University of Science & Technology Meghalaya

Department of Applied Biology

BSc Microbiology

POs , PSOs, COs

SCHOOL OF BIOLOGICAL SCIENCES

UNIVERSITY OF SCIENCE & TECHNOLOGY, MEGHALAYA
ACADEMIC YEAR: 2019 onwards

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:

Microbiology is study of the world of organisms that are too small to be seen with the naked eye. Some of these microorganisms are infectious agents to humans, animals, or plants while some of them, carry out important functions in their niches that are essential for all life on earth. B. Sc. in Microbiology is a unique, interesting and leading programme designed to encourage aspiring students with a cutting edge training to young minds power of thinking, provide them practical training and making them industry ready for a rewarding professional career.

B. Sc. Micobiology is a three years programme, divided into six semesters that will enable the young minds to adopt to both theoretical and practical exposure, parallel to any other conventional Universities B. Sc. programme. Moreover, innovative learner centric innovative teaching practices will be adopted to ensure parity in terms of academic excellence.

Programme Details:

Programme Name	Duration
Bachelor of Science (B. Sc.) in Microbiology	3 Years (Six Semesters)

Programme Structure:

The B.Sc. Biotechnology programme is a three years course, divided into six semesters. The programme is of 128 credits and for the award of the degree students require to complete the credits as per the university norms.

Years	Odd Semester	Even Semester
First Year	Semester I	Semester II
Second Year	Semester III	Semester IV
Third Year	Semester V	Semester VI

Programme Objectives (PO):

The undergraduate programme in Microbiology is the first level of understanding of basic knowledge or understanding of the fundamentals of Microbiology as applicable to wide ranging contexts so that the students may play role as microbiologists in a useful manner contributing their role in the development of the welfare society. The LOCF curriculum developed has a very wide range covering all aspects of Microbiology with reasonable depth of knowledge and skills so as to diversify them in various specialties of the subject and play their role professionally as expected of them.

The aim of the undergraduate degree in Microbiology is to make students knowledgeable about the various basic concepts in a wide ranging context which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject. After successful completion of the programme, student will

- acquire practical skills-plan and execute experimental techniques independently as well as to analyze and interpret data.
- acquire adequate knowledge and leadership skills for a successful career.
- accomplish ability to communicate effectively and able to understand ethical responsibility.
- carry on to learn and to adapt in a world of constantly evolving technology.

Programme Specific Outcomes (PSOs)

PSO1. The objective of the Bachelor's Programme in Microbiology is to increase the understanding regarding the fascinating world of microorganism; the various cytological and biochemical aspects associated with microbes.

PSO2. It develops the concept of diverse microbial and allied groups of organisms present in different spheres of the environment; the life processes as well as their role (both beneficial and harmful) in day to day life.

PSO3. It helps in understanding the different technical aspects (cultural, microscopic and molecular methods) for the study of microbes.

PSO4. It increases the understanding of the association of microbes with other cellular organism and how such host-microbe interaction affecting each other.
It clears the concept of microbial association with human diseases; the different phases of disease development and the laboratory techniques for the detection and treatment of such abnormalities.

PSO5. It helps in learning the potential of microbes in obtaining product of human interest and how some of the microbes are industrially exploited for obtaining such products.

After successful completion of the B. Sc. Microbiology programme, students can opt for higher studies in areas like Medical and Pharmaceutical Microbiology, Food and Industrial Microbiology, Environmental and Agricultural Microbiology and Marine Microbiology and Oceanography. Moreover, the concept in the subject concerned will give the students to establish themselves as professionals in Quality Control (Pharmaceutical and Food sector), Diagnosis (Medical and Health sector) and Research Personals (R & D sector). The knowledge attained during the period of the programme will help the students in qualifying different competitive exams. related to Academics, Research and Professional courses.

SEMESTER-I

Fundamentals of Microbiology
BMB 101
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 industrial application of different microbes for the production of single cell protein, beverages, industrial enzymes and genetically modified (GM) foods.

Biochemistry
BMB 102
Credit: 4

After successful completion, this course enables students

CO1. To get an insight into the various biochemical principles governing the physiology of cellular life.
It also deals with the concept of buffer system acting as the mobile phase for various biochemical pathways.

CO2. To familiarize with the characteristic, types and structural features of important bio-molecules (carbohydrate, protein, lipid, amino acids) that form the building block of cellular organisms.

