

Program: M.Sc. Microbiology

Semester I

S. No.	Course Code	Course Title	Credits
1.	MBFT 720	General Microbiology	3(2-0-2)
2.	MBFT 725	Environmental Microbiology	3(2-0-2)
3.	MBFT 726	Microbiological Techniques	3(2-0-2)
4.	MBFT 727	Virology	3(2-0-2)
5.	MAS 711	Statistics I	3(2-0-2)
6.	COMP 705	Computer Orientation	3(2-0-2)
TOTAL			18(12-0-12)

Semester II

S. No.	Course Code	Course Title	Credits
1.	MBFT 781	Microbial Genetics	4(3-0-2)
2.	MBFT 782	Microbial Physiology	3(2-0-2)
3.	MBFT 811	Food & Dairy Microbiology	4(2-0-4)
4.	CBBI 801	Bioinformatics	3(2-0-2)
5.	MAS 715	Statistics II	3(2-0-2)
6.	MBFT 780	Seminar I	1(0-0-2)
TOTAL			18(11-0-14)

MBFT 800

TRAINING

1(0-0-2)

Semester III

S. No.	Course Code	Course Title	Credits
1.	MBFT 812	Medical Microbiology	4(2-0-4)
2.	MBFT 813	Agricultural Microbiology	3(2-0-2)
3.	MBFT 814	Microbial Biotechnology	3(2-0-2)
4.	MCE 806	Genetic Engineering	3(2-0-2)
5.	MCE 808	Applied Nanoscience	3(3-0-0)
6.	MBFT 880	Seminar II	1(0-0-2)
7.	MBFT 800	Training Evaluation	1(0-0-2)
TOTAL			18(11-0-14)

Semester IV

S. No.	Course Code	Course Title	Credits
1.	MBFT 899	Dissertation	15(0-0-30)

M.Sc. Microbiology

Semester I

1. Course Title: General Microbiology

Course Code: MBFT 720

Credits: 3(2 – 0 – 2)

- History and scope of Microbiology
- General characteristics, classification, morphology and reproduction of Bacteria, Mycoplasma, Chlamydia, Rickettsiae, and Actinomycetes
- General characteristics, classification, morphology and reproduction of Fungi, Algae, Protozoa
- Control of microorganisms by physical and chemical agents

Practical:

- Familiarity with equipment and apparatus used in Microbiology
- Methods of isolation, purification and maintenance of microorganisms
- Staining techniques (Simple, Differential, Special) in bacteria
- Preparation of media and reagents and their sterilization
- Study of cultural and morphological characteristics of important groups of: Fungi, Algae, Protozoa
- Effect of physical agents (viz. temperature, osmotic pressure, UV radiation etc.) on microorganisms
- Effect of chemicals (viz. alcohol, phenol, halogens, heavy metals etc.) on microorganisms

2. Course Title: Virology

Course Code: MBFT 727

Credits: 3(2 – 0 – 2)

- Biology and classification of major groups of viruses: bacterial, plant and animal viruses
- Structural organization and chemistry of viruses
- Isolation, identification and determination of titer of viruses
- Multiplication of viruses: Infection of host cells, synthesis of viral macromolecules, regulation of the expression of phage genes, viral DNA replication, role of DNA modification, maturation release
- Viral Diseases

Practical:

- Transmission of viruses
- Symptomatic diagnosis of important plant and animal viral diseases
- Observation of inclusion bodies
- Isolation and Enumeration of bacteriophages by plaque forming unit (pfu.)
- Cultivation of viruses by Yolk Sac Inoculation technique.

3. Course Title: Environmental Microbiology

Course Code: MBFT 725

Credits: 3(2 – 0 – 2)

- Microbial Diversity: Introduction, abundance, ecological niche. Conventional and molecular methods of studying microbial diversity. Microbial population and community interactions. Culturable and Unculturable bacteria. Extremophiles.
- Microbiology of Air: Sources and types of micro organisms in air, sampling techniques for microbial populations, air pollution, significance of air borne micro organisms in human and plant diseases.
- Microbiology of water: Water environment, types of micro organisms in water, sampling techniques for microbial population in water, water pollution, algal blooms, eutrophication, indicators of excreted pollutants, important water borne diseases of man
- Types of wastewater, bacteriological analysis of wastewater, chemical tests for dissolved oxygen, chloride, BOD and COD. Primary, secondary and tertiary treatment of waste-water.
- Microbial Ecology: Micro organisms and transformations involved in the major geochemical cycles in marine, freshwater and terrestrial ecosystem. Bio-remediation, bio-degradation and bio-deterioration.

