

Department of Studies in Microbiology

Programme: Master of Science (M.Sc.) in Microbiology 9.6.1

**Programme Overview:**

**Duration: 2 Years (4 semesters) Programme Code:**

Master of Science (M.Sc.) in Microbiology programme is designed for students who are willing to excel their career in teaching, research and development and industry. The course aims in providing basic understanding of the concepts of microbiology in various areas such as agriculture, industrial, environment, health care sectors by providing expertise in developing novel technologies and also nurturing young minds for the betterment of society.

**Programme Outcomes (POs):**

At the end of the programme the students will be able to:

- PO1:** Execute their knowledge of Microbiology in handling academics.
- PO2:** Develop productivity and reproducibility in Research and Industrial sector.
- PO3:** Become entrepreneurs by developing low cost technologies by using microorganisms.
- PO4:** Improve their soft skills such as communication, leadership abilities, mindfulness and multitasking and management abilities.
- PO5:** Develop their technical skills in microbiology in turn give societal development by developing antibiotics, vaccines, biological, and synbiotics in health care sector.
- PO6:** They can save environment by removing residual toxins, waste management by knowledge in microbiology.
- PO7:** They can develop analysing capacity by data assessment and validation by handling equipments, instruments such as SEM, TEM, AFM, and XRD.



**Chairman**

**Department of P.G. Studies and  
Research in Microbiology  
Vijayanagara Sri Krishnadevaraya  
University, Ballari - 583105**

## **Programme Specific Outcomes (PSOs):**

At the end of the programme the students will be able to:

**PSO1:** Apply the knowledge of basic concepts of Microbiology in Recombinant DNA technology, Molecular diagnostics, Bioinformatics, Biophysics, and Biochemistry.

**PSO2:** Demonstrate the ability to design & execute experiments in agriculture by developing bio control agents, Bio fertilizers, in food and dairy by developing fermented foods, probiotics, prebiotics and assessing food borne infections and maintain food standards, in industries development of organic acids, alcohols, enzymes, vaccines, antibiotics, in medical sector by analysing and treating the infections caused by bacteria, virus and fungi.



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## Course Outcomes:

M.Sc. Microbiology (Semester I) (CBCS): 2019-20 Scheme

### I Semester

#### COURSE; INTRODUCTION TO MICROBIOLOGY (MB HCT 1.1)

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
CO1	Understand the history, origin, development, evolution of microbes and the contributions of various scientists in the development of microbiology in medical, agriculture.
CO2	Apply the disinfection and sterilization process in controlling of microorganisms.
CO3	Cultivate microorganisms and identify infection microbes.
CO4	Identification of the microscopic characteristics of microorganisms under microscope by staining.
CO5	Isolation of pure culture by culture techniques, principles, mechanism, method and types of staining Simple, Differential, Gram staining. Acid fast staining.
CO6	Handle the microscopes and its modifications – Light, phase contrast and interference, FM, CFM, TEM and SEM and AFM. And lab equipments Autoclave, Laminar air flow system, Incubator, Hot air oven, Orbital shaker, pH meter, Spectrophotometer, Centrifuges.



**COURSE; MICROBIAL TAXONOMY (MB HCT 1.2)****Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
C O1	Learn the biodiversity of micro organisms, Types of biodiversity. The concept of microbial species, microbial systems and construction of taxonomy groups and classification of viruses.
CO2	Understand general characteristics and economic importance of Archae bacteria, Actinobacteria, Cyanobacteria, bioluminescent bacteria Mycoplasma, Rickettsia and Chlamydia.
CO3	Understand the ultra structure of bacteria and its reproduction.
CO4	Understand the configuration and symmetry of viruses – plant animal and bacterial viruses, Oncogenic viruses, satellite viruses prions etc.
CO5	Understand the classification structure of fungi, its reproduction and economic importance.
CO6	Understand the classification structure of Algae, its reproduction and economic importance.

**COURSE: BIOCHEMISTRY (MB HCT 1.3)****Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
C O1	Perform calculations and unit of expressions of solutions; prepare the buffers used in biology.
CO2	Understand the structure and function of biomolecules. Such as proteins amino acids, carbohydrates, lipids, and nucleic acids.
CO3	Understand the basics of bio energetics.
CO4	Understand the concept of respiration and fatty acid oxidation.
CO5	Know the synthesis and degradation of Glycine, Phenylalanine and Tyrosine, and sulfur containing amino acids.
CO6	Know the synthesis and degradation of pyrimidine nucleotides.



