

# Two Year M.Sc. Programme in Biotechnology

## PROGRAM OUTCOMES (PO)

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Upon completion of the Post Graduate programme, the students will be able to achieve the following outcomes:

**PO1: Profound Professional Knowledge:** Obtain proficiency to maneuver in diverse context of the advance subject knowledge.

**PO2: Critical Thinking and Analysis:** Attain the analytical expertise to create, analyse, formulate, and solve challenging problems.

**PO3: Environment and sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO4: Research and Innovation:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Effective Communication:** Demonstrate skills such as effective communication, decision making, problem and adapt ability to create technical writing.

**PO6: Problem Solving:** Understand, interpret, explain, analyse and assess the tools, techniques, models and methodologies to solve problems.

**PO7: Employability:** Demonstrate skills for doctoral, post-doctoral education, professional development and employability.

**PO8: Advance tools and techniques:** Attain ability to work with advanced IT tools and techniques in their domain.

**PO9: Social Consciousness:** Acquire awareness towards gender, environment, sustainability, human values and professional ethics and understand the difference between acting, responding and reacting to various social issues

**PO10: Nation Building:** Introspect and evolve into dynamic and creative individuals capable of socially productive, constructive actions that positively impact our Nation and the World at large

## **PROGRAM SPECIFIC OUTCOMES (PSO)**

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Upon completion of the M.Sc. in Biotechnology program, the students will attain the ability to:

**PSO1:** Acquire competencies in theoretical as well as experimental Biotechnology in order to enhance knowledge in the applied aspect of the subject related to the welfare/development of society.

**PSO2:** Apply written and oral communication skills to communicate effectively in healthcare, industry, academia and research.

**PSO3:** Develop aptitude for research in bio-science at molecular level and its interdisciplinary areas.

**PSO4:** Compete for employment in academia, agriculture, horticulture and need based industry with the biotechnological skills.

**PSO5:** Produce entrepreneurs who can develop sustainable solutions in mushroom cultivation and small scale biofertilizer production.

**PSO6:** Apply responsibilities to promote societal health and safety, upholding the trust given to the profession by the society and develop skills, attitude and values required for self-directed, lifelong learning and professional development.

**PSO7:** Acquire awareness towards gender, environment, sustainability, human values, and professional ethics and understand the difference between acting, responding, reacting to various social issues.

## **COURSE OUTCOME (CO)**

### **MBT CC101: Cell & Molecular Biology and Genetics (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

- CO1:** Describe the concept of cell organization, the concept of biomembrane system, and transport across different cells.
- CO2:** Describe the cell cycle and its control mechanism. To understand the basics of cancer oncogenes and suppressor genes.
- CO3:** Understand the concept of DNA replication in Prokaryotes and Eukaryotes, DNA damage and repair mechanism; Transcription in Prokaryotes and Eukaryotes; Regulatory elements and DNA binding domains of transcription apparatus; Processing of primary transcript and RNA editing in eukaryotes.
- CO4:** Describe the mechanism of Gene Regulation in Prokaryotes and Eukaryotes.
- CO5:** Describe the Antisense technology and its application. Mutation and its application and extra-chromosomal inheritance.

### **MBT CC102: Microbiology (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

- CO1:** Describe the history and scope of microbiology, Sterilization and its type, preservation methods, staining methods, microbial growth kinetics and classification of microbes.
- CO2:** Describe diversity of bacteria, Archaea and detailed structure of bacteria.
- CO3:** Describe general features of Fungi, protozoa, slime mold, viruses, viroids & prions.
- CO4:** Describe host-pathogen relationship and different microbial diseases and its causative agent, and its pathogenesis.

**CO5:** Describe types of antibiotics and its mode of action, nitrogen metabolism and symbiotic nitrogen fixation mechanism.

