Chaitanya Bharathi Institute of Technology (Autonomous)
Department of Biotechnology
B. Tech Biotechnology Program Outcomes (POs)

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems

2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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DEPARTMENT VISION AND MISSION

VISION

To excel in education, research and entrepreneurship in various fields of Biotechnology for contribution to the evolving needs of the society

MISSION

1. To provide an excellent educational experience to the undergraduate students of Biotechnology through quality teaching and advanced curriculum with roots into the fundamentals, that enables students to become leaders in their chosen field of Biotechnology

2. To provide vibrant learning and research environment that enables students to focus on lifelong learning to transform into entrepreneurs, and renowned researchers

3. To instil the spirit of innovation and creativity in young minds through participation in International and National level conferences/hackathons combined with a deep awareness of ethical responsibilities to profession and society

PROGRAM EDUCATIONAL OBJECTIVES (PEOS):

The Biotechnology department is dedicated to graduating engineers who,

1. Will demonstrate successful careers in industry through scientific thinking, interpreting, analysing experimental results and pursue higher education and research in reputed national and international institutes.

2. Will demonstrate leadership and initiative to advance professional and organizational goals with a commitment to ethical standards of profession, teamwork, and respect for diverse cultural background

3. Will be involved in lifelong /self-learning to keep abreast with the constantly evolving technologies for establishing start-ups and becoming successful entrepreneurs.

4. Will be committed to creative practice of engineering and other professions in a responsible manner contributing to the socio-economic development of the society.

B. Tech (Biotechnology) Program Specific Outcomes (PSOs)

[In addition to POs]

The student should be able to

1. Apply the concepts of Biotechnology in the fields of health care, agriculture, biofuels, food industry, and other relevant areas

2. Demonstrate adequate proficiency in good lab practices by adopting standard operating protocols and illustrate independent, safe and accurate handling of the biotechnology lab equipment

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Chaitanya Bharathi Institute of Technology (A)

Department of Biotechnology

Course Outcomes Statements for 2023-24

Semester – I

S. no.	Course Code	Course Name	Course Outcomes
1	22MTC03	MATHEMATICS-I	1. Calculate the elementary transformations of trigonometric functions.
			2. Evaluate the limit and Continuity of the functions
			3. Calculate the differentiation of functions.
			4. Apply the matrix methods to solve the system of linear equations.
			5. Solve the Cubic and Bi-quadratic equations
2	22BTC01	BASICS OF BIOLOGY - I	1. Outline the theories behind the origin of life and evolution studies.
			2. Describe the structure and functions of plant cell and its organelles.
			3. Relate the plants based on the habit and habitat and mechanism of seed development in plants.
			4. Infer the basic physiological processes in plants and various methods of crop improvement.
			5. Demonstrates characteristics of bacteria, fungi, virus and explains virus related diseases and economic importance of microbes.
3	22CYC01	CHEMISTRY	1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
			2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
			3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
			4. Classify the various methods used in treatment of water for domestic and industrial use.
			5. Outline the synthesis of various Engineering materials & Drugs.
4	22EEC01	BASIC ELECTRICAL ENGINEERING	1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
			2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
			3. Infer the basics of single phase transformer

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			4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
			5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.
5	22CSC01	PROBLEM SOLVING AND PROGRAMMING	1. Understand real world problems and develop computer solutions for those problems.
			2. Understand the basics of Python.
			3. Apply Python for solving basic programming solutions.
			4. Create algorithms/flowcharts for solving real-time problems.
			5. Build and manage dictionaries to manage data.
			6. Handle data using files.
6	22CYC02	CHEMISTRY LAB	1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
			2. Estimate the amount of chemical substances by volumetric analysis.
			3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
			4. Calculate the concentration and amount of various substances using instrumental techniques.
			5. Develop the basic drug molecules and polymeric compounds.
7	22MBC02	COMMUNITY ENGAGEMENT	1. Gain an understanding of Rural life, Culture and Social realities.
			2. Develop a sense of empathy and bonds of mutuality with Local Communities.
			3. Appreciate significant contributions of Local communities to Indian Society and Economy.
			4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
			5. Utilise the opportunities provided by Rural Development Programmes.
8	22CSC02	PROBLEM SOLVING AND PROGRAMMING LAB	1. Understand various Python program development Environments.
			2. Demonstrate the concepts of Python.
			3. Implement algorithms/flowcharts using Python to solve real-world problems.
			4. Build and manage dictionaries to manage data.
			5. Write Python functions to facilitate code reuse.
			6. Use Python to handle files and memory

