

# University of Science & Technology Meghalaya

Department of Applied Biology

MSc Biotechnology

POs , PSOs, COs

SCHOOL OF BIOLOGICAL SCIENCES



### **About the Department:**

The Department of Applied Biology, established as the Department of Biotechnology, came into existence in the year 2011 as the pioneering Department of the University of Science & Technology, Meghalaya. The Department was started with seven students in the M. Sc. Biotechnology programme and now has more than 400 hundred students across Bachelor and Masters programmes offered by the Department. This Department meets the national and Regional needs for interdisciplinary teaching and research through its B. Sc., M. Sc. and Ph. D. programmes in Biotechnology, Microbiology and Food Science & Technology.

The Choice Based Credit System (CBCS) was adopted both in the B. Sc. and M. Sc. programmes covering core courses as well as advanced courses mainly focusing on creating employability and developing skill among the students. The main goal of the Department is to impart quality education in frontier and cutting-edge areas where innovation, invention and entrepreneurship remain the cardinal focus and thrust.

### **About the Programme:**

Biotechnology is an innovation that depends on the concept of Biological Sciences and Engineering & Technology, which uses life forms to create products for the improvement of human lives as well as the biosphere. **Master of Science (M. Sc.) in Biotechnology** is a two-year programme, divided into four semesters that deals with the application of science and technology to alter living or non-living materials for the generating knowledge, services and products. M.Sc. in Biotechnology concentrates on Biology and Chemistry alongside the basic principles of the design and engineering to meet life's most prominent needs in a deliberately managed manner.

This programme imparts vital information regarding Biotechnology that cultivates critical thinking and basic reasoning abilities to make the students ready to take charge on working on a different plan and rectify difficulties.

### **Programme Details:**

<b>Programme Name</b>	<b>Duration</b>
Master of Science (M. Sc.) in Biotechnology	2 Years (Four Semesters)

### **Programme Structure:**

The M.Sc. Biotechnology programme is a two years course, divided into four semesters. The programme is of 88 credits and for the award of the degree students require to complete the credits as per the university norms.

<b>Years</b>	<b>Odd Semester</b>	<b>Even Semester</b>
First Year	Semester I	Semester II
Second Year	Semester III	Semester IV

### **Programme Objectives (PO):**

The basic objective of M. Sc. Biotechnology is to produce competent Biotechnologist's who can employ and implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society. This programme mainly focuses to

- develop a detailed technical understanding of the key methods used in the contemporary biotechnology sector
- appreciate the techniques applied in biotechnology and advanced research
- acquire and critically appraise new data arising from the use of these techniques and to interpret the implications of such data
- develop an understanding of the commercial, financial and regulatory context in which the biotechnology sector operates

### **Programme Specific Outcomes (PSOs) of M. Sc. Biotechnology**

**PSO1.**The objective of the Master's Programme in Biotechnology is to equip the students to apply knowledge of living organisms and their cellular processes, classification and interaction among themselves, with physical and chemical agents and higher order organisms.

**PSO2.**The laboratory training in addition to theory is included to prepare them for careers in the industry, agriculture, and applied research where biological system is increasingly employed.

**PSO3.** Basics and current molecular updates in the areas of Industrial Biotechnology, Fermentation Technology, Agriculture and Environmental Biotechnology are included to train the students and also sensitize them to scope for research.

**PSO4.** The Masters in Biotechnology Programme will address the increasing need for skilled scientific manpower with an understanding of research ethics involving living organisms to contribute to application, advancement and impartment of knowledge in the field of Biotechnology.

**PSO5.** The study of Master of Biotechnology will impart in-depth understanding of basic aspects of Biotechnology pertaining to industrial applications that will make the students ready to contribute to:

- better awareness of the major issues at the forefront of the discipline.
- will possess an in-depth understanding of the area of Biotechnology chosen for research emphasis.
- Awareness of ethical issues in Medical, clinical and animal research and careers options.

develop inclination towards own professional goals over a wide range of carrier options expanding from R & D, industrial or Govt. Sector or as an Entrepreneur.

