

DEPARTMENT OF BOTANY
PG PROGRAMMES
1. M.Sc. BOTANY

PROGRAMME OUTCOMES (POs):

- PO 1:** In-depth knowledge about plants, and related practices and techniques, necessary for teaching and research
- PO 2:** Understanding of environmental issues needed to become naturalists or conservationists
- PO 3:** Critical and reflective thinking, enabling them to make an honest assessment of their strengths and weaknesses
- PO 4:** Communication skills through effective presentations and interactive sessions in the class
- PO 5:** Problem-solving skills to help generate confidence for a more substantive life

PROGRAMME SPECIFIC OUTCOMES (PSOs):

After completing the two years (Four Semesters) PG Programme (M.Sc.) in Botany, the student would have:

- PSO1:** Developed a robust comprehension of the diversity of plants and microorganisms, including plant viruses, and understood the vital interactions amongst the plants, environment, microbes, and human beings
- PSO2:** Gained an insight into the functioning of a cell and understood the techniques and methods pertaining to plant physiology, cell and molecular biology, cytogenetics and plant breeding
- PSO3:** Acquired necessary training and skill for writing thesis/preparing a project report based on the information collected through review of literature

COURSE STRUCTURE:

PAPER	PAPER TITLE	CREDITS	MM (30+70=100)
SEMESTER I			
I	Microbiology: Plant Virology and Bacteriology	4	100
II	Fungi and Plant Pathology	4	100
III	Algae, Lichens, Microscopy and Culture Techniques	4	100
IV	Bryophytes	4	100
Practical	Based on Papers I - IV	4	100
Elective	Choice based	3	100

SEMESTER II			
V	Pteridophytes	4	100
VI	Gymnosperms and Palaeobotany	4	100
VII	Angiosperm - Plant Development and Reproduction	4	100
VIII	Angiosperms: Taxonomy and Economic Botany	4	100
Practical	Based on Papers V - VIII (including local excursion)	4	100
Elective	Choice based	3	100
SEMESTER III			
I	Cytogenetics and Molecular Genetics	4	100
II	Plant Breeding and Biostatistics	4	100
III	Environment, Ecology and Plant Soil Relationship	4	100
IV	Analytical Techniques and Computer Applications	4	100
Practical	Based on Papers I-IV	4	100
Elective	Choice based	3	100
SEMESTER IV			
V	Plant Physiology	4	100
VI	Cell Biology and Plant Biochemistry	4	100
VII	Biotechnology and Human Welfare	4	100
VIII	Project (Review/Literature survey based on all Papers from Semester I to IV)	4	100
Practical	Based on Papers V and VII (including Lab Visit)	4	100
Elective	Choice based	3	100
Total maximum marks and credits for all 4 semesters		92	2400

M.Sc. BOTANY SEMESTER I
PAPER I: MICROBIOLOGY: PLANT VIROLOGY AND BACTERIOLOGY

COURSE OBJECTIVES:

To learn about the structure, function and diversity of Bacteria, Archaea, and Plant Viruses, and to understand the various ways in which they affect mankind, including their role in biotechnology

COURSE OUTCOMES (COs):

- CO 1:** Understand viruses, their properties and criteria for classification based on morphological and genomic traits; transmission characteristics of viruses and molecular basis of interaction between the vectors and viruses
- CO 2:** Assimilate techniques involved in the purification and detection of viruses, and get an overview of the methods employed in controlling virus infections
- CO 3:** Understand the process of viral infection and replication, genome expression strategies, structural diversity of bacteriophage and the functioning of the genetic switch in phage lambda

- CO 4:** Acquire knowledge about the prokaryotic domains, and their major phyla, cellular organization and functioning of prokaryotic cells, organization of the bacterial genome and plasmids, and methods of genetic recombination in bacteria
- CO 5:** Recognize metabolic diversity in bacteria and biotechnological applications of microbes in various spheres, mode of action of antibiotics and the development of antibiotic resistance in microbes.

M.Sc. BOTANY SEMESTER I
PAPER II: FUNGI AND PLANT PATHOLOGY

COURSE OBJECTIVES:

Introduction to fungi and fungus-like organism so as to understand the fungal structure, reproduction, and the full spectrum of fungal activities

COURSE OUTCOMES:

- CO 1:** Learn about the general aspects of fungi, fungal systematics and phylogeny
- CO 2:** Gain a comparative knowledge of structure and life cycle patterns of selected fungi and allied organisms
- CO 3:** Understand the principles of plant pathology, host-pathogen interaction and disease management
- CO 4:** Develop an understanding of the epidemiology, symptoms, etiology, prevention and control of diseases caused by fungi and nematodes, and abiotic factors

M.Sc. BOTANY SEMESTER I
PAPER III: ALGAE, LICHEN, MICROSCOPY AND CULTURE TECHNIQUES

COURSE OBJECTIVES:

To equip students with an in-depth knowledge of plant diversity through the study of Algae and Lichens, and related techniques

COURSE OUTCOMES:

- CO 1:** Acquire knowledge about the classification and general features of Algae and fossil algae
- CO 2:** Understand thallus organization, cell structure, reproduction, phylogeny, and inter-relationship of selected members of Cyanophyta, Chlorophyta, Rhodophyta, and other divisions of Algae

CO 3: Have an idea of the classification, structure, distribution, reproduction and importance of Lichens

CO 4: Understand the working of microscopes, and culture methods related to Algae and Lichens

**M.Sc. BOTANY SEMESTER I
PAPER IV: BRYOPHYTES**

COURSE OBJECTIVES:

To get a comprehensive view of the morphological, ecological, physiological and reproductive diversity of Bryophytes, and understand their economic importance and fossil history

COURSE OUTCOMES:

CO 1: Knowledge of the classification, general features, ecology, physiology and reproductive biology of Bryophytes

CO 2: Gain information on spore diversity, and structure of the peristome and moss protonema

CO 3: Understand the diversity in gametophytic and sporophytic organization in Mosses, Liverworts and Hornworts

CO 4: Know the origin, phylogeny, evolution and fossil history of Bryophytes

**M.Sc. BOTANY SEMESTER II
PAPER V: PTERIDOPHYTES**

COURSE OBJECTIVES:

To acquire a deep understanding of the phylogeny, structural and functional diversity of Pteridophytes

COURSE OUTCOMES:

CO 1: Have a general concept of Pteridophytes with respect to their their classification, phylogenetic associations and ecological distribution

CO 2: Comprehend major evolutionary trends in Pteridophytes through cytological studies, stellar organization and Telome theory