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9	22MEC37	ROBOTICS AND DRONES LAB	1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
			2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
			3. Demonstrate knowledge of robot controllers.
			4. Use Linux environment for robotic programming.
			5. Write Python scripts to control robots using Python and Open CV.
10	22EEC02	BASIC ELECTRICAL ENGINEERING LAB	1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
			2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
			3. Determine the turns ration/performance parameters of single-phase transformer
			4. Infer the characteristics of DC shunt motor different tests.
			5. Illustrate different parts and their function of electrical components, equipment and machines.

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Semester – II

S. no.	Course Code	Course Name	Course Outcomes
1	22MTC06	MATHEMATICS-II	1. Apply the basic operations on Scalar and Vectors.
			2. Apply the vector differential operators to Scalars and Vector functions.
			3. Solve partial fractions by various methods.
			4. Evaluate definite and indefinite Integral.
			5. Solve the first order ordinary differential equations.
2	22BTC02	BASICS OF BIOLOGY -II	1. Identify the basic structure, function of various animal cell organelles, level of organization and types of tissues in animals.
			2. Explains nomenclature and the animal kingdom classification with its characteristic features.
			3. Explain and identify the lifecycles, diseases, treatment and preventive measures of human pathogens.
			4. Outline population ecology, various biotic and abiotic environmental factors of ecosystem.
			5. To give an insight on genes, chromosome, blood grouping system and gene expression.
3	22PYC07	PHYSICS	1. Demonstrate the physical properties of the light.
			2. Find the applications of lasers and optical fibers in engineering and technology.
			3. Identify different types of magnetic and dielectric materials.
			4. Recall the fundamentals of nanomaterials.
			5. Apply the ideas of quantum mechanics for related problems
4	22CEC01	ENGINEERING MECHANICS	1. Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure
			2. Understand the mechanism of friction and can solve friction problems
			3. Analyse simple trusses for forces in various members of a truss.
			4. Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
			5. Determine moments of inertia, product of inertia of plane and composite areas and mass moments of inertia of elementary bodies,
5	22EGC01	ENGLISH	1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
			2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.

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			3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
			4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
			5. Critique passages by applying effective reading techniques
6	22PYC10	PHYSICS LAB	1. Interpret the errors in the results of an experiment.
			2. Demonstrate the wave nature of light experimentally
			3. Utilize physical properties of magnetic and dielectric materials for various applications
			4. Make use of lasers and optical fibers for engineering applications
			5. Explain light induced phenomenon and motion of electrons in electric and magnetic fields
7	22EGC02	ENGLISH LAB	1. Define the speech sounds in English and understand the nuances of pronunciation in English
			2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
			3. Analyze listening comprehension texts to enhance their listening skills.
			4. Determine the context and speak appropriately in various situations.
			5. Design and present effective posters while working in teams, and discuss and participate in Group discussions
8	22MEC01	CAD AND DRAFTING	1. Become conversant with appropriate use of CAD software for drafting.
			2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
			3. Construct the projections of points, lines, planes, solids
			4. Analyse the internal details of solids through sectional views
			5. Create an isometric projections and views
9	22MEC38	DIGITAL FABRICATION LAB	1. Understand safety measures to be followed in workshop to avoid accidents.
			2. Identify various tools used in carpentry, house wiring and plumbing.
			3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
			4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
			5. Conceptualize and produce simple device/ mechanism of their choice