**COURSE: INSTRUMENTATION AND TECHNIQUES IN BIOLOGY (MB SCT 1.1)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
C O1	Handle electron microscope and 3D image processing.
CO2	Handle UV Visible Raman spectroscope, Understand the principle of fluorescence, NMR, IR.
CO3	Handle the separation of biomolecules using centrifuges.
CO4	Understand the concept of radioactive isotopes and Autoradiography.
CO5	Develop skills in molecular biology techniques such as PCR, Gel electrophoresis
CO6	Develop the skills in purification of proteins using chromatography techniques gel electrophoresis and blotting techniques.

**PRACTICAL I: INTRODUCTION TO MICROBIOLOGY I (MB HCP 1.1)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
C O1	Know the good laboratory practices and safety practices.
CO2	To study about instrumentations used in microbiology experiments.
CO3	Preparation of culture media, preparation of liquid and solid media; nutrient broth, nutrient agar, potato dextrose agar,
CO4	Know about how to maintenance of micro organisms. stock culture and sub culture storage of micro organisms

## PRACTICAL II: MICROBIAL TAXONOMY (MB HCP 1.2)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
C O1	Perform the distribution of microbes from air, soil, water.
CO2	Perform special staining technique for endospores, capsule, and flagella.
CO3	Perform biochemical tests for identification of Bacteria.
CO4	Isolation of fungi, bacteriophages, viruses, algae, protozoa.

## PRACTICAL III : BIOCHEMISTRY (MB HCP 1.3)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
C O1	Perform qualitative and quantitative analysis of Carbohydrates, Proteins, Amino acids, Nucleic acids
CO2	Perform estimation of Sugars, Proteins, Ascorbic acid, cholesterol.
CO3	Determine the iodine value of oils.

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**DEPT. OF MICROBIOLOGY**  
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## II Semester

### COURSE: MICROBIAL PHYSIOLOGY AND ENZYMOLOGY (MB HCT 2.1)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Classification of the microorganisms based on their physical nutritional source and also the difference of growth.
CO2	Understand the concept of microbial photosynthesis, respiration and fermentation reactions.
CO3	Understand the bacterial signaling systems, bacterial response to environmental stress.
CO4	Understand the concept of enzymes and kinetics by various equations and mechanism of actions.
CO5	Will understand the enzyme activation, regulation and the different types of enzymes Allosteric Enzymes, multienzyme complex and membranes and Enzymes.
CO6	Could able to develop inhibitors for various enzymes and also understand the concept of Isoenzymes.

### COURSE: MICROBIAL GENETICS (MB-HCT 2.2)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Will gain knowledge in the pre mendalian genetic concepts, theories of genetics.
CO2	Will gain understand the principle of genetic recombination in viruses.
CO3	Will gain understand the principle of genetic recombination in bacteria by conjugation, transduction and o transduction.
CO4	Will gain understand the principle of genetic recombination in fungi and importance is plasmids and genetics of yeast.
CO5	Understand the mechanism of regulation of Lac and tryptophan operon
CO6	Understand the different types of mutations, molecular basis of mutation.

**COURSE ; MOLECULAR CELL BIOLOGY(MB HCT 2.3)**

**Course Outcomes (CO): After completion of this course student should able to**

<b>CO</b>	<b>Statement</b>
CO1	Know the cell structure and functions of cell and its organelles.
CO2	Understand the concept of general genomic organization of prokaryotes and eukaryotes and its replication.
CO3	Understand the concept of mechanism of transcription process and post transcriptional modification of mRNA.
CO4	Understand the concept of translation, post translational modification.
CO5	Understand the concept of DNA repair mechanism.
CO6	Understand the concept of transposition and gene silencing.

**COURSE: GREEN NANO TECHNOLOGY (MB SCT 2.1)**

**Course Outcomes (CO): After completion of this course student should able to**

<b>CO</b>	<b>Statement</b>
CO1	Understand the basics of nanotechnology.
CO2	They will know the different types of nanotechnology.
CO3	Understand green synthesis of nanoparticles by bacteria and plants.
CO4	Handle the instruments used in nanoparticles detection using x-ray diffract technology SEM, TEM, AFM spectroscopic technology.
CO5	Know the applications of principles of biosensor and nano sensors.
CO6	Gain knowledge in applications of nanoparticles in agriculture smart environmental wastewater treatment and uses of nanoparticles in medicines.