Practical:

- Isolation of extremophiles (acidophiles, alkalophiles, psychrophiles and thermophiles)
- Study of air borne micro organisms using various methods
- Study of microbial contaminants from water and waste water
- BOD and COD estimation
- Effect of chlorination on microbial counts of water.

4. Course Title: Microbiological Techniques

Course Code: MBFT 726

Credits: 3(2-0-2)

- Methods of sterilization: principles and their limitations
- Growth media
- General methods of isolation of microorganisms
- A general knowledge of techniques used in identification of various types of microorganisms
- Staining techniques: principles, and their applications (Gram stain, acid fast stain, spore stain, capsule stain)
- Microscopy: General knowledge of principles involved in various types of microscopy, phase contrast microscopy, fluorescence microscopy and electron microscopy
- Principles and applications of centrifuge
- Chromatographic techniques: Types and uses of chromatography, paper, thin layer and column chromatography
- Gel filtration, electrophoresis and its applications in identification and purification of proteins and enzymes
- Principles and applications of spectrophotometry
- Bioassay of vitamins, antibiotics and hormones

Practical:

- Preparation of reagents and stains
- Special staining methods

- Sterilization techniques
- Microscopy
- Micrometry
- Pure culture techniques
- Identification of Bacterial isolates by flow chart
- Hanging drop technique for demonstration of motile bacteria.
- Isolation of bioactive compounds by column chromatography
- Separation of proteins using gel electrophoresis
- Bioassay technique

5. Course Title: Statistics I

Course Code: MAS-711

Credits: 3(2 – 0 – 2)

- Standard –deviation, Coefficient of Variation, Standard error of mean
- Theory of Probability: equally likely, mutually exclusive events, definitions of probability, addition and multiplication theorems of probability and problems based on them
- Normal and Binomial Distributions
- Simple Correlation and regression, Multiple-regression, Multiple and partial co-relation.
- Testing of Hypothesis: Concept of Hypothesis, Degrees of freedom, Level of significance. Type I and Type II errors. χ^2 , t, z and F-tests (definition, applications and problems based on these tests.

Practical:

- Coefficient of variation, SE of mean, Skewness and Kurtosis
- Fitting of Normal, Binomial and Poisson distribution
- Simple Correlation, Multiple and Partial Correlation with three variables only
- Regression lines between two variables
- χ^2 , t and F tests

6. Course Title: Computer Orientation

Course Code: COMP-705

Credits: 3(2 – 0 – 2)

- Information Concepts
- Computer Appreciation
 - Definition, Characteristics and Application of Computers
 - Computer Hardware: I/O Devices Memory, CPU
 - Software Concepts
- Operating System
 - DOS
 - Windows
- Application Softwares
 - MS Word
 - MS Excel
- Computer Programming
 - Algorithm & Flowchart
 - Introduction to 'C' Language
 - History
 - Input & Output Statements
 - Variables & Constants

- Expressions & Operators
- Control Statements
 - Branching Statements (if, if-else, Nested if)
 - Looping Statements (while, do-while, for)
 - Functions & Arrays
- Internet Concepts & Search Engine
- Application of statistical packages

Practical

- Demo session on computer and its components, I/O devices, Memory, CPU.
 - MS DOS:
 - Internal DOS Commands: md, cd, dir, time, del, type, edit, copy, exit, path, prompt, rem, ren, ver.
 - External DOS Commands: attrib, backup, chkdsk, diskcomp, diskcopy, doskey, format, label, xcopy, move, tree, undelete.
- Windows: Login, Desktop, Icons and Folders, Taskbar, Changing Desktop Properties, Mycomputer, My Network places, Recycle bin, My Documents, Control Panel
- Application Software
 - MS Word: Getting familiar with various tool bars, Tables and Columns, Mail Merge.
 - MS Excel: Working with Spreadsheets, Mathematical and Statistical functions, Generating Charts, Creating Macros.
- C Programming:
 - Programs illustrating use of printf() and scanf() statements
 - Practicing with decision making statements like IF, IF-ELSE, Nested IF, ELSE-IF, Ladder, Switch, Goto
 - Working with loops
 - Illustration of Arrays
 - Designing programs to demonstrate concept of functions
- Internet: Webpage, Website, browse, URL, surfing, Searching, creating mail accounts.
- A glance over statistical packages like SPSS, MATLAB etc.