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Semester – III

S. no.	Course Code	Course Name	Course Outcomes
1	22CSC35	DATA STRUCTURES USING PYTHON	1. Understand Classes, Objects, linear data structures, nonlinear data structures, time complexity.
			2. Use python packages to work with datasets.
			3. Implement sorting, searching algorithms and analyse their performance.
			4. Build optimal solutions using linear and nonlinear data structures, hashing.
			5. Apply pattern matching algorithms for real time problems.
2	22BTC03	PROCESS PRINCIPLES AND REACTION ENGINEERING	1. Grasp the fundamentals of physical variables, dimensions, units, equations with dimensional homogeneity, and measurement conventions, fostering their ability to apply these principles in practical engineering scenarios.
			2. Analyze and present experimental data using graphs, including understanding errors, significant figures, statistics, and logarithmic coordinate graphs, while following proper data plotting procedures.
			3. Confidently compute material balances for biotech processes, applying principles to real cases along with recycle, by-pass, and purge streams.
			4. Solve enthalpy-related challenges in non-reactive and reactive scenarios, and apply energy balance concepts to practical cases within biotechnology processes
			5. To predict growth kinetics and analyze reaction kinetics for biological systems.
3	22BTC04	BIOCHEMISTRY	1. Identify different biomolecule structures and describe the functions of various biomolecules.
			2. Examine the energy yield from the catabolism of carbohydrates and explain the steps in anabolism.
			3. Evaluate the energy yield from lipids and reconstruct lipids.
			4. Outline steps involved in catabolism and anabolism of proteins.
			5. Summarize steps involved in catabolism and anabolism of nucleic acids.
4	22BTC05	MICROBIOLOGY	1. Relate the contribution of various scientists in the development of microbiology
			2. Classify microorganisms based on their characteristics
			3. Apply the concept of culturing microorganisms aseptically

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			4. Explain various ecological aspects of microorganisms like diversity, distribution, specific interactions, and the effect that they have on ecosystems
			5. Illustrate the mechanisms for the propagation of infectious diseases caused by the microorganism
5	22BTC06	CELL AND MOLECULAR BIOLOGY	1. Recognize the structure and functions of cell organelles.
			2. Interpret the knowledge of the transport of metabolites and cell cycle checkpoints in their experimental work.
			3. Distinguish the organization and Replication of DNA, damages, and repairs.
			4. Identify the structure and function of transcripts and the mechanism of transcription by RNA polymerases.
			5. Illustrate the mechanism of translation and post-translation mechanism
6	22BTC07	GENETICS	1. Estimate the laws of inheritance and gene interactions.
			2. Illustrate the types of chromosomes, structure, aberrations, and mutations.
			3. Predict and map the organization of genes due to the linkage and crossing-over mechanism.
			4. Categorize sex determination, the chromosomal basis of genetic disorders, and sex-linked genes.
			5. Illustrate maternal inheritance genotypic frequencies in a population and categorical data analysis.
7	22CEM01	ENVIRONMENTAL SCIENCE	1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
			2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
			3. Contribute for the conservation of bio-diversity.
			4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
			5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.
8	22CSC36	DATA STRUCTURES USING PYTHON LAB	1. Demonstrate Classes, Objects, linear data structures, nonlinear data structures.
			2. Store, retrieve and visualize datasets using Python built-in packages.
			3. Evaluate the performance of sorting and searching techniques.
			4. Build optimal solutions using linear data structures, nonlinear data structures and hashing.
			5. Apply pattern matching algorithms for real time problems.

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9	22BTC08	BIOCHEMISTRY LAB	1. Apply the laboratory safety and standard operating procedures and prepare the solutions and biological buffers.
			2. Estimate and analyze carbohydrates by different methods.
			3. Estimate and analyze amino acids and proteins by different methods.
			4. Estimate and analyze lipids and compare the acid value, Saponification value, and iodine valve of various lipids**.**
			5. Estimate and analyze nucleic acids.
10	22BTC09	MICROBIOLOGY LAB	1. Examine the microbial cell structures using of Bright Field microscope
			2. Demonstrate sterilization of equipment and various types of media
			3. Prepare the basic culture media for the growth of microorganisms
			4. Demonstrate the isolation of pure microbial culture from soil and water
			5. Predict the nomenclature of microorganisms based on their metabolic activity
11	22BTI01	MOOCS/INTERNSHIP – I	1. Gain proficiency in new biotechnological technologies through hands-on experience with real-time projects.
			2. Engage with challenges and cutting-edge technologies in the biotechnology industry for exposure and practical understanding.
			3. Obtain insights into the current technological demands of the biotechnology industry.
			4. Identify, design, and implement solutions for real-world biotechnological challenges.
			5. Effectively communicate biotechnology-related ideas and share learning experiences through reports and presentations