CO3. To develop the concept on the type, nature and other features of enzyme molecules that controls the different physiological processes of microbes and other cellular organisms.

CO4. To get an insight into the principles of various metabolic/biochemical processes (sugar degradation, electron transport, fermentation etc.) occurring in or carried out by different microbial/ cellular systems.

CO5. To develop the concept of the principles and mechanism of photosynthetic pathway occurring in C_3, C_4 plants and also carried out by various groups of bacteria and Cyanobacteria.

Communicative English
BEN 711
Credit: 2

After successful completion, this course enables students

CO1. To enhance reading and writing abilities mainly focusing academic and day to day uses.

CO2. To develop the idea of grammar usage (determiners, tenses, voice, direct and indirect speech, punctuation, word formation idioms and phrases) in developing communicating skills.

CO3. To get an insight into the format of official correspondence, Letter (formal and informal), Circular and Notice.

CO4. To develop the skill in writing Cvs/Resume, Essay, e-mail, Blog, Story and Paragraph which act as a source of communication at different platform.

CO5. To develop the skill in writing comprehension and precis that enables the students to understand a particular passage and express opinions in their own language.

Phycology and Mycology
BMB 104
Credit: 4

After successful completion, this course enables students

CO1. To get an insight into the taxonomic position, habitat, morphology, cellular, nutritional and reproductive features of different groups of algae.
It also familiarizes students with the beneficial aspects of different algal groups.

CO2. To get an insight into the kingdom of Fungi; their taxonomic position, habitat, morphology, cellular, nutritional and reproductive features and how these features vary among different groups of fungi.

CO3. To familiarize with the important beneficial symbiotic association (lichen and mycorrhiza) of fungi and their specific role in different sectors.

CO4. To familiarize with beneficial aspects of different fungal groups and their industrial and environmental applications.

CO5. To familiarize with specific mechanism adopted by fungi for disease development (mycotoxins) and at the same it also gives an insight to the various means/approaches (antifungal agents) to combat such diseases.

Practical on Microbiology, Biochemistry and Phycology & Mycology
BMB 105
Credit: 4

This course enhances the practical application of the concept based on the theory courses of the semester. After successful completion, this course enables students

CO1. To understand the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
Students also learn the basics of preparing common microbial media used for isolation and maintenance of microbial isolates.

CO2. To get an insight into the laboratory techniques for the isolation and enumeration of microorganisms from fro different environmental spheres like soil, water and air.
Students also learn the basics of isolating bacteria in pure cultures by streaking method and determination of bacterial growth curve.

CO3. To get the idea ofpreparing of biochemical solution of different strength including Stock Solution, PPM, Per cent, Normal, Molar and Millimolar solutions.

CO4. 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.
CO5. To understand vegetative and reproductive structures of different algal (*Volvox, Coleochaete, Vaucheria, Ectocarpus, Polysiphonia* and *Nostoc*) and fungal (*Mucor, Saccharomyces*, *Penicillium, Agaricus* and *Alternaria*) genera through temporary and permanent slides preparation.

SEMESTER II

Bacteriology
BMB 201
Credit: 4

After successful completion, this course enables students

CO1. To familiarize with the characteristic and structural features of bacteria (eubacteria and archaea) as a representative type of prokaryotic cellular organism.

CO2. To get an insight into the differences between eubacteria and protobacteria (archaea) as well as the important groups of organisms studied under them.

CO3. To get an insight into the various required factors (nutritional/physical) for the laboratory cultivation of bacteria.
It also deals with the laboratory techniques for the cultivation and control of different microorganisms.

CO4. To have an idea of different reproductive strategies in bacteria with special emphasis on genetic recombination processes.

CO5. To get an insight into the bacterial systematic *i.e.* taxonomy of different bacterial groups and the application of conventional, molecular, and rRNA oligonucleotide, signature and protein sequencing for establishing bacterial phylogeny.

Virology
BMB 202
Credit: 4

After successful completion, this course enables students

CO1. To get an insight into one of the most important acellular entity lying at the borderline of living and dead called virus and its allied groups including viroids, virusoids and prions.
It also deals with the nomenclature, classification of viruses and other aspects related to virus and its allied groups.

CO2. To have an idea about the general features, morphology, ultra-structure, composition and arrangements of structural components in virus.
To familiarize with the concept and important aspects (types, structural organization, multiplication cycle and therapeutic application) of bacteriophages *i.e.* the virus of bacteria.