**COURSE: BIOINFORMATICS (MB SCT 2,2)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	Understand introduction to Bio informatics.
CO2	Understand the concept of Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods, Evaluation of Gene Prediction methods
CO3	Learn the concept of Transcriptomics, Complete transcript cataloguing and gene discovery- sequencing based approach, Microarray based technologies and computation based technologies. RNA secondary structure prediction
CO4	Study of Protein Computational Biology, Structural classification of proteins, Protein folding, Protein modeling and drug design.
CO5	Understand tools in Bioinformatics, Protparam, Translate, Bioedit, findmod, Coils, TMHMM, Rasmol, and Deepview.
CO6	Understand Genomics, Comparative Genomics. Proteomics, Phylogenetic analysis: molecular basis of evolution, Phylogenetic trees & different methods for phylogenetic inference.



### PRACTICAL IV: MICROBIAL PHYSIOLOGY AND ENZYMOLOGY (MB HCP 2.1)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Perform culturing and cultural characteristics of micro organisms.
CO2	Know about isolation of thermopiles, acidophilus, basophiles, and homophiles, and aerobic facultative aerobic anerobic and microaerophilic microbes.
CO3	Know about growth measurement of bacteria, fungi/ Acitomyces.

### PRACTICAL V : MICROBIAL GENETICS (MB-HCP 2.2)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Prepare of competent cells, and genetic transformation of DNA.
CO2	Know about isolation of plasmids.
CO3	Perform colorimetric estimation of DNA by Diphenyl amine method RNA by Orcinol method.

### PRACTICAL VI: MOLECULAR CELL BIOLOGY(MB HCP 2.3)

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Know about cell cycle, to understand stages of cell cycle, mitosis and meiosis.
CO2	Know about problems related DNA and RNA characteristics.
CO3	Know about separation and elution of DNA from Agarose gel electrophoresis.

**COURSE: MICROBIAL DIVERSITY (MB-OET 2.1)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	Learn the concepts and scope of types of diversity classifying the naming Microorganisms, classification systems ICNB rules, Major characteristics used to classify microorganisms.
CO2	Understand the concept of viral diversity classification of viruses, structure, classification, replication, and diseases caused by satellite viruses, virusoids, viroids, and prions.
CO3	Understand the concept of Bacterial diversity and classification based on Bergey's manual.
CO4	Understand the concept of fungal diversity and classification distribution importance structure and reproduction and characteristics of fungal divisions.
CO5	Understand the importance and conservation of microbial diversity, importance of microbial diversity in agriculture, forestry, environment, industrial and food biotechnology animal and human health.metagenomics.

**COURSE: MICROBIAL TECHNOLOGY (MB-OET 2.2)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	Learn the concept of microbial technology and fermentation economics, Microbial production of antibiotics.
CO2	Learn the microbial production of amino acids, wine, vitamins, and Ergot alkaloids.
CO3	Understand the biotransformation of steroids, nutritional value and safety.
CO4	Understand the concept of Microbial exopolysachrides, xanthan, Alginate, Microbial flavors.
CO5	Know about the fermented food and dairy products and its applications

### III Semester

#### COURSE: FOOD AND DAIRY MICROBIOLOGY (MB HCT 3.1)

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	Gain knowledge on the properties of food and as a as a substrate for microorganisms.
CO2	Understand the principle of food contamination and spoilage of meat egg fish cereals fruits and vegetables.
CO3	Understand the general principles of food preservation.
CO4	Imbibe the knowledge of food borne disease and its treatment and also the preparation of formatted foods probiotics and nutraceuticals.
CO5	know the concept of dairy microbiology and the preservation of milk and milk products production of production of cheese milk
CO6	Understand the food sanitation and safety and also the standards that follow in food industries.

#### COURSE: MICROBIAL ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY

(MBHCT 3.2)

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	Know the concept of environmental microbiology and also the structure and function of microbial communities.
CO2	Diversity of microorganisms in extreme environments.
CO3	Gain skills in maintaining water quality by wastewater treatment.
CO4	Understand air pollution and radiation pollution and the effects of air pollution.
CO5	Understand soil pollution and also solid waste management which provides eco friendly environment.
CO6	Gain knowledge in biology bioremediation bioleaching and degradation of pesticides polycyclic aromatic hydrocarbons and synthetic polymers.