## **MBT CC103: Biomolecules and Basic Enzymology (5 Credits)**

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### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Understand the concept of pH, pK , acid bases, and carbohydrates structure and function

**CO2:** Develop knowledge of Amino acids Structure, function and classification and types of protein structure

**CO3:** Describe the classification, structure, properties and function of lipids and nucleic acid.

**CO4:** Understand Ribozyme technology and its application, Immobilization of enzymes, methods and its industrial application.

**CO5:** Develop knowledge of Enzyme kinetics, allosteric regulations.

## **MBT CC104: Practical (Based on MBT CC101, 102, 103) (5 credits)**

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### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Understand the different stages of the cell cycle and working knowledge of cell counting by hemocytometer

**CO2:** Hands-on understanding of work with microbial culture, media preparation, sterilization, staining techniques & identification of microbes by different biochemical tests

**CO3:** Gain knowledge of the growth curve of bacteria and the effects of different parameters on its growth.

**CO4:** Acquire knowledge of standard graph preparation by measuring optical density, working with protein, and its purification.

**CO5:** Hands-on experience with instruments such as a spectrophotometer, SDS PAGE gel electrophoresis, and column chromatography.

### **Ability Enhancement Compulsory Course (5 Credits Each)**

#### **MAECC101: Environmental Sustainability & Swachh Bharat Abhiyan Activities**

##### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Understand the sustainable development and ecosystem and discuss the environmental pollution, climate change, ozone layer depletion, threats of encroachment on habit and habitat of flora and fauna.

**CO2:** Understand biodiversity and its conservation, three 'R', environmental education, awareness program and ecological economics.

**CO3:** Understand the importance of swachhata, sanitation and hygiene. Describe the Gandhian approach towards social and environmental moral values.

**CO4:** Study the case of sanitation and the effect of cleanliness.

### **SEMESTER – II**

#### **Core Courses (5 Credit Each)**

#### **MBT CC205: Biofertilizer and Mushroom Technology (5 credits)**

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##### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Understand N<sub>2</sub> fixation, phosphate solubilization, & mycorrhizal interaction in maintaining soil fertility.

**CO2:** Understand mass cultivation of cyanobacteria and its application in the rice field.

**CO3:** Develop skills on potent microorganisms to be used as biopesticides.

**CO4:** Understand Mushroom types and their cultivation mechanism.

**CO5:** Develop depth knowledge of Bioinsecticides.

### **MBT CC206: Biophysics and Instrumentation (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Analyze the different biomolecules through different spectroscopic techniques.

**CO2:** Understand the instruments and its techniques to study microbes and its biomolecules.

**CO3:** Develop depth knowledge of observing microbial world through microscopy technique.

**CO4:** Analyze the biomolecule separation techniques: chromatography, gel electrophoresis.

**CO5:** Understand column packing in any form of column chromatography.

### **MBT CC207: Biology of Immune System (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Gain Knowledge of cells and organ system of the immune system.

**CO2:** Understand the Immune system and its response to pathogenic microorganisms.

**CO3:** Develop an Understanding of various immunological disorders.

**CO4:** Apply Knowledge of various immunological techniques.

**CO5:** Understand the effect of different foreign molecules on the immune system and its defense mechanism.

### **MBT CC208: Bioprocess Technology (5 credits)**

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**Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Understand the Methods of isolation of microorganisms from different sources.

**CO2:** Analyse the Methods of preservation of industrially important microbes, industrial fermentation media, and growth kinetics of industrially important microorganisms.

**CO3:** Apply Knowledge of different types of the fermentation process and bioreactors.

**CO4:** Demonstrate Knowledge of downstream processes and enzyme mobilization techniques.

**CO5:** Understand the process technology for the production of industrially important products.

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**MBT CC209: Practical (Based on MBT CC201, 202, 203, 204) (5 Credits)**

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**Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Learn how to produce biofertilizers, and mushroom spawn for its commercial production.

**CO2:** Understand the method of quantification of DNA concentration and its purity by spectrophotometry methods.

**CO3:** Learn how to perform WBC count in blood samples and learn other immunological processes like phagocytosis

**CO4:** Understand the basic concepts of Immunological techniques.

**CO5:** Understand the concept of production and estimation of various industrially important Enzymes, antibiotics, ethanol, and acids.