CO 3: Understand alternation of generation within various forms, development of seed habit, and economic significance of Pteridophytes

CO 4: Gather knowledge about the geographical distribution, affinities and inter-relationships, morphology, anatomy and reproductive biology of fossil and living members of different groups of Pteridophytes

**M.Sc. BOTANY SEMESTER II
PAPER VI: GYMNOSPERMS AND PALAEOBOTANY**

COURSE OBJECTIVES:

To recognize fossil and living Gymnosperms, and identify their distribution, evolutionary trends, and phylogeny

COURSE OUTCOMES:

CO 1: Have a general concept of Gymnosperms regarding their classification, phylogenetic associations and economic importance

CO 2: Acquire knowledge about the morphology, anatomy and reproductive biology of Cycadopsida, Coniferopsida and Gnetopsida

CO 3: Understand the geographical distribution, evolutionary trends, affinities and inter-relationships among Cycadopsida, Coniferopsida and Gnetopsida

CO 4: Learn about fossils, their formation and role in stratigraphy

**M.Sc. BOTANY SEMESTER II
PAPER VII: ANGIOSPERMS: PLANT DEVELOPMENT AND REPRODUCTION**

COURSE OBJECTIVES:

To gain an insight into plant tissue differentiation, microsporogenesis, megasporogenesis, embryogenesis, and organ development

COURSE OUTCOMES:

CO 1: Have knowledge of differentiation, development and functions of different tissues

CO 2: Have an understanding of the morphological nature of the flower along with its development and evolutionary history

CO 3: Understand the concept of microsporogenesis, megasporogenesis, and the phenomenon of sexual incompatibility

CO 4: Have knowledge of fertilization and post fertilization changes leading to fruit and seed formation

CO 5: Have an understanding of the phenomenon of morphogenesis

M.Sc. BOTANY SEMESTER II
PAPER VIII: ANGIOSPERMS: TAXONOMY AND ECONOMIC BOTANY

COURSE OBJECTIVES:

To understand the taxonomy of Angiosperms, conservation of biodiversity, domestication and economic importance of crops

COURSE OUTCOMES:

CO 1: Have an idea of the principles and relevance of different classification systems and their phylogenetic significance

CO 2: Have a clear understanding of ethnobotany, geographical distribution of plant species, and importance of Herbaria, biodiversity hotspots, etc.

CO 3: Be well versed with the modern tools of taxonomy viz. morphological, anatomical, reproductive, cytological and chemical parameters

CO 4: Become aware of the distinguishing taxonomic features and interrelationships of selected Dicot and Monocot families

CO 5: Know the special features of Insectivorous/Parasitic and Saprophytic families of plants

CO 6: Understand the economic utility of plants

M.Sc. BOTANY SEMESTER III
PAPER I: CYTOGENETICS AND MOLECULAR GENETICS

COURSE OBJECTIVES:

To gain practical and theoretical knowledge of genome organization, molecular biology of the gene, inheritance, variability, and mutation

COURSE OUTCOMES:

CO 1: Have a comprehensive understanding of the structure and chemical basis of chromosome, and the physical basis of inheritance and heredity

CO 2: Have an understanding of linkage and crossing over and methods of mapping genes, and comprehend different mechanisms of inheritance, including Mendelian and non-Mendelian systems

- CO 3:** Understand the role of genetic mechanisms in evolution through practical demonstration of aberrations, mutation and polyploidy
- CO 4:** Learn about the molecular basis of inheritance through comprehensive knowledge of the structure, replication and function of DNA and RNA
- CO 5:** Learn about the regulatory mechanisms for gene expression in the cell, along with a detailed conceptualization of the cell cycle, genetic code and apoptosis

M.Sc. BOTANY SEMESTER III
PAPER II: PLANT BREEDING AND BIOSTATISTICS

COURSE OBJECTIVES:

To develop enhanced skills related to plant breeding, germplasm conservation, and learn about the utility of biostatistics in scientific studies

COURSE OUTCOMES:

- CO 1:** Be able to analyze the historical evolution of plant breeding and the key scientific and technical advances that have influenced its development
- CO 2:** Gain knowledge of the different plant reproductive systems and their effect on genetic variability, and understand the strategies and processes of selection and breeding based on the reproductive mechanisms
- CO 3:** Understand the importance of identifying genes, isolating them, determining their function and controlling their expression
- CO 4:** Be able to identify genetic variability, and also locate the genetic regions associated with traits of interest for breeding, and determining the connection between phenotypic and genetic variability
- CO 5:** Be able to use statistical methods to analyze results

M.Sc. BOTANY SEMESTER III
PAPER III: ENVIRONMENT, ECOLOGY AND PLANT-SOIL RELATIONSHIP

COURSE OBJECTIVES:

To understand inter-relationships of plants, ecology and environment

COURSE OUTCOMES:

- CO 1:** Be aware of the current issues related to different types of pollution and also the significance of indicator plants

- CO 2:** Have in-depth knowledge of environmental issues related to ozone depletion and air pollution leading to climate change
- CO 3:** Have knowledge of biotic responses to various environmental factors constituting the ecosystem
- CO 4:** Become aware of community and population dynamics along with principles of plant distribution
- CO 5:** Have knowledge of soil types and their properties along with method of soil formation

M.Sc. BOTANY SEMESTER III
PAPER IV: ANALYTICAL TECHNIQUES AND COMPUTER APPLICATIONS

COURSE OBJECTIVES:

To acquire practical and theoretical knowledge of computers, and pick up techniques for qualitative and quantitative analysis of macromolecules

COURSE OUTCOMES:

- CO 1:** Understand the principles and applications of several important analytical techniques used in the study of bio-molecules
- CO 2:** Acquisition of a hands-on knowledge of computers and software programs with applications in various spheres

M.Sc. BOTANY SEMESTER IV
PAPER V: PLANT PHYSIOLOGY

COURSE OBJECTIVES:

To gain an insight about hormones, photoperiodism and metabolic pathways involved in bioenergetics

COURSE OUTCOMES:

- CO 1:** Understand the significance of plant water relations, essentiality of mineral nutrients for plants growth and development
- CO 2:** Have complete insight into various perspectives of photosynthesis and the function of plants as primary producers of food
- CO 3:** Knowledge of how plants undergo respiration (respiratory pathways) and provide energy (oxidative phosphorylation) for food synthesis

CO 4: Gain an understanding of physiology of flowering in response to light and temperature, and understand the mechanisms developed by plants to overcome abiotic stress