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Semester – IV

S. no.	Course Code	Course Name	Course Outcomes
1	22MTC11	ENGINEERING MATHEMATICS FOR BIOTECHNOLOGISTS	1. Solve the higher order linear differential equations.
			2. Solve Linear and Non-linear Partial differential equations.
			3. Determine the analytic functions.
			4. Expand functions by using Taylor's and Laurent's series and Complex integrals by using Cauchy Theorems.
			5. Solve Nonlinear algebraic and transcendental equations
2	22BTC10	FERMENTATION TECHNOLOGY	1. Gain knowledge on diverse fermentation processes, the historical development of the industry, industrial applications, and emerging trends
			2. Understand about controlling process parameters, media formulation in bioprocesses, and solid-state processes.
			3. Determine the volumetric mass transfer coefficient and factors affecting the same in aerobic fermentation
			4. Apply the knowledge of scale-up and scale-down techniques in fermenters and determine cell growth and sterilization kinetics
			5. Apply the knowledge of different bioreactors like airlift, fed-batch, batch, and continuous in bioreactors while evaluating their performances in bioprocesses industries.
3	22BTC11	IMMUNOLOGY AND IMMUNOTECHNOLOGY	1. Identify immune system components and how they work in a coordinated way.
			2. Differentiate the structure of antigen-antibody and the methods of processing antigen.
			3. Analyze the immune system-related underlying causes of hypersensitivity and complement systems.
			4. Desribe the immune system-related diseases, medical complications, and prevention of diseases.
			5. Apply the principles of immunological techniques in the development of medical diagnostic kits.
4	22BTC12	INSTRUMENTAL METHODS IN BIOTECHNOLOGY	1. Explain the instrumental errors and working of different microscopes.
			2. Describe various techniques to isolate cellular components and products.
			3. Compare various techniques in the purification of cellular products.
			4. Illustrate various electrophoresis techniques to isolate DNA/Protein from a mixture.
			5. Explain the working of various spectroscopic instruments.

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5	22BTC13	THERMODYNAMICS FOR BIOTECHNOLOGISTS	1. Comprehensively analyze heat and work effects within closed systems and cyclic processes.
			2. Learn about the limitations of the First Law of Thermodynamics, the qualitative aspects of the Second Law, entropy calculations for ideal gases, and the application of Maxwell relations and residual properties.
			3. Calculate partial molar properties in binary systems, comprehend chemical potential, Raoult's and Henry's laws, and apply correlations to evaluate activity coefficients, enabling them to analyze solution thermodynamics effectively.
			4. Calculate vapor-liquid equilibria in binary systems and understand the fundamentals of chemical reaction equilibria.
			5. Understand metabolic pathway energetics, energy coupling via ATP and NADH, analyze cell growth energetics, explore microbial growth thermodynamics, and apply energy balance equations to aerobic cultures in cell culture processes.
6	22BTC14	INTRODUCTION TO ANATOMY AND PHYSIOLOGY OF HUMANS	1. Outline the structure of the Human body and explain the structure and function of endocrine glands
			2. Discuss the anatomical structures and the physiological functions of the skeletal, muscular, and digestive systems.
			3. Explain the anatomical structures and the physiological functions of the excretory, circulatory, and respiratory systems.
			4. Describe the anatomical structures and the physiological functions of the nervous system and other sensory systems.
			5. Discuss the anatomical structures and the physiological functions of the reproductive system and the physiology of the blood
7	22EGM01	INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES	1. Understand the history of framing of the Indian Constitution and its features.
			2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
			3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
			4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
			5. Evolve the development of the local governments in India and assess the role of Collector in district administration.
8	22BTC15	FERMENTATION TECHNOLOGY LAB	1. Describe the importance of media and other rheological parameters during the fermentation process