## **MBT SEC201: Skill Enhancement Courses (One selected from the basket) (5 Credits) Project**

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### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

#### **Bio-fertilizer production.**

**CO1:** Understand the isolation & cultivation of biofertilizers and their types.

**CO2:** Learn the mass and application of different biofertilizers.

**CO3:** Gain knowledge of recycling biodegradable wastes.

**CO4:** Develop entrepreneurial skills.

**CO5:** Learn the pilot scale study of biofertilizer application and benefit nearby farmers.

#### **Mushroom Culture.**

**CO1:** Understand and learn mushroom cultivation and technique.

**CO2:** Learn spawn preparation for mushroom cultivation.

**CO3:** Learn entrepreneurship skills in Mushroom cultivation.

**CO4:** Learn the nutritional benefits of mushrooms through experiments.

**CO5:** Study & understand the causative agents of diseases in mushrooms through experiments.

## **SEMESTER – III**

### **Core Courses (5 Credit Each)**

#### **MBT CC310: Biostatistics and Bioinformatics (5 Credits)**

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### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Develop basic knowledge of mathematics as applied to biological phenomenon.

**CO2:** Understand the basic concepts of statistics and their importance.



**CO3:** Apply Various statistical techniques to prove the significance of the biological experiment.

**CO4:** Understand the Biological databases and their tools to use them for bioinformatic studies.

**CO5:** Gain the ability to apply the sequence analysis knowledge to understand the phylogenetic distance between different organisms.

### **MBTCC 311: Recombinant DNA Technology (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Analyze the Genetic engineering tools for the manipulation of DNA.

**CO2:** Understand the concept of cDNA libraries, rDNA, and methods of DNA transfer in a suitable host.

**CO3:** Develop knowledge of advanced Recombinant DNA techniques like DNA isolation, PCR, blotting, DNA sequencing, and gel electrophoresis.

**CO4:** Perform Demonstration of Bacterial Transformation and calculation of transformation efficiency.

**CO5:** Understand the Concept of RDT & its application in the production of therapeutic products.

### **MBT CC312: Plant and Animal Biotechnology (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Learn the regeneration ability of plant cells through various culture techniques.

**CO2:** Understand the application of tissue culture methods for the generation of virus-free plants, haploid plants

**CO3:** Understand the importance of micropropagation techniques to obtain hybrids through protoplast fusion, and somatic hybridization.

**CO4:** Acquire the concepts of transgenic plants and commercial application of plant tissue culture for the propagation of transgenics.

**CO5:** Acquire the concept of Animal cell culture and its application.

### **MBT CC313: Environmental Biotechnology (5 credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Analyze the idea of nutrient cycling with reference to C- cycle, N- cycle and Sulfur.

**CO2:** Understand the basic idea of environmental problems and Biomonitoring of water pollution.

**CO3:** Understand the Role of microorganisms in the degradation of solid/liquid wastes.

**CO4:** Develop a better understanding of bioremediation by exploiting the degradation abilities of microorganisms.

**CO5:** Develop a better understanding of Biopesticides and Microbial role in mining

### **MBT CC314: Practical (Based on MBT CC310, 311, 312, 313) (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Learn how to interpret & analyze mean, mode, median, standard error, and standard deviation manually and with software programs

**CO2:** Acquire the working knowledge of software and online databases for retrieving sequences, 3D structures, and metabolic pathways.

**CO3:** Perform the DNA, Plasmid isolation, and its visualization by agarose gel electrophoresis.

**CO4:** Gain knowledge of advanced molecular biology techniques like PCR, restriction

digestion, ligation, and transformation.

**CO5:** Gain the ability to apply knowledge to establish organ culture, protoplast culture, and haploid production, and also use microbiological techniques to isolate and study indicator organisms.