CO 5: Be able to demonstrate proficiency in the experimental techniques and methods of analysis for various physiological processes

**M.Sc. BOTANY SEMESTER IV
PAPER VI: CELL BIOLOGY AND PLANT BIOCHEMISTRY**

COURSE OBJECTIVES:

To gather an in-depth understanding of cell biology, growth regulators, secondary metabolites and signaling pathways

COURSE OUTCOMES:

CO 1: Know about the structure and functions of carbohydrates, lipids, amino acids and proteins

CO 2: Have an understanding of assimilation of nitrogen and sulfur in plants

CO 3: Gain an insight into the functions of enzymes and growth hormones in plants

CO 4: Learn about the secondary metabolites found in plants, their structure, function and pathways of synthesis

**M.Sc. BOTANY SEMESTER IV
PAPER VII: BIOTECHNOLOGY AND HUMAN WELFARE**

COURSE OBJECTIVES:

To study the importance of biotechnology in our lives, and comprehend the range of associated technologies

COURSE OUTCOMES:

CO 1: Learn about culturing plants through *in vitro* micropropagation techniques

CO 2: Acquire knowledge about the techniques in molecular biology for creation of transgenic plants for disease resistance and crop improvement

CO 3: Learn about biotechnological approaches in pollution control and improvement of soil fertility

M.Sc. BOTANY SEMESTER IV
PAPER VIII: PROJECT (REVIEW/LITERATURE SURVEY BASED ON ALL PAPERS
FROM SEMESTERS I TO IV)

COURSE OBJECTIVES:

To master the skill of writing a comprehensive review on an allotted topic

COURSE OUTCOMES:

- CO 1:** Written, communication, and organizational skill development through a review of literature on topics from combined semesters
- CO 2:** Generate interest in research for higher studies and for a future in academics

2. M.Sc. ENVIRONMENTAL SCIENCE

PROGRAMME OUTCOMES (POs):

After completing the two years (Four Semesters) PG Programme (M.Sc.) in Environmental Science, the student would have:

- PO 1:** Acquired adequate knowledge about the relevance of environmental science
- PO 2:** Gathered insight into the functioning of an ecosystem
- PO 3:** Understood the significance of preserving and protecting biodiversity and environment
- PO 4:** Become informed about the current issues like global warming and climate change and the need for laws protecting the environment

PROGRAMME SPECIFIC OUTCOMES (PSOs):

- PSO1:** Produce quality human resource for preparing necessary road maps/plans for a sustainable use of natural resources
- PSO2:** Promote the concept of re-cycling and bio-conservation of agricultural waste so as to safe guard our planet
- PSO3:** Promote eco-tourism for enhancing socio-economy linked with forest ecosystems and wild life eco-zones
- PSO4:** Extend awareness amongst the people and society towards the necessity of keeping the environment healthy

COURSE STRUCTURE:

PAPER	PAPER TITLE	CREDITS	MM (30+70=100)
SEMESTER I			
I	The Earth and its Environment	4	100
II	Biotic Community and Dynamics	4	100
III	Biotic Responses I	4	100
IV	Biotic Responses II	4	100
Practical	Based on Papers I – IV	4	100
Elective	Choice based	3	100
SEMESTER II			
V	Abiotic Natural Resources	4	100
VI	Biotechnology and Agriculture	4	100
VII	Biotic Resources	4	100
VIII	Air Pollution	4	100

Project	Based on Papers V-VIII	4	100
Elective	Choice based	3	100
SEMESTER III			
I	Water and Soil Pollution	4	100
II	Radiation, Noise, Industrial and Thermal Pollution	4	100
III	Environmental Toxicology	4	100
IV	Environmental Policy and Management	4	100
Practical	Based on Papers I – IV & Academic Tour	4	100
Elective	Choice based	3	100
SEMESTER IV			
Project Dissertation		12	300
Project Presentation		4	100
Project Viva-Voce		4	100
Elective	Choice based	3	100
Total maximum marks and credits for all 4 semesters		92	2400

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER I
PAPER I: THE EARTH AND ITS ENVIRONMENT**

COURSE OBJECTIVES:

To comprehend environmental science, and the concept of atmosphere, lithosphere and hydrosphere

COURSE OUTCOMES:

- CO 1:** Understand the principles of Environmental Science, Biosphere resources, Energy Conservation and Energy crops
- CO 2:** Evaluate the physic-chemical properties of soil and the significance of soil formation
- CO 3:** Acquire information of the freshwater and marine environment and related terms
- CO 4:** Understand the projected global crisis with respect to non-renewable resources, and the need for identifying renewable sources for energy

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER I
PAPER II: BIOTIC COMMUNITY AND DYNAMICS**

COURSE OBJECTIVES:

To gain insight into an ecological niche, biotic communities and ecosystems

COURSE OUTCOMES:

- CO 1:** Gain knowledge of Ecosystem, population ecology, plant succession
- CO 2:** Understand the concept of ecotone, edge effect and ecological niche
- CO 3:** Appreciate the relevance of biogeochemical cycles operating in nature

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER I
PAPER III: BIOTIC RESPONSES I**

COURSE OBJECTIVES:

To keep abreast with aquatic environment, importance of wetlands and ecological adaptations of plants

COURSE OUTCOMES:

- CO 1:** Gather knowledge about habitat in general, and aquatic habitat in particular, along with their flora and fauna
- CO 2:** Learn about ecological adaptations of plants
- CO 3:** Understand the significance of wetlands and their abatement and restoration
- CO 4:** Gain information on the ecological engineering for remediation of wetlands

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER I
PAPER IV: BIOTIC RESPONSES II**

COURSE OBJECTIVES:

To acquire in depth knowledge of phyto-geographical zones, distribution of animals and plants in the biosphere and biotic responses to stress

COURSE OUTCOMES:

- CO 1:** Understand biogeographical realms and distribution of animals
- CO 2:** Recognize palaeobiogeography, phytogeography and Forest types
- CO 3:** Comprehend biomes and biotic responses to various environmental stresses
- CO 4:** Understand the functioning of signaling molecules

M.Sc. ENVIRONMENTAL SCIENCE SEMESTER II
PAPER V: ABIOTIC NATURAL RESOURCES

COURSE OBJECTIVES:

To evaluate and utilize geological and geographical distribution of mineral resources, strategies for water conservation and land management

COURSE OUTCOMES:

- CO 1:** Gain knowledge of geological distribution of natural and mineral resources
- CO 2:** Acquire knowledge of rocks, metallic and non-metallic mineral deposits
- CO 3:** Analyze and identify water and land management strategies
- CO 4:** Learn about factors affecting soil erosion, and soil and water conservation strategies

M.Sc. ENVIRONMENTAL SCIENCE SEMESTER II
PAPER VI: BIOTECHNOLOGY AND AGRICULTURE

COURSE OBJECTIVES:

To achieve competence in biotechnology procedures in agriculture, pros and cons concerning GM crop production

COURSE OUTCOMES:

- CO 1:** Recognize the diverse agricultural practices in India, and identify threats to sustainable agriculture
- CO 2:** Awareness regarding organic farming, slow release fertilizer and GM crops
- CO 3:** Knowledge about tissue culture technique in agriculture and floriculture
- CO 4:** Understand techniques and principles related to bioconversion of agricultural waste, vermin-composting and biogas generation
- CO 5:** Recognize the necessity of gene pool protection and greener genetic engineering

M.Sc. ENVIRONMENTAL SCIENCE SEMESTER II
PAPER VII: BIOTIC RRESOURCES

COURSE OBJECTIVES:

To develop procedures and study designs for biodiversity and its conservation, eco-friendly approaches to exploitation of forest resources

COURSE OUTCOMES:

- CO 1:** Gain knowledge of forest cover and its depletion, green designing, social forestry and agro forestry
- CO 2:** Understand the technology behind fish farming, silviculture and bee farming
- CO 3:** Learn the methods of conservation of biodiversity, and understand the importance of hotspots, Biosphere reserves, wild life sanctuaries and national parks
- CO 4:** Recognize the significant role of NGOs, Tribals, IUCN and red data book
- CO 5:** Comprehend the role of National Forest Policy, Forest Protection Act and Wildlife Protection Act

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER II
PAPER VIII: AIR POLLUTION**

COURSE OBJECTIVES:

To develop skilled approaches in mitigating environmental pollution

COURSE OUTCOMES:

- CO 1:** Recognize the problems associated with environmental pollution and methods for preventing it
- CO 2:** Understand the effects of global warming, climate change, green house gases, ozone layer depletion and acid rain
- CO 3:** Health concerns due to air borne microbes, dust and pollen allergies, and their prevention

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER III
PAPER I: WATER AND SOIL POLLUTION**

COURSE OBJECTIVES:

To develop techniques for soil and water pollution and methods for remediation of pollutants

COURSE OUTCOMES:

- CO 1:** Understand the reasons and consequences of water pollution

CO 2: Learn about water sampling techniques, and recognize the importance of determining water quality standard and management of water pollutants

CO 3: Knowledge about soil pollution and types of pollutants

CO 4: Concept and significance of bioremediation and phytoremediation

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER III
PAPER II: RADIATION, NOISE, INDUSTRIAL AND THERMAL POLLUTION**

COURSE OBJECTIVES:

To gain knowledge about various forms of pollution such as radiation, noise, industrial and thermal pollution, and their management

COURSE OUTCOMES:

CO 1: Gain an insight into radiation pollution, radiation hazards, and the protective measures taken to counter it

CO 2: Gain information on various types of industrial, thermal and noise pollution, its impact on the environment, flora and fauna; and learn methods of mitigating the immense problem of pollution

CO 3: Describe types of solid waste, and management of landfill sites through plantation

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER III
PAPER III: ENVIRONMENTAL TOXICOLOGY**

COURSE OBJECTIVES:

To develop skills to handle hazardous chemicals in the environment and their biotransformation into harmless substances

COURSE OUTCOMES:

CO 1: Insight into mutagenic and carcinogenic agents

CO 2: Understand toxicity due to chemical pesticides, and methods of testing the levels of toxicity, biotransformation and antidotal therapy

CO 3: Learn about heavy metal toxicity and microbial toxins

CO 4: Recognize the importance of Biostatistics and learn about various methods of data presentation

CO 5: Evaluate the ill effects of tobacco chewing and smoking

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER III
PAPER IV: ENVIRONMENTAL POLICY AND MANAGEMENT**

COURSE OBJECTIVES:

To formulate environmental policies and national movements, applications of remote sensing

COURSE OUTCOMES:

CO 1: Understand environmental priorities in India, environmental education programmes, remote sensing and GIS and eco-auditing

CO 2: Gain an insight into environmental disasters, and methods for managing biomedical and e-waste

CO 3: Recognize the significance of National efforts for environmental management, National movements, Environmental Impact Assessment guidelines and International Environmental Laws

**M.Sc. ENVIRONMENTAL SCIENCE SEMESTER IV
INTERNSHIP**

COURSE OBJECTIVES:

To acquire practical knowledge and skills through a project work carried out at an established Institutes/industry

COURSE OUTCOMES:

CO 1: Develop independent and critical thinking, together with learning to appreciate the importance of team work

CO 2: Acquire skills and understanding related to environment, and hone problem-solving ability

CO 3: Evaluate and improve upon communication, thesis writing and data presentation skills

3. M.Sc. PLANT SCIENCE

PROGRAMME OUTCOMES (POs):

After completing the two years (Four Semesters) PG Programme (M.Sc.) in Plant Science the student would have:

- PO 1:** Acquired an in-depth knowledge about plants and related techniques, enabling a career in teaching and research
- PO 2:** Become critical thinkers with novel ideas and an ability to usher in a new era of self sufficiency
- PO 3:** Gathered the necessary communication skills through presentations and interactions in class
- PO 4:** Become adept at problem-solving with a clear vision of the present demands

PROGRAMME SPECIFIC OUTCOMES (PSOs):

- PSO1:** Generate a thorough understanding of the various groups of plants and microorganisms, both cellular and acellular
- PSO2:** Enable students to develop an interest in nature, botanical gardens and herbaria
- PSO3:** Create awareness about conservation of biodiversity and sustainable use of plant resources
- PSO4:** Acquire skills and practical knowledge related to plant sciences so as to render help in the spheres of biotechnology and study of the flora when needed

COURSE STRUCTURE:

PAPER	PAPER TITLE	CREDITS	MM (30+70=100)
SEMESTER I			
I	Microbiology (Bacteriology, Virology) and Microbial Biotechnology	4	100
II	Mycology & Plant Pathology	4	100
III	Algology, Lichenology, Microscopy and Culture Techniques	4	100
IV	Bryology	4	100
Practical	Based on Papers I – IV	4	100
Elective	Choice based	3	100
SEMESTER II			
V	Pteridophytes	4	100