CO3. To get an insight into the cultivational, diagnostic and serological (haemagglutination, immuno-fluorescence ELISA) methods concerned with the characterization and identification of virus.

CO4. To have the basics of salient features, multiplication and replication strategies among important types of plant and animal viruses with special reference to the nature of their nucleic acid.

CO5. To get an insight into the concept of oncogenic viruses i.e. viruses responsible for cancer.
It also deals with the concept of antiviral compounds, interferon and viral vaccines with special reference to their mode of action.
It also gives an idea about the application of virus specifically viral vectors in cloning and expression and gene therapy.

Microbes in Environment
BMB 203
Credit: 4

After successful completion, this course enables students

CO1. To get an insight into the different sphere of the environment (soil, water and air) as microbial habitat and how the microbes are affected/induced in these environments or *vice versa*.

CO2. To familiarize with the different types of microbial association developed in soil and how these associations affecting other cellular life in/on soil.
Italso help indeveloping the concept on the application of microbes or their processes/products for developing beneficial and eco-friendly byproducts like biofertilizers, biopesticides, biopolymers, bioplastics etc.

CO3. To familiarize with the role of microbes in the cycling (mineralizationand immobilization) of nutrient elements like carbon, nitrogen, phosphorus, sulphur, iron required for a proper soil health.

CO4. To develop the idea about the important environmental roles played by microbes specifically in the light of management of municipal solid waste and sewage treatment and remediation of contaminated sites.

CO5. To get an insight into how microbes affecting aquatic health and what are the different approaches for monitoring and maintaining potability of water.

Environmental Studies
EVS 721
Credit: 4

After successful completion, this course enables students

CO1. To get an insight in to the multidisciplinary nature of environmental studies and its importance in other branches of sciences mainly to create public awareness regarding environment.
It highlights the natural resources and associated problems in terms of non-renewable sources describing the role of an individual in conservation of natural resources.

CO2. To have the concept of an ecosystem, it's structure and function with special emphasis on energy flow and ecological succession process.

CO3. To have an idea about the concept of biodiversity at global, national and local levels; threats to biodiversity and conservation strategies.

CO4. To get an insight in to the burning issue of environmental pollution describing the concept of pollutants, cause, effects and control measures of air, water, soil, noise, thermal and nuclear pollution.

CO5. To understand the social issues related to the environment describing human role in biodiversity destruction and its conservation as well as the ethical and legal (Environment Protection Acts) issues related to the environment.

BMB 205 Practical on Bacteriology, Virology and Microbes in Environment Practical Credit: 4

This is a practical course based on various aspects related to bacteria, virus and environmental impact of different microbial groups. After successful completion, this course enables students

CO1. To understand the principle and methods of different staining techniques in Bacteria (Simple staining, Negative staining, Gram's staining, Acid fast staining, Capsule staining and Endospore staining).

CO2. To learn the laboratory methods of pure cultures isolation of bacteria by streaking method as well as estimation of CFU count by spread plate and pour plate method.
It also describes the test of motility in bacteria by hanging drop method.

CO3. To understand the structural features of important animal viruses (rhabdo, influenza, paramyxo, hepatitis B and retroviruses), plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) and bacteriophages (ϕX 174, T4, λ) using electron micrographs that enables students to understand cytopathic effects of these viruses.

CO4. To understand the techniques of isolating microbes from specific microenvironments like rhizosphere, rhizoplane, phyllosphere and phylloplane.
It also gives an idea about the enzymatic activity (qualitatively) of microbes in soil (dehydrogenase, amylase, urease).

CO5. To learn the process of assessment of microbiological quality of water to determine it's potability.

SEMESTER III

BMB 301 Microbial Physiology and Metabolism Theory Credit: 4

After successful completion, this course enables students

CO1. To get an insight into the concept of growth in terms of microbial cells; different cultural approaches for the measurement of microbial growth (growth curve).

CO2. To have the concept on the effect of environmental factors (temperature, pH, solute and water activity, oxygen requirement, nutrition and energy) on microbial growth.

CO3. To familiarize with the mechanism of nutrient uptake and transport in microbial cells.

CO4. To get an insight into the principles of various metabolic/biochemical processes (sugar degradation, electron transport, fermentation etc.) occurring in or carried out by different microbial/ cellular systems.

CO5. To understand the principles and mechanism of phototrophic metabolic pathway carried out by various groups of bacteria and Cyanobacteria.