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			2. Analyze the difference between batch and fed-batch processes
			3. Demonstrate the preparation of media and its optimization using the statistical techniques
			4. Estimate the growth kinetics of microorganisms.
			5. Determine the volumetric mass transfer coefficient in fermentation.
			6. Perform fermentation for the production of a metabolite.
9	22BTC16	IMMUNOLOGY LAB	1. Classify the blood groups, cells, and predict the diseases.
			2. Demonstrate bacterial agglutination reactions
			3. Measure the concentration of antigens and serotypes by using precipitation reactions.
			4. Interpret the concentration of the analytes using electrophoretic techniques.
			5. Analyze the importance of ELISA techniques.
10	22BTC17	INSTRUMENTATION LAB	1. Apply the instrumentation techniques to their real-life applications
			2. Demonstrate the preliminary identification of biomolecules by partition chromatography method
			3. Design the experiment to find the molecular weight of an unknown protein
			4. Examine the analytes by using a UV-Visible spectrophotometer, Conductivity meter, Nephelometer, and flame photometer
			5. Justify their results on the separation of biomolecules by differential centrifugation methods.

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Semester – V

S.No	Course Code	Course Name	Course Outcome
1	20BT C18	FLUID MECHANICS AND HEAT TRANSFER	Measure the viscosity of different fluids in bio processing.
			Derive a relation between pressure drop and viscosity.
			Compare and contrast the merits and demerits of different flow measuring devices.
			Calculate the rate of heat transfer through various geometries.
			Calculate the overall heat transfer coefficient in different evaporators and condensers.
2	20BT C19	GENETIC ENGINEERING AND rDNA TECHNOLOGY	Explain the basic principles and tools used in rDNA research starting from the isolation of nucleic acid, enzymes etc.
			Compare various types of cloning vectors and expression vectors and their use in rDNA technology.
			Discuss the principle, types and applications of PCR and molecular markers.
			Describe the cloning strategies and sequencing methods.
			Summarize the high-level expression of proteins in different hosts and production of recombinant proteins for the human welfare
3	20BT C20	PLANT BIOTECHNOLOGY	Describe the theoretical concepts behind the establishment of in vitro techniques.
			Explain the importance and applications of various in vitro techniques.
			Identify methods used for the production of plant secondary metabolites in in vitro at a commercial scale.
			Analyze the appropriate vectors and gene transfer methods for the production of Transgenics.
			Outline the strategies for the production of transgenics for crop improvement and environmental concerns.
4	20MTC24	BIOSTASTICS	Use basic counting techniques to compute probability
			Compute conditional probabilities using Bayes Theorem
			Analyze the probability function using statistical averages
			Distinguishing the data using different methods of hypothesis
			Analyze the data using analysis of variance technique
5	20BT C21	INTRODUCTION TO ANATOMY AND PHYSIOLOGY OF HUMANS	Outline the structure of Human body and explain the structure and function of endocrine glands
			Discuss the anatomical structures and the physiological functions of Skeletal, Muscular and digestive systems.

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			Explain the anatomical structures and the physiological functions of excretory, circulatory and respiratory system.
			Describe the anatomical structures and the physiological functions of nervous system and other sensory systems.
			Discuss the anatomical structures and the physiological functions of reproductive system and physiology of blood
6	20EG M02	INDIAN TRADITIONAL KNOWLEDGE	Understand philosophy of Indian culture
			Distinguish the Indian languages and literature
			Learn the philosophy of ancient, medieval and modern India
			Acquire the information about the fine arts in India
			Know the contribution of scientists of different eras.
7	20BT C22	FLUID MECHANICS AND HEAT TRANSFER LAB	Calculate the coefficient of discharge of different flow measuring devices and Reynold's Number based on the distinction between the types of flow.
			Determine the friction losses in pipe fittings & verify Bernoulli's Theorem.
			Predict the Thermal conductivity of homogeneous wall insulating powder under steady stat e conditions.
			Determine the heat transfer coefficient in Natural and Forced convection using PIN FIN apparatus.
			Predict the emissivity of a non -black surface.
			Calculate the overall heat transfer coefficient for parallel flow and counter flow in a Double pipe heat exchanger.
8	20BT C23	GENETIC ENGINEERING LAB	Demonstrate the isolation and visualization of nucleic acids.
			Characterize the DNA by restriction digestion and restriction mapping.
			Plan different steps involved in cloning strategies of DNA
			Perform the polymerase chain reaction.
			Analyze the DNA Sequencing and recombinant protein by using SDS PAGE
9	20BT C24	PLANT BIOTECHNOLOGY LAB	Prepare plant tissue culture medium for in vitro studies.
			Execute the protocols for Surface sterilization, Organ culture, and Callus induction using various explants.
			Develop in vitro techniques for micropropagation of meristem /nodal explants of horticulture and medicinal plants.
			Demonstrate the Protoplast isolation from various plant tissues using enzymatic methods.
			Develop a system for genetic transformation in plants using Agrobacterium strains.