**COURSE: AGRICULTURE MICROBIOLOGY (MB HCT.3.3)****Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	Understand the origin and concept of agriculture microbiology and the role of microorganisms in soil formation and fertility.
CO2	Understand the plant microbe interactions such as symbiosis visual ISM synergism.
CO3	Understand the mechanism of biological nitrogen fixation and phosphate solubilization in bacteria Rhizobium, acetobacteria, aceto bacteria blue green algae and mycorrhiza.
CO4	Develop the formulations of microbial biofertilizer's and preparation of green manure, compost.
CO5	By gaining knowledge on plant diseases crops by bacteria fungi and viruses.
CO6	Develop the formulations of biopesticides using bacteria fungi and viruses. To understand Genetically modified organisms.

**COURSE: RECOMBINANT DNA TECHNOLOGY(MB SCT 3.1)****Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO1	The students develop skills in understanding the concept of cloning and various kinds of vectors such as plasmids, phagemids, and cosmids yeast plasmids.
CO2	Skills in the amplification of DNA and its types.
CO3	Develop skills on the construction of recombinant DNA, cDNA and genomic DNA libraries.
CO4	Understand the expression of recombinant proteins in bacteria yeast insect in mammalian cells.
CO5	Understand the concept of genome sequencing such as all genome shotgun sequencing and genome annotation nucleotide protein and process level.
CO6	Understand the concept of transcriptional analysis of gene expression and transcriptomics.

**COURSE: BIOETHICS, BIOSAFETY AND IPR (MB SCT 3.2)**

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Basic concepts of biotics and ethical conflict in biotechnology.
CO2	Learn the logic of biosafety at the level of individuals' institutions society institution.
CO3	Learn the regulations of biosafety.
CO4	Understand the biosafety guidelines.
CO5	Understand the intellectual property includes patents trademarks copyright and related rights trademarks.
CO6	The concept related to patents valets commercialization and licensing.

**PRACTICAL VII : FOOD AND DAIRY MICROBIOLOGY (MB HCP 3.1)**

**Course Outcomes (CO):** After completion of this course student should able to

CO	Statement
CO1	Perform the determination of microorganisms from healthy fruits, vegetables, egg, jam sauce, pickle and spoiled fruits, vegetables, egg, jam sauce, pickle.
CO2	Detection of food borne pathogens from food.
CO3	Production of yogurt, acidophilus milk and temph, microbial lipids.
CO4	Estimation of lactic acid, proteins, aflatoxin from food samples.

**PRACTICAL VIII: MICROBIAL ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY (MBHCP 3.2)**

**Course Outcomes (CO): After completion of this course student should be able to**

CO	Statement
CO1	Determination of dissolved O <sub>2</sub> , CO <sub>2</sub> , BOD, COD and Total dissolved solids of different water samples.
CO2	Perform isolation of microorganisms in polluted and un polluted soil, water and to isolate and determination of Iron and Manganese reducing bacteria.
CO3	Understand the degradation of cellulose, Hemicellulose, Starch, Lignin, Pectin by microorganisms.

**PRACTICAL IX : AGRICULTURE MICROBIOLOGY (MB HCP.3.3)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
CO	Know about enumeration of Rhizosphere and phyllosphere micro organisms and phosphate solubilising bacteria and fungi.
CO2	Know about isolation of bioinoculants and isolation of bacteria and fungi.
CO3	Know about plant diseases-Rust, Smuts, Powdery mildews, Tikka disease of ground nut, citrus canker, bhendi yellow vein mosaic, tomato leaf curl, little leaf of brinjal.
CO4	Perform Mass production of Fungal and B. thuringensis in laboratory.



**COURSE: MICRO ORGANISM IN HUMAN WELFARE (MBOET 3.1)**

**Course Outcomes (CO): After completion of this course student should be able to**

CO	Statement
CO1	Understands the importance of microbiology, the different types of microorganisms their existence, identity by using various microscopic techniques.
CO2	Isolate, Cultivate, identify microorganisms such as bacteria, fungi, actinomycetes using pure culture and staining techniques and also practicing sterilization techniques.
CO3	Importance of microbes in environment, their role in nutrient recycling, soil fertility and crop productivity.
CO4	Importance of microbes in food preservation and contamination, their role in fermented foods, probiotics and nutraceuticals.
CO5	Importance of microbes in industrial applications, their role in production of antibiotics, enzymes, organic acids and pigments.
CO6	Importance of microbes in disease, their role in human health.