BMB: 302 Cell Biology

After successful completion, this course enables students

CO1. To have the concept of cell theory; structural organization and functions of prokaryotic and eukaryotic cells as well as their comparative account.

CO2. To get an insight into the structural organization and functional roles of important cell organelles including plasma membrane, endoplasmic reticulum, golgi complex, lysosome, peroxisome and vacuoles and mitochondria.

CO3. To understand the structural organization and functional roles nucleus, the controlling centre of a cell.

CO4. To understand the structural organization and functional roles of cytoskeleton that gives specific shape and structure to a cell.

CO5. To get an insight into various stages of cell cycle that regulates proper organization in cellular organisms. It also deals with the abnormalities during cell division process leading to cancer like problem.

BMB 303 **Molecular Biology** **Theory** **Credit: 4**

After successful completion, this course enables students

CO1. To get an insight in to the molecular basis of biological activity between biomolecules in the various systems of a cell.

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

CO3. To understand the different mechanism DNA replication adopted in prokaryotic and eukaryotic system. It also highlights the factors inducing and inhibiting replication.

CO4. To get an insight in to the wide range of mechanisms required for the regulation of transcription, translation and expression of gene in prokaryotic and eukaryotic system.

CO5. To understand the responses to environmental or physiological changes or alterations of cell function brought about by mutation.
It also highlights the molecular basis for cancer and other related abnormalities and the molecular tools and techniques to study such abnormalities.

BMB 304 **Agricultural Microbiology** **Theory** **Credit: 4**

After successful completion, this course enables students

CO1. To develop the idea about the formation, stratification and physico-chemical properties of soil.
It also deals with how the microorganisms are affected/ induced in a terrestrial ecosystem.

CO2. To get an insight in to the chemical transformation carried out by microbes during organic matter decomposition wherein mineralization and immobilization of important nutrient occurs resulting in enhancement of soil nutrient profile.

CO3. To familiarize with the concept of diseases of agricultural commodities caused by microbial agents, different terminology associated with such disease and at the same time some of the important measures for controlling/eradicating diseases from crop fields.

CO4. To get an insight into the significance of microorganisms in terms of formulation of biofertilizers, phytostimulators, bioinsecticides which are eco-friendly alternative to their chemical counterparts.

CO5. To have the concept of microbes as a source of bio-fuels and biogas, alternative to non-renewable fossil fuels. It also highlights the issues associated with the development of GM crops and transgenic animals.

BMB 305: Microbial Diagnosis in Health Clinics Theory Credit: 4

After successful completion, this course enables students

CO1. To understand the concept of Stereochemistry with the help of Fischer, Newmann and Sawhorse projection and Wedge formulae.

CO2. To acquaint with various conformations of ethane, butane, ethane-1,2-diol and cyclohexane with reference to relative stability of different conformations in terms of energy difference.

CO3. To understand the mechanism of addition reactionswith the help ofhydrogenation, hydrohalogenation, hydroxylation and ozonolysis in alkenes, alkynes, aldehydes and ketones.
It also help in understanding themechanism of substitution and elimination reactions among organic compounds.

CO4. To understand the mechanism of oxidation reactions occurring in aromatic side chain compounds, alcohols, aldehydes and ketonesand the rules governing such mechanisms.

CO5. To understand the mechanism ofcatalytic hydrogenation, electrolytic and other reduction reactions occurring in aldeydes, ketones, carboxylic acids and their derivatives and nitro compounds.

BMB 306 Practical on Microbial Physiology, Cell- and Molecular Biology and Agricultural Microbiology Practical Credit: 4

This is a practical course based on cyto-morphological, molecular and physiological basis of microbial life. After successful completion, this course enables students.

CO1. To understand the different stages of reductive cell division process of meiosis– chromosome staining in flower bud anthers.

CO2. To study the induction of variation in chromosome number using chemical mutagenes and karyotype analysis in in plant and animal cells.

CO3. To learn the molecular methods of isolation and quantification of DNA using UV-VIS spectrophotometric analysis and agarose gel electrophoresis.

CO4. To understand the concept of soil profile and the distribution of microflora of different types of soils with reference to cellulose degrading organisms

CO5. To understand the pattern of growth in *E. coli* by turbidometric and standard plate count methods and to estimate generation time and specific growth rate from the plotted graph.