VI	Gymnosperms and Palaeobotany	4	100
VII	Plant Development and Reproduction	4	100
VIII	Plant Systematics and Economic Botany	4	100
Practical	Based on Papers V – VIII (including local excursion)	4	100
Elective	Choice based	3	100
SEMESTER III			
I	Cytology, Genetics and Molecular Genetics	4	100
II	Crop Improvement and Biostatistics	4	100
III	Environment, Ecology and Plant Soil Relationship	4	100
IV	Experimental Techniques and Computer application	4	100
Practical	Based on Papers I-IV	4	100
Elective	Choice based	3	100
SEMESTER IV			
V	Plant Physiology	4	100
VI	Cell Biology and Plant Biochemistry	4	100
VII	Biotechnology and Human welfare	4	100
VIII	Project (Review based on all Papers from Semester I - IV)	4	100
Practical	Based on Papers VI-VIII (Including Lab visit)	4	100
Elective	Choice based	3	100
Total maximum marks and credits for all 4 semesters		92	2400

**M.Sc. PLANT SCIENCE SEMESTER I
PAPER I: MICROBIOLOGY (BACTERIOLOGY, VIROLOGY) AND
MICROBIAL BIOTECHNOLOGY**

COURSE OBJECTIVES:

To understand the diversity of Bacteria, Archaea and the acellular Plant Viruses and Viroids, along with their impact and role in environment, medicine, agriculture and biotechnology

COURSE OUTCOMES:

- CO 1:** Gather in-depth information on the phylogenetic classification of prokaryotes, cellular organization and functioning of prokaryotic cells, DNA replication and methods of genetic recombination, and strategies for gene expression in bacteria
- CO 2:** Understand the diverse metabolic capabilities of microbes, applications of microbes in biotechnology, and mode of action of antibiotics and the mechanism of resistance to antibiotics
- CO 3:** Acquire knowledge about the classification of viruses, their structural organization, properties, transmission characteristics, and biochemistry of host-virus interactions

- CO 4:** Understand viroids and viral infection cycles, genome expression strategies of viruses, phage diversity and the working of the genetic switch in lambda phage
- CO 5:** Learn the underlying principles and the procedures involved in virus purification, serological and nucleic acid hybridization, diagnosis and control of plant viruses, and recombinant DNA technology

**M.Sc. PLANT SCIENCE SEMESTER I
PAPER II: MYCOLOGY & PLANT PATHOLOGY**

COURSE OBJECTIVES:

To get a general idea of classification of fungi, comparative morphology and life cycle patterns, plant pathology and disease control methods

COURSE OUTCOMES:

- CO 1:** Acquire information on prevalent schemes of classification of fungi and fungal-like organisms, and general features of fungi
- CO 2:** Comparison of structure and life cycle patterns of selected fungi and fungal-like organisms
- CO 3:** Understand the principles of plant pathology and host-pathogen interactions, fungal disease symptoms and their management
- CO 4:** Gain an idea about plant diseases caused by nematodes and abiotic factors

**M.Sc. PLANT SCIENCE SEMESTER I
PAPER III: ALGOLOGY, LICHENOLOGY, MICROSCOPY AND CULTURE
TECHNIQUES**

COURSE OBJECTIVES:

To learn about the schemes of classification and general features of Algae, distribution and importance of lichen diversity, and culture methods related to these groups

COURSE OUTCOMES:

- CO 1:** Information on classification and general features of Algae, including fossil algae
- CO 2:** Learn about the phylogenetic relationships amongst various groups of Algae
- CO 3:** Gather an insight into the thallus organization, cell structure, reproduction, and life cycle patterns exhibited by different Algae

CO 4: Understand the classification, structure, distribution, reproduction and importance of lichens

CO 5: Learn techniques and methods pertaining to microscopes and cell culture

**M.Sc. PLANT SCIENCE SEMESTER I
PAPER IV: BRYOLOGY**

COURSE OBJECTIVES:

To gain an insight into the diversity, origin, phylogeny, evolution and fossil history of Bryophytes, and study the thallus organization and reproduction in specific Mosses, Liverworts and Hornworts

COURSE OUTCOMES:

CO 1: Acquaint with the classification, ecological and general features, physiology and reproductive biology of Bryophytes

CO 2: An in-depth account of the spore diversity, structure of peristome and moss protonema

CO 3: Promote interest in the diversity encountered in the gametophytic and sporophytic organization in Mosses, Liverworts and Hornworts

CO 4: Learn about the origin, phylogeny, evolution and fossil history of Bryophytes

**M.Sc. PLANT SCIENCE SEMESTER II
PAPER V: PTERIDOPHYTES**

COURSE OBJECTIVES:

To develop a deep understanding of the classification, evolutionary trends, distribution patterns, morphology, anatomy and reproductive biology of fossil and living forms of Pteridophytes

COURSE OUTCOMES:

CO 1: Gain in-sight into the phylogeny, and ecological distribution of Pteridophytes, and recognize the major evolutionary trends within Pteridophytes

CO 2: Learn about the morphology, anatomy and reproductive biology of fossil and living members of different groups of Pteridophytes

CO 3: Comprehend alternation of generation within various forms, and the significance of seed habit

CO 4: Appreciate the economic importance of Pteridophytes

M.Sc. PLANT SCIENCE SEMESTER II
PAPER VI: GYMNOSPERMS AND PALAEOBOTANY

COURSE OBJECTIVES:

To comprehend the evolutionary trends, affinities and inter-relationships, geographical distribution, morphology, anatomy and reproductive biology of Gymnosperms

COURSE OUTCOMES:

- CO 1:** Have a general concept of gymnosperms with respect to their classification, phylogenetic associations and economic importance
- CO 2:** Recognize evolutionary trends, geographical distribution, affinities, inter-relationships, morphology, and anatomy of different orders of Cycadopsida, Coniferopsida and Gnetopsida
- CO 3:** Learn about fossils, their formation and role in stratigraphy

M.Sc. PLANT SCIENCE SEMESTER II
PAPER VII: PLANT DEVELOPMENT AND REPRODUCTION

COURSE OBJECTIVES:

To understand the differentiation and development of different plant organs and specialized structures

COURSE OUTCOMES:

- CO 1:** Understand meristems and their differentiation into various tissues, differentiation and development of different plant organs and specialized structures
- CO 2:** Recognize the morphological nature of the flower, and study its development and evolutionary history
- CO 3:** Understand the phenomenon of microsporogenesis and megasporogenesis, and the phenomenon of sexual incompatibility
- CO 4:** Learn about fertilization and post fertilization changes leading to fruit and seed formation
- CO 5:** Have an understanding of morphogenesis

