Department of Biotechnology

Delhi Technological University, Delhi-42

Programme: B.Tech. (Biotechnology)

After completing this course Students should be able to

B.Tech 2nd Year

SEMESTER III	
	BT-251 Applied Mathematics
CO	**Statement**
1	Analyse and measure the central tendency, dispersion. Moments, Skewness, and Kurtosis, Multiplication rule of probability along with Baye's rule.
2	Illustrate the Mathematical expectation and Statistical parameters as well as the Moment generating function.
3	Identify the Probability Distributions and its type.
4	Analyse the Solution of Algebraic and Transcendental Equations of Bisection method.
5	Organize the System of Linear Algebraic Equations such as Gauss elimination method, Crout's method.
	BT-201 Introduction to Biotechnology
CO	**Statement**
1	To define global significance of biotechnology and examine the potential applications of Biotechnology in all sectors of life.
2	To compare and contrast prokaryotic and eukaryotic cellular architecture.
3	To comprehend the functioning of various biomolecules and enzymes and to compare and contrast various microorganisms.
4	To explain the underlying mechanism of gene expression and to explain and appraise genetic engineering of organisms for human welfare and formulate new ideas.
5	To explain and translate separation, purification and identification techniques for biomolecules in research.
	BT-203 Biochemistry
CO	**Statement**
1	Analyse the Properties of water its biogenic properties of water and interactions in biological systems.
2	Compare different types of biomolecules, Nucleic acids-classification, structure and function, Vitamins and Coenzymes.
3	Simplify the concept of Metabolism and Bioenergetics and applications.
4	Analyse the Carbohydrate Metabolism, Metabolic sources of Acetyl Co-A, enzymes and regulation.
5	Explain the Lipid and Cholesterol metabolism.
6	Summarize the Amino acid and Nucleotide Metabolism biosynthesis of nucleotide coenzymes etc.
	BT-205 Genetics
CO	**Statement**
1	Knowledge of the key concepts and various branches of genetics.
2	Understanding of genome and organization of chromosomes and their structure.

3	Understanding about the idea of inheritance at molecular level.
4	Learning various mechanisms involved in genetic changes including mutation and gene transfer.
5	Knowledge of various techniques currently used in genetics.
	BT-207 Fundamentals of Computational Biology
CO	**Statement**
1	To enlist biological databases such as NCBI, PubMed, Entrez, etc., and identify database types, sequence formats, sequence retrieval, and submission.
2	To define genomics and recognize the importance of the Human Genome Project.
3	To perform and apply programming techniques to analyse and manipulate bioinformatics data, including file handling, regular expression-based pattern matching, and utilization of various data structures.
4	To perform Pairwise Sequence Alignment and learn about scoring matrices and the various algorithms involved.
5	To perform Multiple Sequence Alignment and various algorithms involved.
SEMESTER IV	
	BT-202 Molecular Biology
CO	**Statement**
1	To know the molecular mechanism of DNA replication in both prokaryotes and eukaryotes.
2	To comprehend the basic mechanism of transcription and various post-transcriptional processing events for pre-mRNA, pre-rRNA, pre-tRNA.
3	To gain knowledge about gene expression, the structure of ribosomes, mRNA, tRNA, rRNA, and soluble factors involved in translation.
4	To gain insight into the strategies for gene silencing and their application for genetic engineering purposes.
5	To appraise various genetic manipulation, DNA sequencing, DNA amplification, and Nucleic acid analysis techniques.
	BT-204 Drug Design Delivery
CO	**Statement**
1	Illustrate the process of drug discovery and discussing the diverse sources of drugs
2	Examine the traditional vs new age drug design and development
3	Elucidate the receptor theory and role of enzyme kinetics in drug design and development.
4	Outline the role of clinical trials in drug development system
5	Demonstrate the various drug delivery mechanisms for effective active drug concentration.
	BT-206 Microbiology
CO	**Statement**
1	Elucidating the discovery of the microbial world and illustrating the methods of microbial culture and enrichment techniques. Demonstrate the Prokaryotic Structure and Function and analyzing characteristics of viruses