It is also concerned with the effect of temperature, pH, C and N sources and salt on growth of *E. coli* that demonstrates the thermal death time and decimal reduction time of *E. coli.*

SEMESTER IV

BMB 401: MICROBIAL GENETICS **Theory** **Credit: 4**

After successful completion, this course enables students

CO1. To have the concept about the genome organization in prokaryotic and eukaryotic system.

CO2. To have an idea of the responses to environmental or physiological changes or alterations of cell function brought about by mutation and their expression at genetic level.

CO3. To get an insight into the extra-chromosomal inheretary material called plasmids; their type, specificity and regulation.

CO4. To have an idea about the mechanisms of genetic exchange including transformation, conjugation and transduction and at the same time molecular aspects of mapping by recombinants.
It also highlights the genetic mechanisms in phage particle with reference to T4 lambda.
CO5. It deals with the concept of transposable elements in prokaryotes and eukaryotes with special emphasis on their role in transmission of hereditary characters.

BMB 402: ENVIRONMENTAL MICROBIOLOGY **Theory** **Credit: 4**

After successful completion, this course enables students

CO1. To understand existence of microbes in different parts of the biosphere wit special emphasis on microbes present in environments with extreme conditions and microbial strategies to survive in those extreme environments.

CO2. To get an insight into the different sphere of the environment (soil, water and air) as microbial habitat and how the microbes are affected/induced in these environments or *vice versa*.
It also familiarizes with the different types of association developed between microbes, microbes with plants and microbes with animals and how these associations affecting other cellular life.

CO3. To have the concept about the role of microbes in the cycling (mineralization and immobilization) of nutrient elements like carbon, nitrogen, phosphorus, sulphur, iron required for a proper soil health.

CO4. To familiarize with the important environmental roles played by microbes specifically in the light of sewage treatment and remediation of contaminated sites.

CO5. To get an insight into the microbial applications in remediation of polluted ecosystem.

BMB 403: FOOD AND DAIRYMICROBIOLOGY **Theory** **Credit: 4**

After successful completion, this course enables students

CO1. To have an idea about the association of microbe with different food product and the physico-chemical alteration occurring in food items due to microbial contamination that bring about spoilage of them.

CO2. To get an insight into various strategies (physical and chemical) for preserving food from microbial spoilage.

CO3. To have the concept of microbial fermentation and different fermented food products obtained through microbial process.

CO4. To conceptualize the pharmaco-nutritional assessment of fermented food products.

CO5. To have the idea about the food-borne infections and intoxications resulting from microbial contamination of food; the laboratory diagnosis of such food-borne infections and their preventive measures.

BMB 404: **Genetic Engineering** **Theory** **Credit: 4**

After successful 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.

BMB 405: **Food Fermentation Techniques** **Theory** **Credit: 4**

After completion, this course enables students

CO1. To understand the structure of molecule following valence bond approach as well as the concept of resonance in various organic and inorganic compounds. It also gives an ideaVSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds.

CO2. To get an idea on various intermolecular forces like van der Waals forces, Hydrogen bonding and their effects on melting point, boiling point and solubility of compounds.

CO3. To have the concept on transition elements specifically their electronic configuration, variable valency, color, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for with special reference to Mn, Fe and Cu.

CO4. To understand the concept ofValence Bond Theory with reference to inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu; their structural and stereoisomerism with coordination numbers 4 and 6.

CO5. To understand the concept ofCrystal Field Theory with reference to crystal field effect for weak and strong fields and crystal field stabilization energy.

BMB 405 Chemistry-II: Chemical Bonding, Transition Metals and Coordination Chemistry

Theory Credit: 4

After completion, this course enables students

CO1. To understand the structure of molecule following valence bond approach as well as the concept of resonance in various organic and inorganic compounds. It also gives an ideaVSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds.

CO2. To get an idea on various intermolecular forces like van der Waals forces, Hydrogen bonding and their effects on melting point, boiling point and solubility of compounds.

CO3. To have the concept on transition elements specifically their electronic configuration, variable valency, color, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for with special reference to Mn, Fe and Cu.

CO4. To understand the concept ofValence Bond Theory with reference to inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu; their structural and stereoisomerism with coordination numbers 4 and 6.

CO5. To understand the concept ofCrystal Field Theory with reference to crystal field effect for weak and strong fields and crystal field stabilization energy.