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Semester – VI

S.No	Course Code	Course Name	Course Outcome
1	20BT C25	BIOSEPARATION ENGINEERING	Outline the key aspects of downstream processing of biotechnological process and develop process design for bio products.
			Distinguish the various techniques of cell disruption and unit operations for separation of bio products.
			Compare and contrast various membrane separation processes.
			Interpret application of various chromatographic process for separation of bio products.
			Analyze various product finishing techniques and case studies of important bio products
2	20BT C26	BIOINFORMATICS AND COMPUTATIONAL BIOLOGY	Explain various types of biological databases used for the retrieval and analysis of the information
			Identify the methods used for sequence alignment and construction of the phylogenetic tree
			Discuss genome sequencing and gene prediction tools.
			Describe biochemical databases and protein structure prediction tools
			Demonstrate docking methods for Identification of lead molecules
3	20MBC01	ENGINEERING ECONOMICS AND ACCOUNTANCY	Apply fundamental knowledge of Managerial Economics concepts and tools.
			Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
			Understand Production and Cost relationships to make best use of resources available.
			Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
			Evaluate Capital and Capital Budgeting decision based on any technique.
4	20BT C27	ANIMAL BIOTECHNOLOGY	Explain the animal cell culture requirements and techniques.
			Outline the establishment maintenance and scale-up of animal cell culture.
			Discuss Stem cells and their applications and procedure for measurement of cell viability and cytotoxicity and cell death.
			Explain various methods for IVF and embryo transfer, cloning and generation of transgenic animals and their applications.
			Outline various applications of animal biotechnology.

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5	20BT C28	MASS TRANSFER OPERATIONS	Predict the rate of molecular diffusion in solids, liquids and gases.
			Determine the number of trays needed for separation by Distillation.
			Determine the number of trays needed for separation by Extraction and Leaching.
			Calculate the rate and time of drying in constant head and falling rate methods.
			Write the principles and application of membrane separation processes and understand the types of adsorbents.
6	20BT E06	VIROLOGY	Explain classification, morphology of viruses.
			Compare the techniques for cultivation of plant & animal viruses.
			Outline various characterization techniques for detection of viruses.
			Illustrate the structural, functional and disease control measures of plant viruses.
			Describe the classification, pathogenesis of animal viruses and therapeutic strategy for vaccine development.
7	20BT E07	MEDICAL BIOTECHNOLOGY	Outline the various diagnosis and treatment of Cancer.
			Explain the concepts of Stem cell therapy and Tissue engineering.
			Discuss the principle and applications of biomedical devices and molecular diagnostics.
			Classify the molecular therapies and bioethical issues.
			Classify the molecular therapies and bioethical issues.
8	20BT E08	PHARMACEUTICAL BIOTECHNOLOGY	Summarize the fundamentals of biopharmaceuticals.
			Explain the ADME properties of drugs, pharmacokinetics, pharmacodynamics, and drug delivery systems.
			Outline the different manufacturing procedures of drugs.
			Discuss the blood and plasma substitutes.
			Describe the therapeutic activity of drugs used for treating diseases
9	20BT E09	CANCER BIOLOGY	Summarize the etiology of cancer.
			Explain the principles and mode of action of physical and chemical carcinogens.
			Discuss the molecular genetics of cancer.
			Outline the cancer metastasis, diagnosis and different forms of therapy
			Describe the principles of cancer pharmacology.
10	20BT C29	BIOSEPARATION ENGINEERING LAB	Evaluate various techniques for cell disruption, filtration and separation of bioproducts.
			Analyze the optimum protein precipitation technique.