2	Summarize Microbial Nutrition and Growth, mathematical expression of growth, Growth kinetics and examine methods of sterilization
3	Demonstrate the Microbial Taxonomy such as ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual
4	Demonstrate the Microbial Taxonomy nomenclature and Bergey's manual
5	Applications of microbiology in different spheres like environment, medicine, fermentation technology
	BT-208 Advances in Computational Biology
CO	**Statement**
1	Define genetic variations and factors affecting it. List databases for mapping genetic variations and mutations.
2	Make use of Structure Databases such as PDB and MMDB for visualizing structural information of proteins.
3	Define Pharmacogenomics and Personalized Medicine. Summarize the historical perspectives and current scenario.
4	Discuss phylogenetic prediction, types, tree building methods and tree interpretation analysis. Make use of the phylogenetic prediction tools. Differentiate between identity and similarity, orthologs and paralogs.
5	List Soft Computation methods Machine learning, support vector machines, Neural Networks, fuzzy logic, genetic algorithms
SEMESTER V	
	BT 301 Immunology and Immunotechnology
CO	**Statement**
1	Elucidating the molecular and cellular mechanisms involved in immune responses and their contribution to immunity and disease prevention.
2	Exploring the different types of immune cells, their roles in humoral and cellular immunity.
3	Understanding the concepts of immunological tolerance, autoimmunity, hypersensitivity, and immunodeficiencies, and their clinical implications.
4	Application of knowledge of immunology for development of immunotherapies in infectious diseases, tumor therapies and vaccine development.
5	Development of immunological diagnostic techniques and their applications
	BT 303 Genetic Engineering
CO	**Statement**
1	Understanding of basic principle of gene cloning and vectors used for cloning in different type of cells.
2	Knowledge of various tools and enzymes deployed for manipulation and modification of DNA.
3	Comparison of various methods deployed for gene delivery in host and identifying recombinant cells.
4	Learning of skills for construction of DNA libraries and utilization of expression system.
5	Appraisal of industrial applications of gene cloning and understanding of various challenges and ethical issues.

	HU-301 Engineering Economics
CO	**Statement**
1	Elucidate the Nature and significance of economics, Preparation of Cost Sheet Profit Maximisation- numerical problem.
2	Demonstrate Money its evaluation and function in Bank, Commercial Bank and Central Bank and brief idea about function of banking system,
3	Elucidate the Role of Science, Engineering and Technology in Economic Development.
4	Explain the Elementary Economic Analysis such as the Interest formulas and their applications.
	BT-302 Plant Biotechnology
CO	**Statement**
1	Understanding of the basic concepts used in plant biotechnology and tissue culturing.
2	Knowledge of production means and mass cultivation using tissue culturing.
3	Analysis of various techniques used in genetical modifications of plant.
4	Knowledge of applicability of transgenics in solving various issues faced by humanity.
5	Learning of regulatory issues and ethical concerns involved in plant genetic engineering.
	BT-304 Animal Biotechnology
CO	**Statement**
1	Enlist basic principles of animal cell culture. Identify serum type's media, characterize, and preserve cell lines. Distinguish between cytotoxicity and viability assays.
2	Define animal diseases and outline the therapy and variation of diseases. Explain modes of transmission of diseases in animal and focus on control and management of diseases spreading.
3	Assess the intricacies of stem cells. Make use of micromanipulation of embryos and summarize the generation of modified stem cells.
4	Describe the basic principle behind transgenic. Distinguish between knock in and knock out animal. Outline the attributes retroviruses and DNA microinjection method.
5	Identify monoclonal antibodies by going through hybridoma technology. Apply use of monoclonal antibodies in diagnostics and therapeutic field.
	BT-306 Genomics & Proteomics
CO	**Statement**
1	To appraise various next generation DNA sequencing technologies and learn the basics of DNA fingerprinting for forensic analysis.
2	To understand the fundamentals of comparative genomics and transcriptomics and to appraise various gene expression profiling and gene function prediction techniques.
3	To comprehend genome-wide protein analysis by sequencing, electrophoretic, chromatographic and spectrometric techniques.
4	To get insight into various techniques for isolation and analysis of DNA-interacting proteins.