## SEMESTER-I

### Cell and Developmental Biology

**MBT 101**

**Credit: 4**

**After successful completion, this course enables students**

- CO1.** To get the historical basis and concept of cell and developmental Biology.
- CO2.** To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.  
It also gives an idea how these cellular components are used to generate and utilize energy in cells.
- CO3.** To find answer to the question “how continuity of life is maintained from one generation to another?”
- CO4.** To explore the biomedical research involving tissue engineering that aims to grow and replace tissue *in-vitro* using stem cell technology.
- CO5.** To understand the mechanism of plant development/improvement using breeding processes that contribute to the efforts of achieving sustainable food security in times of over population.

### Biochemistry

**MBT 102**

**Credit: 4**

**After successful completion, this course enables students**

- CO1.** To understand the actual chemical concepts of biology through the functioning of various body processes and physiology using bio-molecules.
- CO2.** To understand the chemical basis of cellular life as well as the internal chemistry of biological systems of animals and plants.
- CO3.** The study of biochemistry helps one to understand the actual chemical concepts of biology. That is the functioning of various body processes and physiology by uses of bio-molecules.
- CO4.** To understand the concept of enzymes, its kinetics and importance in metabolism and other physiological reactions inside the cell.
- CO5.** To understand the underlying concept of physiological processes occurring in plants and animals and their regulations. It also deals with the regulation and synthesis of plant and animals and animal hormones.

**Microbiology**  
**MBT 103**  
**Credit: 4**

**After successful completion, this course enables students**

- CO1.** To explore the fascinating world of microorganism and their role (both beneficial and harmful) in day to day life. It imparts knowledge on the various phases and contribution of different Scientists how Microbiology established itself as a separate branch of Science.
- CO2.** To understand the different categories of microbes and sub-microbial groups with their position in the tree of life (classification), their characteristic features and importance.
- CO3.** To become familiarize with the different technical aspects [isolation, cultivation, observation (microscopy), and identification] of studying microbes.
- CO4.** To get an insight on the existence of microbes in different spheres of the environment and how the microbes are affected/induced in these environments or *vice versa*.
- CO5.** To get the basic idea about the food substrate, microorganisms involved in food spoilage and food preservation methods. It also deals with the basic concept on food borne diseases in humans.

**Bioinstrumentation**  
**MBT 104**  
**Credit: 4**

**After successful completion, this course enables students**

- CO1.** To develop concept on the important techniques necessary for the study and prediction of different processes occurring in microbes and other cellular organisms.
- CO2.** To familiarize with the importance, principle and types of chromatography and centrifugation techniques and their role in the study of biological system.
- CO3.** To familiarize with the importance, principle and types of electrophoretic techniques and their role in the study of biological system.
- CO4.** To get an insight into the concept of radioactivity and its application in biochemical and immunological processes.
- CO5.** To familiarize with *advanced techniques like* Protein Crystallization, MALDI-TOF, Mass Spectrometry, Enzyme and Cell Immobilization which are extensively used in Industrial and R & D sectors.

**Cell Biology, Biochemistry and Microbiology**  
**MBT 105**  
**Credit: 4**

**This course enhances the practical application of the concept on Microbiology, Biochemistry and Cell Biology. After successful completion, this course enables students**

**CO1.** To understand the different phases of cell-cycle during mitotic and meiotic cell division.

**CO2.** To learn the principle and process for quantitative estimation (spectrophotometry) of DNA using (Diphenylamine method), RNA (Orcinol method) and protein analysis (vertical slab gel electrophoresis).

**CO3.** To get an insight into the laboratory techniques for the isolation and enumeration of microorganisms from different environmental spheres like soil, water and air with special reference to  
-antibiotic producing microbes from soil  
-the effect of physical factors (temperature and pH) on growth

**CO4.** To learn the principle and the process concerned with the study of bacteria including:  
-isolating bacteria in pure cultures by streaking method  
-determination of growth-phases in bacteria with the help of growth curve  
-identification of unknown bacteria with the help of specific biochemical activity and staining techniques (Gram's, capsule and flagella staining)  
-determination of sensitivity/resistance in bacteria against different antibiotic substances

**CO5.** To get an insight into the biochemical methods for the estimation of carbohydrates, proteins and amino acids- both quantitatively and qualitatively.