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			Demonstrate chromatographic separation process for a given compound.
			Apply a strategy for final product purification/ polishing of a bioproduct.
			Develop methods for determining enzyme activity.
11	20BT C30	BIOINFORMATICS AND COMPUTATIONAL BIOLOGY LAB	Retrieve the information from biological databases
			Utilize BLAST, FASTA and other online tools
			Use online sequence alignment tools and construction of evolutionary tree by phylogenetic analysis
			Predict gene and protein structure and design primers and construct restriction map.
			Retrieve macromolecular structures and perform docking of a ligand to its target
12	20BT C31	ANIMAL BIOTECHNOLOGY LAB	Demonstrate aseptic culture techniques and preparation of animal cell culture media.
			Identify and enumerate animal cells by using microscopic techniques.
			Apply animal cell culture techniques to the establishment of primary culture.
			Evaluate cell viability and cytotoxicity of animal cell culture.
			Perform the maintenance and preservation of animal cells.
13	EMPLOYABILITY SKILLS	20EG CO3	Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
			Write resumes, prepare and face interviews confidently.
			Be assertive and set short term and long-term goals, learn to manage time effectively and deal with stress.
			Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
			Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

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Semester – VII

S.No	Course Code	Course Name	Course Outcome
1	20BT E10	TISSUE ENGINEERING	Outline the concepts of tissue engineering, ethical issues, and future prospects
			Illustrate the molecular mechanisms at the tissue level and in cell-matrix in tissue engineering.
			Identify in vitro culturing techniques and scale-up designs.
			Classify the compatible biomaterials used for the fabrication of scaffolds in Tissue engineering.
			Summarize the therapeutic applications of tissue engineering.
2	20BT E11	GENOME EDITING	Outline the Genome editing and its tools for genome engineering
			Describe the genome editing strategy and target site
			Explain the Genome editing in Plants for crop improvement
			Discuss the Genome editing in animals and for human welfare
			Summarize the application genome editing and emergent challenges for CRISPR technologies
3	20BT E12	PHYTOCHEMICALS AND HERBAL PRODUCTS	Classify the sources of various crude drugs and their medicinal values.
			Outline the procedures involved in the detection, extraction, and analysis of crude drugs and adulterants.
			Interpret the structure, types and extraction procedure of different plant secondary products.
			Outline the applications of phytochemicals.
			Discuss the various aspects of herbal products and licensing of herbal drugs
4	20BT E13	DEVELOPMENTAL BIOLOGY	Discuss basic concepts of Developmental Biology.
			Describe the anatomy of gametes and biochemistry involved in gamete recognition
			Analyze the role of genes in the body axis formation of drosophila.
			Outline the importance and differentiation of germinal layers into different organs and compare the role of genes in the sex determination of Drosophila and Mammals.
			Explain the genetic anomalies that lead to diseases.
5	20BT E14	FOOD BIOTECHNOLOGY	Apply the fundamentals of food biotechnology to their real-life situation
			Differentiate types of food and explain their nutritive value

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			Examine the types of pathogens and their effect on food
			Demonstrate the physical and chemical methods of food processing.
			Apply the techniques to preserve the food material to avoid food spoilage.
6	20BT E15	NANO BIOTECHNOLOGY	Discuss the multidisciplinary nature of nanotechnology and Nano scale paradigm in terms of properties at the nano scale dimension.
			Describe different methods used for the synthesis and characterization of nanomaterials.
			Interpret various types of nanostructures.
			Summarize general applications of Nanobiotechnology.
			Outline the current applications of Nanobiotechnology
7	20BT E16	GOOD MANUFACTURING LABORATORY PRACTICE	Learn and adopt quickly in a GMP environment and understand the principles and applications of the GMP.
			Evaluate the criteria for drug approval related documentation and quality systems Importance of GMP and GLP for drug regulation
			Describe quality assurance, design of quality systems, risk analysis and risk assessment
			Able to apply knowledge of laws related to drug development approval process and regulations related to clinical trials
			Safely practice basic laboratory procedures and protocols, maintain laboratory records compliant with current industry standards.
8	20BT E17	REGULATORY AFFAIRS AND CLINICAL TRIALS	Classify the role of regulatory committees in controlling the risk and information on ethical issues linked to research on animal models, transgenics.
			Summarize the Government of India rules and regulations about the ICH, GCP, FDA guidelines.
			Discuss the role of regulatory affairs and their significance globally.
			Outline the criteria for drug approval related documentation.
			Discuss the various phases of clinical trials and the basis of approval of new drugs, their outcome in new drug discovery.
9	20BT E18	RATIONAL DRUG DISCOVERY	Describe drug discovery process, CADD, molecular modeling etc.
			Explain the quantum Mechanics and molecular mechanism.
			Identify various molecular dynamics simulation methods.