5	To appraise various techniques for the isolation and analysis of interacting proteins and to understand the basis of genetic interactions.
	MG-302 Fundamentals of Management
CO	**Statement**
1	Define management its importance, management principals, managerial roles, managerial ethos.
2	Explain the Concept of business environment, corporate social responsibility
3	Illustrate the Objectives and importance of financial management its basics of capital budgeting, and financial approaches.
4	Compare and Contrast marketing vs sales, new product development and some unethical issues in marketing.
5	Elucidate the knowledge of management such as knowledge of society, knowledge of economy, challenges in Indian context for example Digital India programme.
	BT-305 Instrumentation in Biotechnology
CO	**Statement**
1	To elucidate the basics of hydrodynamics and centrifugation. Further application in cell disruption, cell organelle isolation, and extraction of DNA RNA and proteins.
2	To master the electrophoresis techniques in separation and analysis of Macromolecules (DNA, RNA and proteins) and their fragments, based on their size and charge.
3	To get insight into the chromatographic techniques and application of methods in biotechnology, pharmacy, diagnostics, therapy and scientific investigation
4	To apprehend the spectrophotometric principles, instrumentations and its type and applications in diagnostics, therapy and scientific investigation.
5	To master the spectrophotometric principles, instrumentations and its type and applications in diagnostics, therapy and scientific investigation.
6	Understanding of Sensing technology and development of biosensors for medical diagnostics.
	BT-307 Food Biotechnology
CO	**Statement**
1	To understand food biotechnology, scope of food biotechnology and its tools for trade.
2	To master recombinant proteins and their biological roles.
3	To elucidate the application of plant biotechnology in food.
4	To understand cell culture and Food (Brewing, dairy biotechnology, food additives), in Diagnostic Systems.
5	To apprehend biotechnological approach for the exploitation of food and industrially important microorganism, Bio Gas Plant.
6	Explain downstream processing Ethics and safety of food biotechnology products Regulations of food biotechnology.
	BT-309 Object Oriented Programming
CO	**Statement**
1	Discuss the fundamentals of object-oriented paradigm and C++.

2	Outline classes and objects, objectives of C++ and characteristics.
3	Introduce dynamic objects, pointers to objects, array of objects, pointers to object members, this pointer, self-referential classes.
4	Understanding of Operator overloading and Inheritance.
5	Evaluate the generic programming with templates their functions and different types.
6	Analyse data types, byte code and the basics of programming language.
	BT-311 Introduction to Biomedical Engineering
CO	**Statement**
1	Distinguish between different types of roles of biomedical engineering and intro to anatomy and physiology of the human body.
2	Outline basics and principles of rehabilitation engineering.
3	Identify the basic bioinstrumentation system, design, and biomedical sensors.
4	Critically analyse different instrumentations and imaging devices like MRI, biomedical optical imaging.
5	Evaluate the molarity and ethics of biomedical engineering in FDA process.
	BT-313 Thermodynamics of Biological Systems
CO	**Statement**
1	Compare nonbiological and biological thermodynamics systems.
2	The course familiarizes the students with the laws of thermodynamics.
3	Fabricate the chemical potential of the laws in biological state.
4	Explain non-equilibrium thermodynamics using Fick's law.
5	Evaluate thermodynamics in biological systems.
	BT-315 Current Topics in Biotechnology
CO	**Statement**
1	Classify stem cell research based on its characteristics, types and application.
2	Explain the different types of nuclear and molecular medicines.
3	Outline emerging field of nanotechnology and its applications.
4	Identify the type of GMO's their production and their current status.
5	Apprehend the applicability of biotechnology in Pharmacogenetics and translational research:
	BT-317: Enzymology and Enzyme Technology
CO	**Statement**
1	Compare and contrast different types of enzymes, their classification and application in various fields.
2	To know the enzyme mechanisms its regulation and kinetics of enzyme catalysed reaction.
3	Understand Immobilization of enzymes, their methods of kinematics.
4	Implement knowledge of enzyme reactor and analyse the mass transfer reaction.
5	To gain knowledge about the design of bioprocess, its physical parameters and stability.
6	Analyse and interpret the different industrial based bioprocess using different case studies.
	BT-319: Drug Design and Delivery