It also helps students to develop the idea of separation of plant pigments and amino acids using chromatographic methods of TLC/ Paper chromatography.

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## SEMESTER II

### Molecular Biology

**MBT 201:**

**Credit: 4**

#### After successful completion, this course enables students

**CO1.** To understand the molecular basis of biological activity between biomolecules in the various systems of a cell.

**CO2.** To familiarize with the basics of DNA, RNA, and proteins structure and their interactions within the cell to promote growth, division and development.

**CO3.** To have the concept on the responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

**CO4.** To get an insight in to the wide range of mechanisms required for gene regulation in different organisms.

**CO5.** To understand the molecular basis of cancer and other diseases and the pattern of interaction of animal cells with micro-organisms and viruses.

It also deals with the application of recombinant DNA techniques to problems in basic science and biotechnology.

### Immunology

**MBT 202:**

**Credit: 4**

#### After completion, this course enables students

**CO1.** To familiarize with the concept of non-specific (innate) and specific (acquired) resistance mechanism developed in man against pathogens and other non-self factors which is the basis of this course.

**CO2.** To get an insight into the formation, types, organization and functional specificity of different cellular and organ level components conferring resistance in man.

**CO3.** To understand the nature, types and function of antigens that induce immunological response in man and how the product of this response (antibody, B and T cells) help in neutralizing them (agglutination and precipitation reactions).

**CO4.** To have the concept of different mediators/cell signaling molecules (complement, cytokines: interferons, Interleukins, hematopoietins and chemokines) associated with immunological responses as well as their biological consequences.

**CO5.** To deal with the different diagnostic and serological approaches for the study of interaction between an antigen and its specific antibody including Widal Test, immunodiffusion, Immuno-electrophoresis, ELISA and RIA.

It also gives an idea on immune-disorders (hypersensitivity, autoimmune disorders, oncogenesis etc.) and induced immunity (vaccination) to overcome such abnormalities.

**Genetics**  
**MBT 203:**  
**Credit: 4**

**After successful completion, this course enables students**

**CO1.** To understand basic principles of Mendelian inheritance.

**CO2.** To study cell division and chromosome segregation during the process.

**CO3.** To explore the multifactorial inheritance and understand the chromosome structure, chromatin organization and variation.

**CO4.** To learn the concepts of Linkage, concept of sex determination and sex linked inheritance which help to understand about different sex influenced human diseases.

**CO5.** To gain knowledge about the organellar inheritance, genome evolution, mutation and basis of several hereditary diseases.

**Biostatistics, Bioethics and IPR**

**MBT 204:**

**Credit: 4**

**After successful completion, this course enables students**

**CO1.** To understand the ethical and safety issues concerned with Biotechnological experiments.

**CO2.** To understand the basics of intellectual property rights including the concept, types, importance and legal issues related to patents, trademarks, copyright, industrial design and rights, traditional knowledge and geographical indicators.

**CO3.** To get the idea about the process of granting patent by patenting authorities with reference to types of patent applications, patent filing procedures, patent licensing and agreement and rights and duties of patent owner.

**CO4.** To have knowledge on the agreements, treaties and international recognition in connection to protect innovations and novel works; It also gives an idea on Indian Patent Act (1970) and recent amendments.

**CO5.** To understand the guidelines in using radioisotopes in laboratories, safety measures and disposal mechanism.

**Course Content**

**Practical on Immunology and Molecular Biology**  
**MBT 205**  
**Credit: 4**



**This practical course enhances the applicability of the concept on Molecular Biology and Immunology. After successful completion, this course enables students**

**CO1.** To understand the principle and process of

- blood group determination following slide agglutination test,
- blood cell count and identification following blood film preparation and
- immuno-diagnostic methods like Radial immunoassay and ELISA

**CO2.** To acquaint with the principle and process of the immunodiffusion techniques like ODD, SRID, Immuno-electrophoresis and counter-current electrophoresis.