**COURSE: BIOPHARMACEUTICALS (MB OET 3.2)**

**Course Outcomes (CO): After completion of this course student should be able to**

CO	Statement
CO1	Understand the importance of drug discovery and development includes computer aided drug design.
CO2	Know the significance and production of pharmaceuticals, biological in production of therapeutic enzymes, cytokines.
CO3	Know the significance and production of antibiotics and vaccines.
CO4	Understand the spoilage of pharmaceutical products, regulatory practices and policies in pharmaceutical industries.
CO5	Know the quality assurance and validation and know the designing layout for microbiology laboratory.
CO6	Learn the concept related to patents novelty, utility, anticipation, patent application, PCT and implications, Role of a country patent office.



## IV Semester

### COURSE: BIOPROCESS AND FERMENTATION TECHNOLOGY (MB HCT 4.1)

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
CO1	Understand the origin concept of fermentation, the different types of fermentation and strain development.
CO2	Get acquainted with preparation of culture media formulations for the production of metabolites.
CO3	Understand the construction and design of fermentor and the types of fermentors.
CO4	Understand the kinetics of microbial growth, product formation kinetics.
CO5	Learn the basic component of bioprocess engineering includes Upstream and Downstream bioprocess.
CO6	Production of purification of microbial products such as enzyme, organic acids, amino acids, antibiotics, alcoholic beverages.

### COURSE: MEDICAL MICROBIOLOGY (MBHCT 4.2)

Course Outcomes (CO): After completion of this course student should able to

CO	Statement
CO1	Understand the overview of human anatomy and physiology with special reference to infections.
CO2	Understand the mechanism of microbial pathogenesis and pathogenesis of Microorganisms.
CO3	Learn the Systemic bacteriology which includes epidemiology symptoms diagnosis and treatment of diseases.
CO4	Learn the viral disease which includes epidemiology symptoms diagnosis and treatment of diseases.
CO5	Learn the fungal infections and human parasites which include epidemiology symptoms diagnosis and treatment of diseases.
CO6	Understands the chemotherapy against the microbial infections and also WHO guidelines.



**COURSE: IMMUNOLOGY AND IMMUNOTECHNIQUES (MB SCT 4.1)**

**Course Outcomes (CO): After completion of this course student should able to**

<b>CO</b>	<b>Statement</b>
CO1	Understand the basics of immunology, types of immunity, the cells and organs of the immune system.
CO2	Learn the structure and function of immune cells (B and T cells) its origin development maturation and surface receptors such as MHC molecules.
CO3	Learn the structure and function of antigens and antibodies .Skill development in diagnostic immunology by understanding the antigen and antibody reactions and assays.
CO4	Learn the types of immune response and mechanism of humoral and cell mediated immunity.
CO5	Understands the types and mechanisms of hypersensitivity reactions, autoimmunity disorders.
CO6	Understands the tumours and transplantation immunology.

**COURSE: BASICS OF CLINICAL RESEARCH (MB SCT 4.2)**

**Course Outcomes (CO): After completion of this course student should able to**

<b>CO</b>	<b>Statement</b>
CO1	Understand the introduction to clinical research and historical guidelines in clinical research.
CO2	Introduction to drug discovery and drug development.
CO3	Learn the clinical trials phase 1, 2, 3, 4, trails in new drug discovery process.
CO4	Learn the concept of pre clinical toxicology.
CO5	Understand and imbibe the guidelines and regulations for good clinical practice, career in clinical research.



**PRACTICAL X; BIOPROCESSING ENGINEERING AND FERMENTATION TECHNOLOGY (MB HCP 4.1)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
C O1	Study the fermentation antibiotic penicilin, citric acid production.
CO2	Understand the production of vitamins and alpha amylase.
CO3	Preparation of wine, and immobilized cells.

**PRACTICAL XI ; MEDICAL MICROBIOLOGY (MBHCP 4.2)**

**Course Outcomes (CO): After completion of this course student should able to**

CO	Statement
C O1	Study the antibiotic sensitivity test, and study of cancer cells.
CO2	Learn how to diagnose of HIV by using Dot-ELISA.
CO3	Perform preparation of culture media and to perform presumptive identification of pathogens using colony morphology on selective/differential/ selective differential enrichment media.
CO4	Determination of Drug susceptibility testing by various methods.
CO5	Study the Bacteriological examinations of urine, blood, Pus samples from Hospitals.

**COURSE: PROJECT**

**Course Outcomes (CO): After completion of the project student should able to**

CO	Statement
1	The docking parameters of the ligand and protein interactions.
2	The biodiversity of microorganisms in Ballari region.
3	The determine the microbial quality of milk.

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