CO	Statement
1	Illustrate the process of drug discovery and discussing the diverse sources of drugs
2	Examine the traditional vs new age drug design and development
3	Elucidate the receptor theory and role of enzyme kinetics in drug design and development.
4	Outline the role of clinical trials in drug development system
5	Demonstrate the various drug delivery mechanisms for effective active drug concentration.
	BT-321: Bioprocess Plant Design
CO	**Statement**
1	Outline the key technologies used in bioprocess plant design.
2	Discuss construction material for a bioprocess plant and its mechanical design.
3	Compare designs of bioreactor to ensure its sterility of equipment using different case study.
4	Knowledge of mass transfer equipment designing and utilities in Biotechnology.
5	Explain Production plants; Process economics; Bioprocess validation; Safety considerations. Case studies.
	BT-323 Population Genetics
CO	**Statement**
1	Discuss basic scope and promises of population genetics.
2	Identify the population structure using various methods like hardy Weinberg equilibrium and Darwinian selection.
3	Differentiate between population genomics and proteomics.
4	Analyse evolutionary process using quantitative methods.
5	Define uniselection, quantitative traits and developmental constraints.
6	Define the genetic variation in the given population.
	BT- 325 Cell Biology
CO	**Statement**
1	To compare and contrast prokaryotic and eukaryotic cellular architecture and understand the mechanisms behind cell motility, shape, and strength.
2	To explain the underlying mechanism of cell cycle, cell division and programmed cell death.
3	To comprehend cell communication mechanisms.
4	To understand the process of protein targeting to various organelles.
5	To get insight into the causes of cancer and to devise strategies for specifically targeting cancer cells.
	BT -308 Stem Cells and Regenerative Medicine
CO	**Statement**
1	Explain basics of stem cells and tissue engineering.
2	Describe regenerative medicine, repair and regeneration of tissues for therapeutic purpose.
3	Develop understanding of molecular targeted therapies in blood disorder and malignancy.
4	Identify latest developmental and molecular biology of regeneration.
5	Develop knowledge of practices and principals of tissue engineering.

6	Discuss on stem cells whether it is a cure or diseases.
	BT-310 Biopolymers
CO	**Statement**
1	Develop the understanding of the basics of the biopolymers, bioplastics like starch based, cellulose based.
2	Identify the classes of biodegradable polymer which can be natural, synthetic, and modified.
3	Identify mechanisms of improvement of properties by incorporating different elements.
4	Compare bioplastics and bio composites, processing of bioplastics and biocomposites.
5	List the uses of biomaterials for manufacture of plastic films, various types of films and application.
	BT-312 Metabolite Engineering
CO	**Statement**
1	Develop a basic understanding of the concepts of metabolite engineering and overview of cellular metabolism.
2	Detailed knowledge of synthesis of primary and secondary metabolite.
3	Identifying the factors affecting bioconversion and application.
4	Integration of anabolism, catabolism and regulation of enzyme production.
5	Applicability of metabolic engineering in bioinformatics.
	BT-314 Ecology and Evolution
CO	**Statement**
1	Appraise the relevance of studying ecology and its history.
2	List abiotic factors, laws of limiting factors and other laws.
3	Define ecosystem, community, sustainable development trophic levels and nutrient cycles.
4	Discuss basics of evolution like Lamarckism, Darwinism, Neo-Darwinism.
5	Impart knowledge of Population Genetics and evolutionary changes.
	BT-316 Transgenic Technology
CO	**Statement**
1	Compare different types of vectors –bacterial, plant and animal and the method of transformation of vectors.
2	Discuss nuclear transfer, therapeutic cloning, gene targeting and their application.
3	Outline the production of recombinant biopharmaceuticals, learning improved production of alcohol, fructose and glycerol.
4	Discuss transgenic technology in plant and agriculture and list the applications, developing plants with improved quality.
5	List biosafety guidelines for the recombinant DNA, and implementation of this by national regulatory mechanism for handling GMOs.
	BT-318 Bioenergy and Biofuels
CO	**Statement**
1	Discuss biofuels production process, importance and knowing status of research in India.

2	Summarize process technology for bioethanol production using sugars, starch, and lignocellulose.
3	Identify lipids as a source of biodiesel its methods of production from microalgae and future prospect.
4	Discuss the production of biohydrogen by anaerobic bacteria and photosynthetic algae, also about the factors affecting it.
5	Explain microbial fuel cell development their design and performance.
	BT-320 Genomics in Medicine
CO	**Statement**
1	Discuss involvement of biotechnology and genomics in medicine like gene medicine, disease models and their impact.
2	Compare between functional and comparative genomics, learning another genomics including mutational genomics.
3	Identify causative microbes, molecular epidemiology, host resistance to infection.
4	List applications of genomics in genetic diseases like detection and treatment of single gene disorder.
5	Explain molecular basis of cancer, genomics impact and methods in cancer therapy.
6	Perform case studies of cardiovascular and single gene disorder, therapies and application.
	BT- 322 Protein Engineering
CO	**Statement**
1	Compare and contrast between different types of bonds like covalent, ionic, hydrogen and van der walls interaction in protein structure.
2	Understand amino acid structure, their molecular properties and chemical reactivity in relation to post –translational modification.
3	Analyse and determine primary, secondary, super secondary and tertiary structure of protein.
4	To know the relationship between structure and function of DNA binding proteins, prokaryotic and eukaryotic transcription factors.
5	Identify and analyse protein by 2D analysis, Mass Spectrometry.
	BT-324 Biodiversity and Bio-resource Planning
CO	**Statement**
1	Discuss biodiversity different aspects like agriculture and animal flora and fauna, factors affecting biodiversity changes.
2	Outline roles of plants, microbes and animal in natural ecosystems and life also supports importance of traditional cultivators and wild species in agriculture.
3	Discuss management of agrobiodiversity, human animal conflict and its impact on distribution and consequences.
4	List uses and applications of animal, domestic livestock. Also, primary, and secondary metabolite from plants animals and microbes.
5	Discuss international conventions, national laws policies, action plans and treaties for conservations of forest, wildlife, biodiversity and other bioresources.
	BT-326 Medical Microbiology
CO	**Statement**