**CO3.** To learn the principle and process for the isolation DNA from bacterial, plant and animal sources and their quantification using agarose gel electrophoresis

**CO4.** To learn the principle and process of restriction digestion analysis by agarose and polyacrylamide gel electrophoresis (over-expression of proteins by SDS-PAGE).

**CO5.** To learn the principle and process for the isolation and cloning of plasmid DNA and their amplification by PCR (RAPD analysis).

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### SEMESTER III

#### Genetic Engineering MBT 301 Credit: 4

**After completion, this course enables students**

**CO1.** To have the basic concept of genetic engineering and r-DNA technology laying the basis of genetic modification of cellular organisms.

**CO2.** To develop the concept about the types, nature and functions of restriction enzymes that act as the mediators of DNA modification during genetic manipulation process.

**CO3.** To get an insight into the concept of different vectors (plasmids, cosmids, phagemids, artificial chromosome vectors) that act as carrier of DNA fragment between cellular organisms during genetic modification.

**CO4.** To understand the different blotting techniques (Southern, Northern and Western) hybridization process as well as the construction and screening genomic and c DNA libraries.

**CO5.** To have concept about the most versatile molecular technique of Polymerized Chain Reaction (PCR); its types, applications and different PCR based and PCR independent marker (RAPD, RFLP, AFLP) methods in Molecular Biology.

#### Plant and Animal Biotechnology MBT 302 Credit:4

**After successful completion, this course enables students**

**CO1.** To familiarize with the techniques of plant and animal cell culture, mechanisms of gene transfer and various molecular marker assisted methods in improvement of live-stocks and crop plants.

**CO2.** To have knowledge on different tissue and cell culture media and their preparation methods.

**CO3.** To explore the biomedical research involving tissue engineering that aims to grow and replace tissue *in-vitro* using stem cell technology.

**CO4.** To understand the various vectorless and vector mediated gene transfer methods used in plant and animal cell cloning.

**CO5.** To have the basic understanding of plant and animal tissue culture and its maintenance as well as to get the insight in to the concept of callus and suspension culture, somaclonal variation, callus cultur, totipotency, hybrid and cybrids.

## **Omics and Bioinformatics**

**MBT 303:**

**Credit: 4**

### **After successful completion, this course enables students**

**CO1.** To understand the contents and properties of bioinformatics databases; perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge.

**CO2.** To learn about the major steps in pair wise and multiple sequence alignment, and execute pair wise sequence alignment by dynamic programming.

**CO3.** To learn the techniques of predicting the secondary and tertiary structures of protein sequences.

**CO4.** To become familiar with the use of a wide variety of internet applications, biological database that can be applied in solving research problems.

**CO5.** To understand the theoretical and practical development of useful tools for automation of complex computer jobs, and making these tools accessible on the network from a Web browser.

## **Food and Industrial Biotechnology**

**MBT 304:**

**Credit- 4**

### **After successful completion, this course enables students**

**CO1.** To understand the role of biotechnology in food production, food processing, and food security.

**CO2.** To learn about the conditions under which the organisms responsible for the deterioration of food can be inactivated, killed or made harmless.

**CO3.** To understand the principles involving food preservation via fermentation processes.  
It also acquaints with various kinds of Bioreactor and fermenters used in Industries for food production.

**CO4.** To have knowledge for improving the industrially useful microorganisms genetically and to understand the process and role of enzyme immobilization in food industries.

**CO5.** To get an insight in to the principles and current practices of processing techniques and the effects of processing parameters on product quality.  
It also deals with the pre- and probiotic microorganisms and their importance.

## **Practical on Genetic Engineering, Plant & Animal Biotechnology, Bioinformatics and Food & Industrial Biotechnology**

**MBT 305**

**Credit: 4**

**This practical course gives the idea of industrial production of important material using fermenter, improvement of crop using the concept of Genetic Engineering and methods like micropropagation. After successful completion, this course enables students**

**CO1.** To acquaint with methods for the isolation of chromosomal DNA from plant and microbial cells, their qualitative and quantitative analysis as well as to become familiar with the technical process of PCR.