BMB 406: Practical on Microbial Genetics, Environmental Microbiology, Genetic Engineering and Food & Dairy Microbiology Practical Credit: 4

This is a practical course concerned with microbial genetics and technical aspects of genome modification as well as importance of such genetically modified strains in the field of food and dairy industry. After successful completion, this course enables students

CO1. To learn the laboratory techniques of preparing Master and Replica Plates for the study of the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells.

CO2. To understand the process of genetic recombination in bacteria including conjugation, transformation and transduction

CO3. To learn the differentanalytical methods to determine physic-chemical properties of soil (pH, moisture content, water holding capacity, percolation, capillary action) and water (BOD, COD and microbial count).
It also helps in learning different microbial activity in soil like enzymatic activities and root nodule formation.

CO4. To learn different laboratory methods to determine quality of food products (MBRT and Alkaline phosphatase test to check the efficiency of pasteurization of milk).
It also deals with different microbes associated with spoilage of vegetables, fruits and other food products.
It also helps in learning the preparation process of fermented products like Yogurt and Dahi.

CO5. To learn the techniques for isolation of genomic DNA (from bacteria, plant and animal tissues) and plasmid DNA (*E. coli*).
It also helps in learning the technique of restriction digestion of DNA and its separation by Gel Electrophoresis.
Protein profiling- SDS PAGE.

SEMESTER V

BMB 501: MEDICAL MICROBIOLOGY Theory Credit: 4

After successful completion, this course enables students

CO1. To have an understanding about the microbial associated with human body (skin, respiratory tract, digestive tract, urino-genital system); their source, path of entry and the infection resulted from such association.

CO2. To get an insight into the host-pathogen relationships (disease cycle), transmission of pathogens and post-infectional changes in the host.

CO3. To understand the various stages of laboratory diagnosis of microbial infections including collection and processing of clinical specimen and microscopic, biochemical examination for the characterization and identification of clinical specimens.

CO4. To have the concept about pathogenicity, symptomology, transmission, disease cycle, laboratory diagnosis and treatment of diseases caused by bacteria, fungi, protozoa and virus.

CO5. To understand the different antimicrobial and chemotherapeutic agents, antibiotics and antiseptics with mechanism of action against targeted pathogens.

BMB 502: IMMUNOLOGY Theory Credit: 4

After successful 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 familiarize with 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).
It also deals 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, RIA etc.

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

CO5. To understand the immune disorders (hypersensitivity, autoimmune disorders, oncogenesis etc.) and induced immunity (vaccination) to overcome such abnormalities.

BMB 503: BIOINFORMATICS Theory Credit: 4

After successful completion, this course enables students

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

CO2. To understand the major steps in pairwise and multiple sequence alignment including the principle and execution of pairwise sequence alignment by dynamic programming.

CO3. To have the concept of the process of predicting the secondary and tertiary structures of protein sequences.

CO4. To familiarize with the use of a wide variety of internet applications, biological database and will be able to apply these methods to 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.

BMB504 Instrumentation and Biotechniques Theory Credit: 4

After successful completion, this course enables students

CO1. To familiarize with the important techniques necessary for the study and prediction of different processes occurring in microbes and other cellular organisms.

CO2. To get an insight into the concept of radioisotopic techniques applied in biochemical and immunological processes as well as the biohazard of using radioisotopes.

CO3. To understand the importance, principle and types of basic and advanced chromatography techniques and their role in the study of biological system.

CO4. To familiarize with the importance, principle and types of electrophoretic techniques and their role in the study of biological system.

CO5. To get an insight into the important immunological techniques (immunodiffusion, immunoelectrophoresis, radio-immunoassay, ELISA, immunofluorscence) used in diagnostic process.

BMB 505 Practical on Medical Microbiology, Immunology, Bioinformatics and Bioinstrumentation

Practical Credit: 4

This is a practical course concerned with technical aspects of study and identification of microbes associated with human or animal diseases. It is also concerned with computational methods of Bioinformatics in understanding the structural and other aspects related to biomolecules. After successful completion, this course enables students

CO1. To isolate bacterial flora of skin by swab method and their identification on the basis of cultural, morphological and biochemical characteristics.

CO2. To understand the principle and process of antibiotic sensitivity (Kirby-Bauer method) in bacteria using minimal inhibitory concentration (MIC) of an antibiotic.
It also deals with the study of various stages of diseases (symptoms and life-cycle) like Polio, anthrax, herpes, chicken pox, HPV warts, AIDS, candidiasis, dermatomycoses (ring worms) and malaria.