1	Enlist various bacteria, microorganism like staphylococcus, streptococcus, pneumococcus, vibrio etc.
2	Summarize life cycle, morphology, disease, and lab diagnosis of various protozoans and nematodes.
3	Define morphology, diseases and lab diagnosis of many virus pathogens.
4	Analyse morphology, structure, classification of fungi and learning its process of nutrition and cultivation.
5	Apply medical knowledge in microbiology to know about urinary tract infection, nosocomial infections, and introduction to immunization.
	BT-328 Bioinformatics Approaches in Complex Disorders
CO	**Statement**
1	List different types of disorder and the interplay of genetical and environmental factors on this disorder.
2	Explain genome sequence and extract information related to length of the sequence, organism specificity and evolutionary origin
3	Identify relationship between genotypes and phenotypes.
4	Construct database interface, collect and retrieve sequences.
5	Analyse on the basis of sequence and structure by comparing them and find similarity, identity and variation.
6	Utilize machine learning technique and develop algorithms based on requirements.
	BT401 B.Tech Project - I
CO	**Statement**
1	Discover potential research areas in the field of Biotechnology.
2	Conduct a survey of several available literature in the preferred field of study.
3	Compare and contrast the several existing solutions for research challenge.
4	Demonstrate an ability to work in teams and manage the conduct of the research study.
5	Formulate and propose a plan for creating a solution for the research plan identified.
6	To report and present the findings of the study conducted in the preferred domain.
	BT403 Training Seminar
CO	**Statement**
1	Identify, interpret, and construct appropriate messages for a variety of contexts
2	Display oral and written skills in the English language in different scenarios of business communication.
3	Enhance the proficiency to use appropriate language for technical writing.
4	Demonstrate good comprehension, inference making, vocabulary building, paraphrasing, and summarizing.
5	Explain the summary of research paper using Power point presentation studied by the student.
	BT-405 Fundamentals of Computational Biology
CO	**Statement**
1	To enlist biological databases such as NCBI, PubMed, Entrez, etc., and identify database types, sequence formats, sequence retrieval, and submission.
2	To define genomics and recognize the importance of the Human Genome Project.

3	To perform and apply programming techniques to analyse and manipulate bioinformatics data, including file handling, regular expression-based pattern matching, and utilization of various data structures.
4	To perform Pairwise Sequence Alignment and learn about scoring matrices and the various algorithms involved
5	To perform Multiple Sequence Alignment and various algorithms involved.
	BT-407 Bioprocess Technology & Downstream Processing
CO	**Statement**
1	Distinguish between bioprocessing vs. chemical processing. Understand the basics of cell culture techniques, media design and inoculum development and aseptic transfer methods.
2	Compare and contrast primary and secondary metabolite, their process technology and extraction of metabolites from plant and animal cell culture.
3	Apply the knowledge for understanding an industrial set up to produce products such as microbial enzymes, biomass, biofertilizers and biopesticides.
4	To gain knowledge about characteristics of bio products, cell disruption methods and mechanical methods of separation.
5	To gain insight to the working of downstream processes at an industrial scale. Summarize solid liquid separation- Protein precipitation, aqueous two-phase extraction.
6	Understand the types and uses of chromatography, crystallization and drying.
	BT402 B.Tech Project - II
CO	**Statement**
1	Discover potential research areas in the field of Biotechnology.
2	Conduct a survey of several available literature in the preferred field of study.
3	Compare and contrast the several existing solutions for research challenge.
4	Demonstrate an ability to work in teams and manage the conduct of the research study.
5	Formulate and propose a plan for creating a solution for the research plan identified.
6	To report and present the findings of the study conducted in the preferred domain.
	BT-404 Advances in Computational Biology
CO	**Statement**
1	Define genetic variations and factors affecting it. List databases for mapping genetic variations and mutations.
2	Make use of Structure Databases such as PDB and MMDB for visualizing structural information of proteins.
3	Define Pharmacogenomics and Personalized Medicine. Summarize the historical perspectives and current scenario.
4	Discuss phylogenetic prediction, types, tree building methods and tree interpretation analysis. Build phylogenetic trees and analyse phylogenetic relations. Differentiate between identity and similarity, orthologs and paralogs.
5	List Soft Computation methods Machine learning, support vector machines, Neural Networks, fuzzy logic, genetic algorithms.
	BT-409 Concepts in Neurobiology
CO	**Statement**