Semester II

1. Course Title: Microbial Genetics

Course Code: MBFT 781

Credits: 4(3-0-2)

- Introduction to nucleic acids, chemistry of DNA, replication, transcription, translation and genetic code
- Genetics of bacteria and bacteriophages, bacterial phenotypes, genotypes. Transformation, Transduction and Conjugation. Regulation of bacterial gene activity, transposable elements and mapping of bacterial chromosomes
- Bacteriophages: characteristics, fine structure and mapping of genes
- Mutation: characteristics, and types in bacteria and viruses
- Introduction to genetic engineering: vectors, plasmids, cosmids, phage derivatives, phagemids. Restriction and modification systems, restriction endonucleases, enzymes used in gene cloning and their applications. Recombinant DNA technology and nucleotide sequencing.
- Genetics of Nitrogen fixation.
- Genetic control of sexual development and macromolecular structures
- Molecular markers

Practical:

- Induction of mutation by chemical and physical methods
- Isolation and characterization of mutants
- Plasmid detection and isolation
- Transformation in bacteria
- Fractionation of nucleic acid by centrifugation

2. Course Title: Microbial Physiology

Course Code: MBFT 782

Credits: 3(2-0-2)

- Structure and functions of various cellular components
- Nutritional requirement of different group of microorganisms
- Bacterial growth, effect of environment and chemicals on growth
- Transport in microorganisms
- Enzymes: classification, mechanism of action, enzyme kinetics
- Bacterial photosynthesis
- Aerobic and anaerobic respiration
- Regulation in microorganisms

Practical:

- Demonstration of sugar (glucose, sucrose and lactose) fermentation
- Sugar, mannitol fermentation by bacteria
- IMViC test for enteric bacteria
- Catalase activity for H₂O₂ production
- Oxidase activity of a given bacterial sample
- Demonstration of carbohydrate metabolism by Hugh Leifson's test
- Determination of nitrate reduction by bacteria
- Demonstration of starch hydrolysis by given bacterial culture
- Demonstration of protein (gelatin) hydrolysis

- Fat hydrolysis by bacterial culture
- Phenylalanine deaminase production
- Demonstration of lysine decarboxylase activity of bacteria
- Degradation of sulphur containing amino acids for H₂S production
- Demonstration of urease production
- Measurement of bacterial growth curve

3. Course Title: Food and Dairy Microbiology

Course Code: MBFT 811

Credits: 4(2-0-4)

- Systematic study of major groups of microorganisms of importance in food industry
- Principles and methods of food preservation
- Food spoilage (cereals, vegetables, egg, meat and fish) and its causes
- Food in relation to diseases
- Sources and types of microorganisms in milk
- Starter culture
- Role of microorganisms in the manufacture of milk and milk products
- Microbial spoilage of dairy products and their control
- Principles of Food safety and food hygiene.
- Food regulations, grades and standards, Concept of Codex alimentarius/HACCP/USFDA/ISO 9000 series etc.

Practical:

- Isolation and identification of microorganisms involved in food spoilage
- Enumeration and diagnosis of food poisoning organisms
- Isolation of microorganisms from milk and milk products and their identification
- Microbiological grading of milk and milk products

4. Course Title: Statistics II

Course Code: MAS-715

Credits: 3(2-0-2)

- Analysis of variance: Definition and assumptions, One way classification, two way classification with more than one observation per cell
- Design Experiments: Principles of experimental design, Randomized Block Design (R.B.D)
- Latin Square Designs (L.S.D), Missing plot technique in R.B.D and L.S.D, Critical difference (C.D), Split plot design.
- Factorial –Experiments: 2², 2³, 3², 3³ factorial-designs (Yates method of Analysis) 2X3 & 2X4 factorials.
- Durcan's Multiple Range Test. Newman's Kuel's Test
- Sampling Techniques: Simple random sampling, stratified random sampling and Systematic sampling

Practical:

- Analysis variance, Randomized block design

5. Course Title: Bioinformatics

Course Code: CBB1 801

Credits: 3(2-0-2)