It also helps in learning the technique of restriction digestion of DNA and its separation by Gel Electrophoresis and Protein profiling using SDS PAGE.

**CO2.** To learn the preparation of medium used in plant tissue culture and carry out the process like micropropagation and artificial seed preparation.

**CO3.** To understand the design and working principle of a fermenter and its use in the industrial production of solvent, enzymes etc.).

**CO4.** To learn the different laboratory methods to determine quality of food products (MBRT and Alkaline phosphatase test to check the efficiency of pasteurization of milk).

**CO5.** To understand the practical aspects of Bioinformatics including

a. operating systems like UNIX, LINUX and Windows;

b. bioinformatics databases systems like NCBI/ PDB/ DDBJ, Uniprot, PDB;

c. sequence retrieval using BLAST and sequence alignment & phylogenetic analysis using clustalW & phylip;

d. protein structure prediction using psipred, homology modeling using Swissmodel, and molecular visualization using jmol.

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## **SEMESTER IV**

### **Environmental Biotechnology**

**MBT 401:**

**Credit: 4**

**After successful completion, this course enables students**

**CO1.** To understand the environment around us and the organisms living in normal and extreme conditions of the environment.

**CO2.** To learn the utilization of the unique properties microorganisms living in the extreme habitats to remediate degraded environment: such as solid and liquid waste management.

**CO3.** To get the information on the ethical and safety issues concerned with Biotechnological experiments.

**CO4.** To get an insight into how microbes affecting aquatic health and what are the different approaches for monitoring and maintaining potability of water.

**CO5.** To familiarize with the important environmental roles played by microbes specifically in the light of sewage treatment, litter decomposition, maintenance of soil health and at the same time in metal recovery process (bioleaching).

### **Research Methodology**

**MBT 402:**

**Credit: 4**

**After successful completion, this course enables students**

**CO1.** To understand the concept, types and criteria of research, addressing the identification of a research problem, objectives, designs and methodology to carry out a research work.

**CO2.** To get the basic knowledge on qualitative research techniques and on the collection and analysis quantitative data.

**CO3.** To get an insight in to formulating a hypothesis, data analysis for hypothesis-testing as well as formulation of research synopsis and report.

**CO4.** To have adequate knowledge on measurement and scaling techniques for analyzing research outcomes thereby enabling them in justifying their findings.

**CO5.** To develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/ Research problem.

**Practical on Environmental Biotechnology**

**MBT 403:**

**Credit: 06**

**This practical course gives the idea of analytical methods used in biological laboratories, application such methods in solving issues related to the environment. After successful completion, this course enables students**

**CO1.** To understand the quality/potability of water through bacteriological analysis of water samples.

**CO2.** To learn the laboratory methods for the estimation of Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) through which the condition of a water body can be determined.

**CO3.** To learn the estimation of nitrate/phosphate/silicate content of waste water which can make an aquatic system eutrophic.

**CO4.** To study of different physico-chemical parameters (pH, water holding capacity, soil moisture content, soil organic carbon, soil organic matter) of soil thereby to assess the nature of a particular soil.

**CO5.** To study different enzymatic processes carried out by microbes in soil including amylase and cellulase activity during decomposition of litter.

**Dissertation Work and lab Visit Report**

**MBT 404:**

**Credit: 4**

**Course Title: Human Values and Professional Ethics**

**Course Code: HVP-740**

**[Non-Credit Compulsory Course]**

**Course Description:** The purpose of this course is to comprehend the various ethical issues that may arise in one's professional life. The course will provide understanding of the expected professional ethics and behavior in diverse professional settings. It will also facilitate the students to develop detail insight on the different human values transmitted by diverse sources as constitution, culture, religion, family and society. On successful completion of the course the students will learn to acclimatize to the expectations of an ideal professional and a responsible member of the society.

**Course Objectives:**

- 1) To critically understand ethical issues as they pertain to professional and personal identity.
- 2) To learn to consider oneself and the world around from these basic ethical positions.
- 3) To develop sharpened analytical capabilities in order to develop and maintain a good interpersonal relationship in both professional and social space.

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