1	Explain the working of the nervous system, its membrane and action potential while also learning its development and neurogenesis.
2	Distinguish the nervous system into central and peripheral nervous system.
3	Define the movement, memory and learning of the neural control system.
4	Discuss various network of neuroendocrine –immune system and homeostasis.
5	Analyse various neurodegenerative disease like sleep and wakefulness also different types and stages of sleep and memory Diseases of the nervous system.
6	Outline new approaches which can be used in neuroscience.
	BT-411 Industrial Biotechnology
CO	**Statement**
1	Outline the basic concepts of fermentation, upstream and downstream processes.
2	Summarize the production of primary metabolites like organic acid Amino acids and alcohols and production of secondary metabolites like Antibiotics, Vitamins and Steroids.
3	Illustrate production of industrial enzymes, Biopesticides, Biofertilizers, and Bio preservatives
4	Explain production of modern biotechnology products like recombinant proteins, vaccines.
	BT-413 Nanobiotechnology
CO	**Statement**
1	Define and give an overview of nanotechnology and nanoscale materials its effect of length scale on properties also explains bionanotechnology its challenges and opportunities.
2	Define nanomaterials and list its characteristics, Unique functional properties of natural and synthetic biomolecular-sized constructs such as quantum dots and carbon nanotubes.
3	Define biosensors their component, Immobilization of the molecule, and applications of molecular recognition elements also application of various transducing elements as part of nanobiosensors.
4	Give an overview of imaging biological systems, from the cellular level through to whole-body medical imaging and fluorescence spectroscopy.
5	Discuss principles of toxicology its models, experimental toxicology studies and applications, risks and precautions.
	BT-415 Medical Physics
CO	**Statement**
1	Describe the functions of various cellular constituents like action potential and its measurements, functioning of skeletal muscles.
2	Summarize the physics of the lungs and breathing by blood and lungs interactions, measuring the volumes, pressure of lungs and alveoli.
3	List the major components of the cardiovascular system with oxygen and carbon di-oxide exchange in the Capillary System and applying Bernoulli's Principle to Cardiovascular system.
4	Gain introduction to Bio molecules with their structure and properties of mono, di oligo, and polysaccharides.
5	Discuss on structure and properties of amino acids, proteins, nucleic acids, vitamins and minerals.

	BT-417 Plant Bioinformatics
CO	**Statement**
1	Outline importance of plant bioinformatics, protein and Gene Information Resources PIR, SWISSPROT, PDB, gene bank.
2	Describe plant specific genomic data and resources like HarvEST, TARI database, legume resources, Grain Genes, Maize GDB, Grameen.
3	Find software used to discover phylogenies their use and status of specimen data, also learning the current priorities in biodiversity informatics its challenges and future prospect.
4	Explain KEGG Bioinformatic Resource for Plant Genomic Research its tools, Resources, and management system.
5	Apply annotation gene ontology, manual and computational annotation on plants using several plant GDB resources.
	BT-419 Cancer Biology
CO	**Statement**
1	Gain introduction to cancer by learning its nature, types, discovery of oncogenes and relation to mutation.
2	Explain the process of DNA replication, Mechanisms of oncogene activation and the role of growth factors and receptors in carcinogenesis.
3	Describe cell cycle control, pRb tumour suppressor, apoptosis and the basics p53 tumour suppressor.
4	Discuss on cellular senescence, telomeres, cellular immortalization, and tumorigenesis, Cancer stem cells, DNA repair defects and their relationship to cancer.
5	List various methods and their application in treatment of cancer like traditional chemotherapies, immunotherapy targeted therapy, new genomic and proteomic technologies.
	BT-421 Pharmacogenomics and Personalized Medicine
CO	**Statement**
1	Introduction to the roots of pharmacogenomics, learning its historical perspectives and status.
2	Understanding computational genome analysis of human genome.
3	Analysing of aspects influencing the method of selection and differentiating SNP and TaqMan Genotyping.
4	Analysing of aspects influencing the method of selection and differentiating SNP and TaqMan Genotyping.
5	Practical knowledge from different case studies.
	BT-423 Technological Advancements in Food Technology
CO	**Statement**
1	Compare and contrast material science by learning its properties, classification, crystal geometry, Structure determination by X-ray Diffraction- Crystalline and Non-crystalline.
2	Gain in depth knowledge of food technology and its various aspects.
3	Analyse different types of chromatography, learning their principles and applying different techniques of chromatography in food analysis.
4	Distinguish different methods of manufacture of various foods, fruits and