## **SEMESTER – IV**

### **MBT DSE/EC 401: Dissertation and Viva-voce (5 Credits)**

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#### **Course Outcomes (CO):**

**After completion of the course, the students will be able to:**

**CO1:** Apply an Experimental approach to various scientific phenomena.

**CO2:** Enhance knowledge on research aptitude and designing experiments independently.

**CO3:** Develop knowledge on Augmenting reading habits of research/review articles.

**CO4:** Apply knowledge of project work within a bound time period.

**CO5:** Gain abilities to analyze the experimental results to compile Project reports.

### **MBT DSE/EC 402: Literature Review & Presentation (5 Credits)**

**CO1:** To be able to learn dissertation /thesis writing.

**CO2:** To be able to prepare a manuscript for research publication

**CO3:** To be able to develop the skill of presentation.

**CO4:** Understand and able to perform a review of the literature of research papers.

**CO5:** Understand research methodology concepts.

## **Semester IV**

## **MBT DSE401 : Microbial Biotechnology (5 credits)**

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### **COURSE OUTCOME**

**After completion of the course, the students will be able to:**

- CO1:** Understand the concept of Microbial biotechnology
- CO2:** Develop the concept of industrial production of organic acids and amino acids.
- CO3:** Develop knowledge of commercial production of enzymes
- CO4:** Develop knowledge on commercial production of fermented beverages and dairy products
- CO5:** To understand the concept of the production of single-cell protein and Mushroom cultivation.

### **MBT DSE402: Practical based on MBT DSE 401 (Microbial Biotechnology)**

- CO1:** The student will be able to understand microbial diversity, physiology, and nutrition through experiments.
- CO2:** Understanding advanced microbiology using modern techniques.
- CO3:** To culture and identify agriculturally important bacteria and know how to preserve different bacteria and know how to preserve them.
- CO4:** Acquire knowledge of fermentation technology at the pilot scale level.
- CO5:** Understand various products of industrial importance.
- CO6:** Facilitates understanding of the importance of microbial technology in the industry.

## **Semester IV**

### **MBT DSE401: Advanced Plant and Agriculture Biotechnology (5 credits)**

#### **COURSE OUTCOME**

**After completion of the course, the students will be able to:**

**CO1:** Understand the concept of biotechnology for crop improvement

**CO2:** Develop the concept of protoplast technology

**CO3:** Understand the application of genetic engineering in crop improvement

**CO4:** Understand the concept of metabolic engineering

**CO5:** Understand the application of plant tissue culture as a source of medicine

### **MBT DSE402: Practical based on MBT DSE 401 (Advanced Plant and Agriculture Biotechnology (5 credits)**

**CO1:** Understanding the aspects of in vitro regeneration and applications related to crop improvement and plant germplasm conservation.

**CO2:** Critically understanding the advantages of in vitro plant cell & tissue cultures and associated techniques for enhanced production of secondary metabolites.

**CO3:** Understanding the principles and techniques of plant transgenic technology.

**CO4:** Critically understanding the applications & limitations of plant transgenic technology in developing crops that are biotic & abiotic stress tolerant.

**CO5:** Comprehend basic concepts of establishing animal cell cultures.

## **Semester IV**

### **MBT DSE401 : Food Biotechnology (5 credits)**

#### **COURSE OUTCOME**

**After completion of the course, the students will be able to:**

**CO 1:** Understand the fundamental aspects of food and nutrition

**CO 2:** Critically understand the principles, and techniques of food processing

**CO 3:** Understand the scope, technology, and importance of functional foods

**CO 4:** Critically understand the importance of evaluation of food quality and food safety management

**CO 5:** Understand the fermented foods and their spoilage mechanism

**MBT DSE402: Practical based on MBT DSE 401 (Food Biotechnology (5 credits))**

**CO1:** Understanding the fundamental aspects of food and nutrition through experiments.

**CO2:** Critically understanding the principles, and techniques of food processing through experiments.

**CO3:** Understanding and analyzing various microorganisms involved in food spoilage.

**CO4:** Learn evaluation of food quality.

**CO5:** Understand the concept of nutraceuticals and therapeutics obtained from food sources.