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			Discuss the methods for Molecular Docking and lead optimization, ADMET properties of the drug.
			Summarize about the Pharmacophore and QSAR.
10	20BT E19	MOLECULAR MODELING & DRUG DESIGN	Calculate the total energy of the molecule by using force field potentials.
			Calculate Internal energy, Heat capacity, Temperature, and pressure.
			Hard sphere potential, Continuous potential by Finite differential method.
			Choosing the initial configuration and analyzing the results of computer simulation.
			Simulation of polymers by Random walk method, Self-avoiding walk method.
			Classification of Drug Design. CADD to treat Alzheimer's and Tuberculosis diseases
11	20BT E20	STRUCTURAL BIOLOGY	Demonstrates the hierarchy in protein organization and structure-function relationship
			Outlines the mechanisms, dynamics, and physical interactions that maintain protein structure.
			Demonstrate the basic techniques involved in determining the structure of a biomolecules
			Assess conceptual basics of structural dynamics of other macromolecules DNA, RNA & enzyme
			Illustrates the computer-based visualizations and molecular simulations
12	20BT E21	GENOMICS AND PROTEOMICS	Describe genomes, types of genomes and the advanced techniques used for analyzing the genome.
			Explain the methods of functional genomics.
			Discuss the various sequencing technology in genomics.
			Describe the tools used for the characterization of proteins
			Explain about personalized medicines their uptake, action and metabolism
13	20EG MO4	GENDER SENSITIZATION	Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
			Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
			Appreciate women's contributions to society historically, culturally and politically.
			Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.

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			Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.
14	20BT C33	PROJECT PART-I	Survey and study of published literature on the assigned topic;
			Working out a preliminary Approach to the Problem relating to the assigned topic;
			Conducting preliminaryAnalysis/Modelling/Simulation/Experiment/Design/Feasibility;
			Preparing a Written Report on the Study conducted for Presentation to the Department;
			Final Seminar, as oral Presentation before a departmental Committee.

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Semester – VIII

S.No	Course Code	Course Name	Course Outcome
1	20BT E22	IMMUNODIAGNOSTICS	Outline the principle, importance, scope, classification of immunodiagnostic tests and antigen-antibody reaction
			Explain the principles and application of immunodiagnostics tests for diagnosing various diseases
			Discuss the production of monoclonal antibodies for diagnosis, treatment, and prevention of disease.
			Describe various methods used for vaccine development.
			Summarize the various novel techniques used in immunodiagnostics.
2	20BT E23	BIOMATERIALS	Explain types and properties of Biomaterials.
			Compare the techniques for manufacture of metallic Biomaterials and their use in health care industry.
			Outline the physiological properties and various techniques for manufacture of ceramic biomaterials.
			Illustrate the preparation of polymer and composite Biomaterials.
			Apply the different type of Biomaterials in health industry.
3	20BT E24	METABOLIC ENGINEERING	Summarize the basic concepts of metabolic engineering.
			Describe the various biosynthesis of secondary metabolites & their applications in various fields.
			Discuss the factors influence the bioconversions and genetic manipulations of metabolic pathways.
			Explain the analysis & applications of metabolic flux.
			Outline the metabolic pathway modeling synthesis using bioinformatics tools and its applications.
4	20BT E25	BIOSIMILAR TECHNOLOGY	Outline the biologics, biosimilars and super biologics.
			Distinguish the various biosimilar drugs
			Compare and contrast various biosimilar characterization methods.
			Interpret various bioequivalence studies.
			Analyze various case studies of biosimilar products of Indian companies
5	20BT C35	PROJECT PART-II	In depth study of the topic assigned;
			Review and finalization of the Approach to the Problem relating to the assigned topic;
			Preparing an Action Plan for conducting the investigation, including teamwork;

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			Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
			Final development of product/process, testing, results, conclusions and future directions;
			Preparing a paper for Conference presentation/ Publication in Journals, if possible;
			Preparing a Dissertation in the standard format for being evaluated by the Department.
			Final Seminar presentation before Departmental Committee.

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