- Introduction to Bioinformatics, philosophical, directional and application oriented background of bioinformatics.
- HGP – influence area in Bioinformatics, Application in different industries, and its Indian scenario, as a business, problem and future aspects.
- Information network – Internet, web Browser and address (NCBI, EBI etc).
- Databases – information resources for Proteins and Genomics.
- SRS, Algorithms, Alignment.
- Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation – Paralogues and orthologues, Tree building and tree evaluation, Phylogenetic software.
- Comparative Genome Analysis: Introduction, application, genome analysis and annotation.
- Molecular structure Predication and visualization (X-ray crystallography/NMR/Bioinformatics).
- Micro array data analysis.
- Different analysis packages and other Miscellaneous Tools etc.

Practical

1. Introduction to NCBI

- Familiarity with the tools available at NCBI.
- Searching using author's name.
- Retrieval of Sequence in FASTA format.
- Working with Sequences
- From Expasy
- Retrieving list of related proteins
- Retrieving DNA sequences

2. Working with Protein Sequences

- Computing amino acid composition, molecular weight, isoelectric point and other properties.
- Computing hydrophobic / hydrophilic profile
- Predicting antigenic sites
- Locating membrane spanning segments.
- Predicting element of Secondary structure.
- Finding all protein sharing sequence similarity.
- Classifying protein into families.
- Finding best alignment between two or more proteins.
- Finding Evolutionary relationship between protein, Tree Drawing.

3. Analyzing DNA/RNA

- Retrieving DNA sequence from database.
- Computing Nucleotide composition.
- Identifying restriction sites.
- Designing PCR Primer.
- Identifying open reading frames.
- Computing the optimal alignment between two or more DNA sequence.
- Finding Polymorphic sites in genes.
- Assembling sequence fragments.

4. Working with entire Genome.

- Finding which Genome is available.
- Analyzing sequence in relation to specific Genome.
- Locating Gene homologous in a genome.
- Displaying Genomes.
- Parsing a microbial genome sequence (ORF).
- Parsing a eukaryotic genome sequence, GenScan.
- Finding orthologues and Paralogues Genes.
- Discovering unknown Genes.
- Finding Repeats.

Semester III

1. Course Title: Medical Microbiology

Course Code: MBFT 812

Credits: 4(2-0-4)

- History of medical microbiology
- Host parasite relationship, defence mechanisms of host, immunoglobulins, antigen antibody reactions, complement, toxin and antitoxins
- Hypersensitivity, preliminary knowledge of blood cells and serum
- Pathogenic microorganisms, diseases caused by them, laboratory diagnosis, epidemiology, prevention and treatment
- Principles of chemotherapy, role of antimicrobial agents synthetic compounds and antibiotics, their mechanism of action, drug resistance in bacteria, drug sensitivity tests

Practical:

- Laboratory examination of blood and identification
- Antigen and antibody reactions to identify the serotypes of pathogenic bacteria
- Staining techniques for identification Mycobacterium in sputum
- Biochemical tests for identification of enteric bacteria
- Morphological studies of pathogenic fungi
- Identification of pathogenic bacteria by urine culture
- Drug sensitivity tests

2. Course Title: Agricultural Microbiology

Course Code: MBFT 813

Credits: 3(2-0-2)

- History and development of agricultural microbiology. Microbiota of soil, interrelationship between soil microorganisms and higher plants
- Transformation of nitrogen compound. Nitrogen cycle, symbiotic and non-symbiotic nitrogen fixation. Microbiological methods of evaluation of soil fertility. Biofertilizers
- Degradation of organic residues in soil
- Microbiological control of plant pathogens
- Important diseases of crop plants and their management

Practical:

- Isolation and enumeration of microbes from soil
- Demonstration of different steps in nitrogen cycle
- Isolation of symbiotic and non symbiotic nitrogen fixing bacteria
- Isolation and characterization of PGPR
- Isolation and identification of field and storage fungi from cereal grains and oil seeds
- Isolation of plant pathogenic bacteria and fungi from diseased plants
- Study on important bio-control agents

3. Course Title: Genetic Engineering

Course Code: MCE 806

Credits: 3(2-0-2)