	vegetables also learning the basics of preservation treatments of food.
5	Design food packaging in detail by learning testing of packaging, effect of environmental factors in packaging and Vacuum Packaging.
6	Define various laws, organisations and their structure relate dot food analysis, which helps in keeping the food safe and learning of nutritional labelling.
	BT-425 Biomaterials
CO	**Statement**
1	Explain biomaterials by learning its definition, requirements, properties, effects of physiological fluid and biological responses involved in biomaterials.
2	Differentiate various metallic implant material like stainless steel Co-based alloys, Ti-based alloys and their corrosion behaviour
3	Distinguish between different types of bio ceramics, composite implant materials and learning mechanics of improvement of properties by incorporating different elements.
4	Classify of different polymeric implant material and describing use of biodegradable polymers for medical purposes.
5	Interpret the biocompatibility of biomaterials by methods like blood compatibility Toxicity tests and In-vitro and In-vivo testing.
	BT-427 Pharmaceuticals Sciences
CO	**Statement**
1	Infer the classification and nomenclature of organic pharmaceutical compounds and their different types of effects like steric, inductive and mesomeric effect.
2	Compare physiochemical properties of drugs in relation to biological, its effect on drug receptor interaction.
3	Know the basics of drug metabolism and its various topics like Oxidative Reductive, Hydrolytic and Conjugative.
4	Define toxicity, tolerance, dependence, addiction, interaction and reaction of drug with various factors like diseases and food.
5	Perform survey of various drug classes like Anaesthetics, Analgesics, Neurotransmitters CNS depressants, CNS stimulants, Antibiotics and Steroids.
	BT-406 Agriculture Microbiology
CO	**Statement**
1	Understand the basics of Microbiology by going through its history and study the role of microbes in different fermentation processes.
2	To comprehend the mechanism of ATP generation in bacteria during respiration, fermentation and understand the structure and properties of Bacteriophages.
3	To gain knowledge about different of microbes and their roles in biological nitrogen fixation and composting.
4	Understand microbiology of food spoilage and principles of food preservation.
5	Apply the benefits of microorganisms in agriculture as Biofertilizer, microbial insecticides, biogas production.
6	To know the interaction of microbe with plants and use of calcium, nitric oxide and salicylic acid in plant development.
	BT-408 Bioethics and Intellectual Property Rights
CO	**Statement**