CO3. To understand the principle and process of blood group determination following slide agglutination test, blood cell count following blood film preparation and immune-diagnostic methods like Radial immunoassay and ELISA.

CO4. 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.

CO5. To understand the working principle and application of
a) phase contrast and Electron microscopy,
b) paper, thin layer and column chromatography and
c) polyacrylamide Gel Electrophoresis (PAGE).

SEMESTER VI

BMB 601: INDUSTRIAL MICROBIOLOGY Theory Credit: 4

After successful completion, this course enables students

CO1. To have the concept on the sources, isolation, preservation and maintenance of industrially important microbial strains as well as their specific features.

CO2. To get an insight into the principle, types and components of a typical industrial fermentor; the basic requirement, process, measurement and control of fermentation parameters.

CO3. To develop the basic concept and different phases of operation (cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying) of down-stream processing.

CO4. To understand the mechanism of industrial production of alcoholic beverages, antibiotics, solvents, vitamins and industrial enzymes using microbial fermentation process with special reference to micro-organisms involved, media, fermentation conditions, downstream processing and their uses.

CO4. It deals with one of the important industrial process of enzyme immobilization describing the methods of immobilization and large scale applications of immobilized enzymes.

BMB 602: RECOMBINANT DNA TECHNOLOGYTheory Credit: 4

After successful completion, this course enables students

CO1. To get the basic concept of recombinant DNA technology which is the basis of genetic modification of cellular organisms.
CO2. To understand the types, nature and functions of restriction enzymes that act as the mediators of DNA modification during genetic manipulation process.
It also gives an insight into the concept of different vectors (plasmids, cosmids, phagemids, and artificial chromosome vectors) that act as carrier of DNA fragment between cellular organisms during genetic modification.

CO3. To get an insight in to the methods in molecular cloning process for transformation and delivery of gene with special emphasis on different blotting techniques (Southern, Northern and Western) in hybridization process.

CO4. To understand 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.
It also describes the construction and screening genomic and c- DNA libraries.

CO5. To learn the application of recombinant DNA technology for the production of human therapeutic agents (insulin, HGH, recombinant vaccines) and transgenic crops.

BMB 603 ADVANCES IN MICROBIOLOGY Theory Credit: 4

After successful completion, this course enables students

CO1. To have an advanced concept in microbial science with special emphasis on microbial genome sequencing and horizontal gene transfer technique.

CO2. To understand the evolution of bacterial virulence through the concept of genomic (GI) and pathogenicity islands (PAI).

CO3. To develop the concept of metagenomics and its utilization in understanding microbial diversity.
It also gives the idea advanced techniques of meta- transcriptomics, metaproteomics and metabolomics.

CO4. To get an insight in to the molecular basis of host-microbe Interactions with special emphasis on virulence and antimicrobial resistance in case of plant and animal pathogens.

CO5. To develop the idea on the networking in biological systems (Quorum sensing) and future implications of synthetic biology with respect to bacteria and viruses.

BMB 604 BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTSTheory Credit: 4

After successful completion, this course enables students

CO1. To get the idea of biosafety issues in biotechnological processes as well as the biosafety guidelines and regulations (National and International) in case of the application of GMOs/LMOs.

CO2. To get an insight in to the concerns and challenges associated with GMO applications in food and agriculture.
It also deals with the assessment, analysis and management of risk in application of GMOs as well as International Agreements related to this.

CO3. To get an insight in to the guidelines for using radioisotopes in laboratories, safety measures and disposal mechanism.

CO4. 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.

CO5. 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.

BMB 605: Practical on Industrial Microbiology and Recombinant DNA Technology

Practical Credit: 4

This practical course concerned with genomic modification of important microbes through R-DNA Technology and their industrial application to get new and novel products. After successful completion, this course enables students

CO1. To understand structural parts and working process of industrial fermenter (a visit to fermentation industry, included as a part of the practical, gives an exposure to the students in learning the use of a fermenter).

CO2. To understand the process of microbial fermentations for the production and estimation of enzyme (amylase and protease), amino acid (glutamic acid), organic acid (citric acid) and ethanol.

CO3. To understand the principle and process of bacterial transformation.

CO4. To learn the technique of digestion of DNA (using restriction enzymes), ligation of DNA fragments and analysis by agarose gel electrophoresis

CO5. To learn the technique of DNA amplification by PCR and designing of primers for this process.

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