- Biology of cloning vectors: Plasmids, cosmids, phagemids, *Agrobacterium tumefaciens* based vectors, binary and shuttle vectors, enzymes used in genetic engineering, restriction endonucleases, reverse transcriptase, terminal transcriptases, ligases, exonucleases, SI nucleases, kinases, polymerases, alkaline phosphatases
- Principles of recombinant DNA technology: Gene splicing, construction of recombinant DNA selection and screening of desired clones by hybridization method, genetic method and immunological method
- Recombinant DNA expression: Genomic and cDNA libraries, YAC and BAC, expression of heterologous genes in bacteria (*E.coli*), detection of expression of foreign genes, maximizing the expressions of recombinant DNA applications of recombinant DNA technology
- Gene cloning in mammalian cells: Requirements of gene expression vectors, transient vs. stable expression, reporter gene assays-luciferase, β galactosidase, CAT, selectable and scorable markers, transfection methods, electroporation, protoplast fusion, microinjection.

Practical:

- Digestion of DNA with restriction endonuclease
- Ligation of DNA fragments by ligation reaction
- Preparation of competent cells
- Transformation of bacterial cell with foreign DNA
- Selection of transformed cells by blue white selection techniques

4. Course Title: Microbial Biotechnology

Course Code: MBFT 814

Credits: 3(2 – 0 – 2)

- History and scope of Biotechnology. Bioreactors: Types of Bioreactors e.g. packed bed, bubble column, air lift, fluidized bed bioreactor, membrane/hollow fiber, photo-bioreactor etc.
- Industrial production of alcohol, glycerol, solvents (acetone, butanol, isopropyl alcohol), vinegar, acids (lactic, citric, gluconic acid), vitamins (Riboflavin, B12), antibiotic (penicillin, streptomycin, tetracycline, griseofulvin) by micro-organisms.
- Concept of various types of fermentation: Batch, continuous, semisolid and solid state etc.
- Methods of enzyme production, their immobilization and application in therapeutic, analytical manipulation and industrial uses.
- Use of microbes in producing SCP, substrates used in producing SCP, their nutritional value.
- Biotransformation

Practical:

- Study of fermentor and fermentor operation.
- Isolation and purification of important microbial enzymes.
- Production of lipase by submerged fermentation.
- Production of lipase by semisolid fermentation.
- Effect of pH and temperature on enzyme production.

- Isolation of yeast from fruit juice and rice flour.
- Quantitative estimation of ethanol produced during yeast fermentation.
- Production of wine from grapes by using yeast
- Citric acid production by solid state fermentation
- Preparation of fungal spore in large scale by bread culture method.
- Immobilization of cell on sodium alginate gel

5. Course Title: Applied Nanoscience

Course Code: MCE – 808

Credits: 3(3-0-0)

- Introduction and basic concept of Nanoscience; Background and Definition of Nanotechnology; Why Nano? Lessons from Nature, Applications in Different Fields, Reliability Issues.
- Methods of measuring properties; Spectroscopy (UV/VIS and IR) and mass spectrometry; Atomic Force Microscopy, Principles of Operation, Standard Probe Tips, Probe Tip Performance, Oxide-Sharpended Tips, FIB tips, EBD tips, Carbon Nanotube Tips; Scanning Tunneling Microscopy; mechanically Cut STM Tips, Electrochemically Etched STM Tips.
- Nanomaterials- man made and natural; CNT Production characterizations and applications 0-D, 1-D and 2-D Nanostructures; Chemical Approaches to Nanostructured Materials, From Molecular Building Blocks to Nanostructures, Nanoscaled Biomolecules: Nucleic Acids and Proteins, Chemical Synthesis of Artificial Nanostructures, From Structural Control to Designed Properties and Functions.
- Metabolic engineering for production of desirable products; In vivo cellular process analysis, manipulation and alteration of pathways with nano devices and nanomaterials and nano-composites.
- Production of nano materials from microbes; Production of metal nano particles and protein. Nanoparticle, their recovery, purification and characterizations.
- DNA-Protein nanostructures, synthesis and applications; Structural DNA Nanotechnology: An Overview; Nanowires for Biomolecular Sensing, Nanoimaging of Biomolecules, Nanostructured DNA Templates; Probing DNA Structure With Nanoparticles.
- Application of Nanoparticle in medical science, drug, drug targeting and pathway alteration, Novel Bionanomaterials for Tissue Engineering Integrated Cantilever-Based Biosensors for the Detection of Chemical and Biological Entities. Nano-biomechanical robots application in cancer therapy