1	Outline the basics of Intellectual Property Rights, its history, evolution of IPR like patent, design and copyright, WIPO, WTO and property right.
2	Summarize patents and understand the process of applying, requirement, and classification.
3	Identify the need of biosafety and other regulatory framework for the safety of living organisms.
4	Discuss the relationship between IPR and biosafety Benefits of transgenics to human health, society, and the environment.
5	List ethical issues related to healthcare & medicine, food & agriculture, genetic engineering, and testing.
	BT-410 System Biology
CO	**Statement**
1	Explain system biology and its importance in reshaping our understanding of biochemical pathways.
2	Analyse networking in systems biology and how perturbations affect the overall network.
3	Elaborate complex systems and their topological and network evolution models, differentiating between the types of biological networks.
4	Interpret Dynamical Systems by computation with MATLAB, and other Computational Model of the cell.
5	Integrated analysis of system biology by experimental design and discuss the issues of reproducibility.
	BT-412 Advance Bioanalytical Techniques
CO	**Statement**
1	Distinguish between different types of microscopies like confocal and fluorescence microscopy, also learning basics of SEM, TEM, atomic force microscopy and various other dynamic methods.
2	Outline the basics of spectroscopy by electromagnetic radiation and Spectrum, also studying interaction of Radiation with Matter including Bear –Lambert Law and other techniques.
3	Define X ray spectrometers in detail with its equipment's, principle and other devices which follow the same principle like X-ray absorption meter, X-ray fluorescence spectrometry.
4	Discuss principle and working dynamics of various hybrid techniques like GC-MS, LC-MS and ICP-MS.
5	List immunochemical methods like immunoassay immunodiffusion and rocket immunoelectrophoresis.
6	Summarize the working of flow cytometry its Fluorochromes, fluorescence and data analysis of readings on flow cytometry also understand isoelectric focusing and 2-Dimensional polyacrylamide gel electrophoresis and their uses.
	BT-414 Clinical Biotechnology
CO	**Statement**
1	Identify basic principles of photometry and fluorometry and understanding the water & mineral metabolism distribution of fluids in the body.
2	Functions & assessment of Liver based on carbohydrate metabolism, Protein metabolism, lipid metabolism, measurements of serum enzyme levels, bile

	pigment metabolism and jaundice.
3	Analyse and application of Immunodiffusion Techniques like radioimmunoassay & ELISA principles & applications.
4	Outline the principle, types & applications of electrophoresis & PCR.
5	Identify cardiac profile Pattern of Cardiac Enzymes in heart diseases.
6	Explain principal advantage and disadvantage of different methods Different methods of Glucose and Cholesterol Estimation.
	BT-416 Plant Metabolic Engineering
CO	**Statement**
1	Illustrate classification, synthesis and degradation of sucrose and starch and learn diurral fluctuations in plants and their regulation.
2	Summarize photosynthesis whole process including light absorption and energy conservation, pigment systems I and II and their structural organization, electron transport and ATP synthesis.
3	Discuss synthesis and degradation of fats and fatty acids and α- and β-oxidation.
4	Construct pathways and networks and analyse the importance of secondary metabolites in medicine and agriculture.
5	List the steps involved in pathway engineering for new products and new pathways and redirecting metabolic flow desensitization of feedback inhibition.
	BT-418 Crop Protection and Pest Management
CO	**Statement**
1	Perceive the losses in crops due to pest and realize their importance. Classify plant diseases and understand their causes and symptoms.
2	Explain genetics of pathogenicity, Pathotypes and Mechanism of disease resistance.
3	Analyse of genetic engineering for improvement of disease resistance, Genetic manipulation of Crops for insect resistance, herbicide resistance and abiotic stress resistance.
4	Identify concepts and techniques for biological and chemical control like Bio-organism for pest management, Bt based pesticides, Baculovirus pesticides, Mycopesticides, production and formulation technologies.
5	Outline the principles of integrated Pest Management (IPM), IPM practices for important crops.
	BT-420 Biosensors
CO	**Statement**
1	Define biosensors and understand its history, properties, design features and the biological component.
2	Distinguish between different type of biosensors like amperometric and potentiometric biosensor and detecting of various cations using calorimetric biosensor.
3	Show overview of sensors and transducers measurement systems their Classification and Important design considerations.
4	List examples of biosensors with the relatable opportunities and obstacles. And learning about miniaturized devices in nanobiotechnology.
5	Discuss the Future of Biosensors and Transducers and the importance of computers in sensor and transducer technology.

	BT-422 Green Energy Technology
CO	**Statement**
1	Classify energy sources; review conventional energy resources.
2	Discuss solar radiation and its measurements, prediction, and utilization of solar radiation in different aspects.
3	Identify biomass generation, utilization and Properties and learning techniques for biomass assessment, Bio-based chemicals, and materials.
4	Outline principles and conversion of wind, ocean, geothermal & waste energy into each other.
5	Define and distinguish between green chemistry and green nanotechnology.
	BT-424 Nutraceuticals
CO	**Statement**
1	Define nutraceuticals and outline basis, properties, structure, and functions. Classify them into different groups.
2	Analyse nutraceuticals in diseases management especially for cancer, diabetes, cardiovascular and cholesterol management.
3	Discuss development and manufacturing of nutraceuticals and identifying analytical techniques in it.
4	Outline interactions of prescription drugs and nutraceuticals and analyse adverse effects and toxicity of nutraceuticals.
5	Explain nutrigenomics and its relation to nutraceutical, Scope of genetic engineering in nutraceutical production.