production, separation and detection of antibiotics by bioautographic methods** • **microbiological assay of antibiotics using tube dilution, well diffusion and agar dilution methods**
MICR-CP-306	BIOSTATISTICS AND BIOINFORMATICS	• **hands on knowledge about the following topics:** • • **application of computers in biostatistics and usages of different statistical packages** • **application of various biological databases, multiple sequence alignments and phylogenetic tree construction** • **application of different protein structure prediction software**

MICR-ET 307A	QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRY	• **microbiological aspects of quality control of food and pharmaceutical products** • **safety concern, haccap and management in dairy and pharmaceutical industry** • **application of microarrays (biochips) and biosensors, etc. for detection of food pathogens; biosafety of genetically modified organism**
MICR-ET 307B	SOIL MICROBIOLOGY	• **studying the microflora of soil** • **understanding the mechanisms of various geochemical pathways carried out by soil microorganisms** • **knowledge about various methods involved in bioremediation of soil and formation and composition of soil organic matter**
MICR-ET 307C	MANAGEMENT OF MICROBIAL DISEASES IN HUMAN	• **detail account of different diagnosis of infectious disease** • **knowledge about culture & handling: cases illustrating collection & handling of specimens, types of pathogens to be expected for various body fluids & tissues** • **idea about epidemiological survey, antibiotics resistance pattern, cause and prevention of nosocomial infection**
MICR-ET 307D	BIOFERTILIZER AND BIOCONTROL AGENTS	• **basic concept about biofertilizer and its types** • **application of various biofertilizer** • **production and application of different biopesticides and other biocontrol agents**
MICR-CT-308	Class test/assingment / seminar	• **mode of continuous assessment for judging the progress of a student throughout the semester** • **seminar presentation helps in inculcation of scientific knowledge, oratorship and selfconfidance buildup of a student**

SEMESTER—IV		
Course Code	Course Name	Course Outcome
MB 4.1 A	Genomics	• **Gaining knowledge and practical skills of functional genomics** • **Learning social, legal and ethical implications of genomics** • **Imparting knowledge to radically advance and transform the understanding of life.**
MB 4.1 B	Proteomics	• **Introduction to the basic biology of proteins and an insight into the entire set of proteins in the milieu.** • **Gaining knowledge about the two major aspects of proteomics i.e. gel based and MS basedanalytic studies** • **Learning about application of proteomics in research and its role in advancement of life sciences.**
MB 4.2	Dissertation Work /Review	• **Exposure to lab based research and induction of critical thinking** • **Learning to design and set experiments as per the needs of their scientific investigation.** • **Learning to write details of their experiments along with their results and discussion and to defend their results in seminars and/or viva voce.**
MB 4.3 A	Bioethics and IPR	• **Learning the importance of ethics in life science studies** • **Concept on intellectual property rights trade mark, patents law, Indian patent act etc.** • **Understanding the role of Indian and international Legal system in maintenance of bioethics, Intellectual Property Rights, commercialization and licensing.**
MB 4.3 B	Inheritance Biology	• **Understanding genes as the unit of inheritance for individual characters and that genes may also contribute to susceptibility to**

		certain diseases. • **Insights into methods of prokaryotic and eukaryotic genetic transfers** • **Insights into human genetics and quantitative genetics.**
MB 4.3 C	Biodegradation and Bioremediation	• **An insight into the role of microorganisms in controlling and alleviating pollution, bioremediation, bioaugmentation, oil spill control etc.** • **Becoming conscious of the alarmingly increasing levels of pollution and other Global Environmental Problems, like green house effect, UV radiation, acid rain etc.** • **An idea of all harmful xenobiotics and hazardous wastes that are present in the environment and their effect in animal and plant life.**
MB 4.3 D	Evolutionary Biology	• **Learning the history of life on Earth and identifying major evolutionary transitions over time.** • **Understanding the concept of Lamarkism and Darwinism.** • **Understanding the concept of molecular evolution.**
MB 4.4	Industrial Visit/Field Study/Summer Training	• **Exposing students to Industries and creating awareness about the functioning mechanism of industries.** • **Understanding the role of microbiologists in Quality control and waste management in industries.** • **Learning to identify any biological samples with bioprospects and learning techniques of proper sample collection in field visits.**
MB 4.5	Seminar/Journal Club/Assisnments /Class Test	• **mode of continuous assessment for judging the progress of a student throughout the semester** • **seminar presentation helps in inculcation of scientific knowledge, oratorship and selfconfidance buildup of a student**