M.Sc. PLANT SCIENCE SEMESTER II
PAPER VIII: PLANT SYSTEMATICS AND ECONOMIC BOTANY

COURSE OBJECTIVES:

To learn about the taxonomy of Angiosperms, phytogeographic zones, and relevance of ethnobotany and economic botany

COURSE OUTCOMES:

- CO 1:** Understand the significance of different systems of classification, from the earliest, to the most recent one, based on molecular phylogeny, and learn about the relevance of herbaria, botanical gardens and conservation of biodiversity
- CO 2:** Become well versed with the criteria for taxonomy viz. morphological, anatomical, reproductive, cytological and chemical parameters
- CO 3:** Exhaustive information on the distinguishing features and inter-relationships of selected Dicot and Monocot families
- CO 4:** Acquire knowledge on the origin and domestication of crop plants, economic importance of plants and understand special categories of plants based on their nutritional requirements, such as insectivorous, parasitic and saprophytic plants

M.Sc. PLANT SCIENCE SEMESTER III PAPER I: CYTOLOGY, GENETICS & MOLECULAR GENETICS

COURSE OBJECTIVES:

To comprehend the structure and composition of chromosomes, basis of inheritance and heredity, gene expression and apoptosis

COURSE OUTCOMES:

- CO 1:** Comprehensive knowledge of the structural and chemical organization of chromosome, concept of alleles, linkage and crossing over
- CO 2:** Understanding of the physical basis of inheritance and heredity, cytoplasmic inheritance and population genetics
- CO 3:** Understand different mechanisms of inheritance, including Mendelian and non-Mendelian systems
- CO 4:** Recognize the molecular basis of mutation and its role in evolution
- CO 5:** Learn about the regulation of gene expression in the cell, cell cycle and significance of apoptosis

M.Sc. PLANT SCIENCE SEMESTER III
PAPER II: CROP IMPROVEMENT AND BIOSTATISTICS

COURSE OBJECTIVES:

To understand the necessity and the principle of plant breeding, technical and molecular advances in this area, and biostatistics as a tool

COURSE OUTCOMES:

- CO 1:** Analyze the historical evolution of plant breeding and the key scientific and technical advances that have influenced its development
- CO 2:** Recognize the role of pure line selection, polyploidy, mutation, and somatic hybridization in plant breeding
- CO 3:** Identify genes of interest for breeding, and carry out marker assisted selection for generation of desirable hybrids
- CO 4:** Understand the use of statistical methods in plant breeding

M.Sc. PLANT SCIENCE SEMESTER III
PAPER III: ENVIRONMENT, ECOLOGY AND PLANT SOIL RELATIONSHIP

COURSE OBJECTIVES:

To have in-depth knowledge of soil science and environmental issues

COURSE OUTCOMES:

- CO 1:** Awareness of issues related to environmental pollution, and significance of indicator plants
- CO 2:** Comprehensive understanding of ecosystems and their functioning
- CO 3:** Knowledge of phyto-geographic zones, community characteristics and population dynamics
- CO 4:** In-depth understanding of the process of soil formation, its properties and types. Along with an idea of the soil fertility parameters and its testing

M.Sc. PLANT SCIENCE SEMESTER III
PAPER IV: EXPERIMENTAL TECHNIQUES & COMPUTER APPLICATION

COURSE OBJECTIVES:

To understand plant physiology, water relations, essentiality of mineral nutrients for plants growth and development, and related techniques

COURSE OUTCOMES:

- CO 1:** Understand the techniques of growing/culturing plants in sand and water
- CO 2:** Recognize the principle, instrumentation, procedure and applications of centrifugation, chromatography and spectrophotometry
- CO 3:** Comprehend techniques that are employed in the analysis of nucleic acids and proteins such as electrophoresis, sequencing, and DNA/RNA/protein transfers and detection
- CO 4:** A basic knowledge of computers, operating systems and usage of MS office

**M.Sc. PLANT SCIENCE SEMESTER III
PAPER V: PLANT PHYSIOLOGY**

COURSE OBJECTIVES:

To learn about the structure and functions of carbohydrates, lipids, amino acids and proteins, secondary metabolites, hormones

COURSE OUTCOMES:

- CO 1:** Recognize the significance of plant water relations and the role of mineral nutrients in plant growth and development
- CO 2:** In-depth understanding of the phenomenon of photosynthesis, pathways of carbon dioxide assimilation, and energy generation
- CO 3:** Knowledge of respiratory pathways operating in plants, and the principle behind oxidative phosphorylation
- CO 4:** Comprehensive understanding of physiological changes in plants growing under varied stressed conditions
- CO 5:** Understand physiology of flowering in response to light and temperature, and nitrogen metabolism

**M.Sc. PLANT SCIENCE SEMESTER III
PAPER VI: CELL BIOLOGY AND PLANT BIOCHEMISTRY**

COURSE OBJECTIVES:

To gain knowledge of the structural and functional aspects of the cellular components,

bioinformatics and cellular signaling

COURSE OUTCOMES:

- CO 1:** Comprehensive account of the cellular organization and functioning, ion uptake and role of membrane transport proteins
- CO 2:** In-depth understanding of the structure, synthesis and mode of action of plant growth hormones
- CO 3:** Knowledge about the macromolecules and the synthesis and functions of secondary metabolites
- CO 4:** Learn about enzymes, their classification and catalytic function, and understand the signaling molecules and the signal transduction pathways

**M.Sc. PLANT SCIENCE SEMESTER III
PAPER VII: BIOTECHNOLOGY AND HUMAN WELFARE**

COURSE OBJECTIVES:

To understand the importance of biotechnology and its applications in our lives

COURSE OUTCOMES:

- CO 1:** Understand the techniques related to cell and tissue culture, generation of haploids and somatic hybrids
- CO 2:** In-depth understanding of the principles and techniques related to recombinant DNA technology
- CO 3:** Understanding applications of biotechnology in bioremediation, degradation of xenobiotics and toxic substances, production of GMOs and transgenic plants, for improving soils, disease resistance and crop improvement

**M.Sc. PLANT SCIENCE SEMESTER III
PAPER VIII: PROJECT (REVIEW BASED ON ALL PAPERS FROM
SEMESTER I - IV)**

COURSE OBJECTIVES:

To submit a review on an assigned topic of interest in plant science from combined semesters in order to develop writing skills and acquaint with related methodology

To master the skill of writing a comprehensive review on an allotted topic, and to visit Research Institutes and labs followed by a report submission to gauge the scientific interest and understanding of the student

COURSE OUTCOMES:

CO 1: Development of written, communication, presentation, and organizational skills

CO 2: Generate enthusiasm in research and prepare for a future in academics

4. M.Sc. MICROBIOLOGY

PROGRAMME OUTCOMES (POs):

After completing the two years (Four Semesters) PG Programme (M.Sc.) in Microbiology, the students would have:

- PO 1:** Gathered substantive knowledge that prepares post graduates for careers in areas of Biochemistry, Medical Microbiology, Environmental and Food Sciences, Molecular Biology and Biotechnology
- PO 2:** Developed an exploratory mind-set along with problem-solving and analytical skills, to enable a smooth progression into the area of research and teaching
- PO 3:** Accumulated skills such as critical scientific thinking needed for data analysis
- PO 4:** Received training in the preparation of a Dissertation from the Internship in the last Semester, designed as a vital, gainful component of practical training for the students

PROGRAMME SPECIFIC OUTCOMES (PSOs):

- PSO1:** Exploration of the diversity of the microbial world, the structure and function of microbes/microbial cells
- PSO2:** Adept at a multitude of techniques involved in microbial study, ranging from culture and microscopy to molecular
- PSO3:** Understand the role of microbes in evolution and life on earth, importance of microbes in natural environments and microbial ecosystems
- PSO4:** Appreciate the impact of microbes in biotechnology, industry, agriculture, health and medicine

COURSE STRUCTURE:

PAPER	PAPER TITLE	CREDITS	MM (30+70=100)
SEMESTER I			
I	Techniques and Tools in Microbiology	4	100
II	Microbial Diversity	4	100
III	Cell Structure	4	100
IV	Microbial Genetics	4	100
Practical	Based on Papers I-IV	4	100
Elective	Choice based	3	100
SEMESTER II			
I	Microbial Physiology and Biochemistry	4	100

II	Molecular Biology and Genetic Engineering	4	100
III	Plant Virology	4	100
IV	Medical Microbiology and Immunology	4	100
Practical	Based on Papers I-IV	4	100
Elective	Choice based	3	100
SEMESTER III			
I	Environmental Microbiology	4	100
II	Industrial and Food Microbiology	4	100
III	Biostatistics and Computer Applications	4	100
IV	Microbial Biotechnology	4	100
Practical	Based on Papers I-IV	4	100
Elective	Choice based	3	100
SEMESTER IV			
Project Dissertation		4	100
Project Presentation		4	100
Project Viva-Voce		4	100
Elective	Choice based	3	100
Total maximum marks and credits for all 4 semesters		92	2400

**M.Sc. MICROBIOLOGY SEMESTER I
PAPER I: TECHNIQUES AND TOOLS IN MICROBIOLOGY**

COURSE OBJECTIVES:

To identify principles and techniques commonly applied in microbiology, biochemistry and molecular biology

COURSE OUTCOMES:

- CO 1:** Learn the concept of sterile techniques for isolation of microbes in pure culture, and understand the principles of optical microscopy including generation of contrast
- CO 2:** Gain knowledge about the instrumentation, working principle and applications of varied forms of spectroscopy needed to study bio-molecules and crystal structures
- CO 3:** Understand chromatographic techniques for separation of bio-molecules
- CO 4:** Understand the working principle behind electrophoresis, and study of antigen-antibody interactions, including applications for the identification of microbes
- CO 5:** Learn centrifugation techniques, and forms of electron microscopy for the purification and characterization of microorganisms

**M.Sc. MICROBIOLOGY SEMESTER I
PAPER II: MICROBIAL DIVERSITY**

COURSE OBJECTIVES:

To compare and study classification, structure and pathogenic aspects of selected microorganisms

COURSE OUTCOMES:

- CO 1:** Gain insight into the bacterial and archaeal diversity, in a morphological and phylogenetic context
- CO 2:** Know how to classify and compare the morphological and genomic characteristics of plant viruses
- CO 3:** Comprehend the diversity of fungi and algae along with their comparative structure and classification
- CO 4:** Understand the characteristics of pathogenic nematode and protozoa
- CO 5:** Acquaint with the pathogenic aspects of the various groups of microorganisms, their disease cycles and control measures

**M.Sc. MICROBIOLOGY SEMESTER I
PAPER III: CELL STRUCTURE**

COURSE OBJECTIVES:

To study the principles of microbial growth and its measurement, and to learn about the prokaryotic and eukaryotic cellular organization

COURSE OUTCOMES:

- CO 1:** Compare and contrast prokaryotic and eukaryotic cell structure and function
- CO 2:** Know the structure and role of cell components such as cell wall, cell membrane, and cell organelles
- CO 3:** Learn about microbial growth, factors affecting microbial growth, and methods for its measurement
- CO 4:** Get an overview of microbial cell cycle and movement in response to external stimuli

**M.Sc. MICROBIOLOGY SEMESTER I
PAPER IV: MICROBIAL GENETICS**

COURSE OBJECTIVES:

To describe genome organization, genetic switch, principles of gene assortment, DNA repair and mutation

COURSE OUTCOMES:

- CO 1:** Understand the concept of Mendelian inheritance, genetic linkage and crossing over
- CO 2:** Comprehend the molecular basis of mutations and mechanisms of DNA repair
- CO 3:** Understand the organization of the bacterial chromosome, plasmid, eukaryotic genome, and the mechanism of DNA replication
- CO 4:** Learn about the bacteriophage diversity and replication pathways of virulent and temperate phages, and manipulation of the genetic switch in bacteriophage Lambda
- CO 5:** Compare and contrast the stages in mitotic and meiotic cell division, and the mechanisms of genetic recombination in bacteria

**M.Sc. MICROBIOLOGY SEMESTER II
PAPER I: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**

COURSE OBJECTIVES:

To discuss the fundamentals of microbial physiology and biochemistry

COURSE OUTCOMES:

- CO 1:** Understand the structure of macromolecules and their basic building blocks
- CO 2:** Gain an in-sight into the mechanisms of ATP generation by microbes, and importance of heterotrophic metabolism, fermentation and chemolithotrophy
- CO 3:** Learn the generation of ATP in a light driven process and pathways of CO₂ fixation by phototrophic microorganisms, along with biological nitrogen fixation
- CO 4:** Understand the catalytic function of enzymes, their classification and regulation, and factors affecting enzyme activity

M.Sc. MICROBIOLOGY SEMESTER II
PAPER II: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

COURSE OBJECTIVES:

To gain an insight into molecular biology of the gene and its regulation, and its application through recombinant DNA technology

COURSE OUTCOMES:

- CO 1:** Understand the regulation of transcription through the various operons, and the mechanics of translation in bacteria
- CO 2:** Know about enzymes, vectors and cloning strategies in genetic manipulation
- CO 3:** Understand the protocol for cloning of a DNA fragment in a plasmid vector, transformation of bacterial cells and screening of cDNA libraries to identify a clone of interest
- CO 4:** Learn techniques in molecular biology such as PCR, RFLP and DNA microarray that are useful in diagnosis
- CO 5:** Learn about recombinant DNA technology and methods of DNA sequencing

M.Sc. MICROBIOLOGY SEMESTER II
PAPER III: PLANT VIROLOGY

COURSE OBJECTIVES:

To describe structure, classification, genome organization, and pathogenicity of plant viruses

COURSE OUTCOMES:

- CO 1:** Understand the basic principles of virology, and the structural diversity of plant viruses
- CO 2:** Understand the genetic diversity of viruses and the contrasting replication strategies of viruses possessing an RNA or a DNA genome
- CO 3:** Learn about the transmission characteristics of the viruses at the molecular level, and understand the genetic basis of host responses to virus infection
- CO 4:** Understand the concept of sub-viral pathogens, and methods of plant virus control, both conventional and modern

CO 5: Understand the biology of viroids, and study symptomatology and pathology of diverse plant viruses

M.Sc. MICROBIOLOGY SEMESTER II
PAPER IV: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

COURSE OBJECTIVES:

To learn about microbes in relation to human health and disease, and understand the essentials of immunology

COURSE OUTCOMES:

CO 1: Understand pathogenesis and the role of toxins, enzymes and host factors in infection and disease

CO 2: Gain information on diseases caused by diverse microorganisms with emphasis on emerging diseases and pandemics

CO 3: Get an overview of immunology with a detailed account of molecular and cellular interactions that control innate and adaptive immunity

CO 4: Understand the concept of autoimmunity, hypersensitive and allergic responses of the host and to learn methods of inducing immunity against the pathogen in the host

CO 5: Learn about the oncogenic viruses and cell transformation, and understand the importance of antimicrobial agents and drug resistance

M.Sc. MICROBIOLOGY SEMESTER III
PAPER I: ENVIRONMENTAL MICROBIOLOGY

COURSE OBJECTIVES:

To study the role played by microorganisms in our ecosystem, with special reference to microbiology of air, water and soil

COURSE OUTCOMES:

CO 1: Understand biomes, ecosystems, ecological pyramids and trophic levels in food chains and food webs

CO 2: Learn about the diversity of microbes in aquatic environments, factors affecting their growth, and water-borne diseases caused by infectious microbes

- CO 3:** Understand the concept of oxygen demanding wastes through BOD and COD, water pollution and its remediation, and waste management
- CO 4:** Define remarkable role of microbes in cycling of nutrients, and study species interactions and associations in soil affecting physiology and growth of plants
- CO 5:** Learn about microbes thriving in harsh environments, microbial blooms and their adverse effects, and methods of sampling air borne microbes

**M.Sc. MICROBIOLOGY SEMESTER III
PAPER II: INDUSTRIAL AND FOOD MICROBIOLOGY**

COURSE OBJECTIVES:

To evaluate application of microbes in food industry and methods of preventing food spoilage
Microorganisms

COURSE OUTCOMES:

- CO 1:** Understand industrial fermentation, manipulation of microbial strains, and techniques for producing optimal product
- CO 2:** Learn of the valuable products obtained from industrially important microbes
- CO 3:** Know about the ubiquitous presence of microbes, hence contamination of food items and food spoilage, and factors affecting their growth
- CO 4:** Know the physical and chemical techniques utilized worldwide in food preservation
- CO 5:** Learn about diseases caused by contaminated food stuffs and the lab tests for detecting the causal

**M.Sc. MICROBIOLOGY SEMESTER III
PAPER III: BIOSTATISTICS AND BIOINFORMATICS**

COURSE OBJECTIVES:

To relate computer basics, statistical concepts and bioinformatics in microbiology

COURSE OUTCOMES:

- CO 1:** Understand statistical concepts of population size, sample design, sampling methods and the significance of the results emerging from data analysis
- CO 2:** Learn how to determine correlation, standard statistical distributions and learn of their uses

- CO 3:** Understand the basic working of computers, input-output devices, and data storage
- CO 4:** Learn how to fetch and align amino acid and nucleotide sequences and correlate it with molecular phylogeny
- CO 5:** Learn to explore the biological databases for protein and nucleotide sequences, understand standard deviation and statistical significance

**M.Sc. MICROBIOLOGY SEMESTER III
PAPER IV: MICROBIAL BIOTECHNOLOGY**

COURSE OBJECTIVES:

To understand the importance of microbial biotechnology in agriculture, pharmaceutical and food industries

COURSE OUTCOMES:

- CO 1:** Learn the protocols for production of valuable pharmaceutical products utilizing microbes and recombinant DNA technology
- CO 2:** Understand the role of microbes in food industry, development of GMOs and the related concerns, and application of microbes in improving soil fertility
- CO 3:** Learn about the impact of microbes on habitat modification, microbial mining, and biodegradation of harmful waste
- CO 4:** Understand the role of microbes and GMOs in cleaning oil spills and understand the concerns associated with release of Bt cotton

**M.Sc. MICROBIOLOGY SEMESTER IV
INTERNSHIP**

COURSE OBJECTIVES:

To apply the knowledge gained in the previous three semesters in specific areas of interest in a problem solving environment; gaining bench-experience, to serve as a springboard for a professional future. Internship is to be carried out by the students in various recognized/established labs of Other Universities, of Institutes under CSIR, ICMR, IIT, ICAR, DST, DBT, and of Industry etc. (to be arranged by the students themselves, including whatever expenses become due in this regard).

COURSE OUTCOMES:

CO 1: Enhanced practical and theoretical knowledge of the activity spectrum of the microorganisms

CO 2: Improved critical thinking and problem solving ability

CO 2: Effective analysis of data and results, and enhanced skills related to oral communication, thesis writing and data presentation

CO 4: Generation of sufficient interest to foray into related areas of research