AMITY UNIVERSITY

MADHYA PRADESH

Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

Bachelor of Science (H) Biotechnology

Program Educational Objectives (PEO)

PEO-1: To inculcate the scientific approach to develop deep insight through flexible, research-oriented program to meet the present and futuristic demand of academia and industry.

PEO-2: To develop professional and innovative approach and its impact on human health, agriculture, and environment for sustainable development.

PEO-3: To develop individual and team building ability for providing opportunities for students to manage and work on multidisciplinary projects through interaction with their peers.

PEO-4: To apply the acquired biotechnological and technical skills to inculcate leadership qualities for innovative entrepreneurship.

PEO-5: To acquire leadership qualities, and scientific aptitude for life-long learning.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1. Knowledge: Biotechnology deals with developing knowledge of biological sciences and effective implementation of engineering technologies that manipulate living organisms and biological systems to produce products for advance healthcare, medicine, agriculture, food, Pharmaceuticals and environment control etc.

PO2. General Scope: In general course structure emphasized on distribution, morphology and physiology of microorganisms, in addition to development of skills, working under several aseptic procedures, isolation and identification. This course also includes sophomore level material covering immunology, virology, microbiology, epidemiology and recombinant DNA technology.

PO3. Students understand: Basic Structure and metabolism of Biomolecules, along with instrumentation of several techniques involved in course structure, Atomic theory, Valiancy, Atomic weight.

PO4: Environment and sustainability: Development of fundamental concepts of Ecosystem, energy flow and role of biodiversity in maintaining sustainability.

PO5. Coverage: Courses contain topics covering of several commercial aspects of protecting commercial interests of the applied research, such as intellectual property (IPR) and patents, commercializing

Prof.(Dr.) Kuldip Dwivedi
Dy. Dean & I/c Dean (Academics)
Amity University Madhya Pradesh

AMITY UNIVERSITY MADHYA PRADESH
Maharajpura
Gwalior

technology, promoting entrepreneurship, with lectures and case studies from specific domain business leaders and academic experts.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

Program Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioral attributes.

COURSE OUTCOMES

FIRST SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1.	**BSB 101**	**CELL BIOLOGY**	• Understand the theories given by scientists for the origin of cell along with different types of prokaryotic and eukaryotic cells. • Know the cellular structure of cell organelle and their functions. • Differentiate between chromosomal structures in different stages of a cell cycle. • Understand towards cell differentiation, malignancy and cell death. • Develop verbal and written skills of subject along with interdisciplinary approach.
2.	**BSB 102**	**MATHS AND BIOSTATISTICS**	• The first outcome defines a bridge between the basic mathematical concepts to be used and to explore them regarding further study. • Can apply the concepts of matrix theory and basic calculus to their biological experiments done during the course. • Can apply the statistical concepts to their experiments to get better outputs. • Eligible to identify the applications of correlation in their experiments of lab and real-life problems.
3.	**BSB 103**	**Plant Sciences - I**	• The students will be able to identify basic concepts of algal plants morphology, anatomical features, evolutionary pathways & mode of reproduction. • Understand the role of algae in freshwater, marine and soil environments as primary producers, suppliers of nutrition to animals and as resources for humans. • Study and acquire knowledge about the occurrence, distribution, structure, phylogeny, evolutionary concepts and life history of fungi, lichens & mycorrhiza. • Have a good overview of the general morphology, diversity, distribution, sexual reproduction, diversity of bryophytes, the significance of bryophytes as pioneer plants on land and their role in the origin of

			pteridophytes.
4.	**BSB 104**	**Animal Sciences - I**	• Learn about characteristics and variations of invertebrates. • Develop scientific outlook for research and innovation. • Get knowledge of typical invertebrates and their economic importance. • Develop conservative outlook for animals. • Generate written and verbal communication skills over the subject.
5.	**BSB 105**	**CHEMISTRY - I**	• To understand the very basic bonding mechanism and the application to materials in different field. • To understand the Chemical properties and basic bonding behavior of Radioactive elements • To understand the Chemical properties and basic bonding behavior of inorganic chemistry elements • To understand the Chemical Kinetics, Gas Kinetics, Gas behavior, rate of reaction

SECOND SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1.	**BSB 201**	**INTRODUCTORY BIOCHEMISTRY AND BIOPHYSICS**	• Get familiarize with structures and functions of biomolecules like Carbohydrates, Fats and Nucleic Acids. • Understand the role of covalent and non-covalent bonds, inter-and intramolecular interactions and their contribution to the native conformation of biomolecules. • Know the molecular transport within the cell and across membranes and get familiar with the different laws of Physics that are valid in biological systems. • Calculate energy changes in biological pathways, understand mechanism of light and sound reception. • Understand how electricity can act as potent signal as well the role of neurotransmitters.
2.	**BSB 202**	**BIOANALYTICAL TECHNIQUES**	• Understand the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc.

			• Understand principle instrumentation of chromatographic techniques and their types. • Principle and applications of electrophoresis I.e., PAGE, Immunoelectrophoresis etc. • Understand radioisotope tracer techniques and application. • Develop broad knowledge base, deep theoretical understanding of instruments and their practical implementation in the laboratory.
3.	**BSB 203**	**Plant Sciences – II**	• The students will develop an understanding of the characteristics, life cycles & interrelationships among different forms of gymnosperm. • The course content will help the students to trace the evolutionary history, diversity of gymnosperms & develop an understanding of fossils, fossilization & geological time scale and its significance in the evolution of angiosperms. • The students will develop an understanding of the basis, guiding principles & salient features of the various classification systems of angiosperms. • Know the economic importance of the angiosperm plants. • Systematic position, distinguishing characters and economic importance of some important families like Rutaceae, Cucurbitaceae,Rosaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Lamiaceae, Euphorbiaceae, and Poaceae.
4.	**BSB 204**	**Animal Sciences – II**	• Develop knowledge about Chordates. • Learn about comparative account of vertebrates. • Learn about anatomical & physiological variability among vertebrates. • Generates interdisciplinary and collaborative approach. • Develops ethical and conservative outlook for animals.
5.	**BSB 205**	**CHEMISTRY – II**	• To understand the very basic Stereochemistry, Structure, Bonding

			mechanism & Molar mass so that application of materials in different field can be understood. • To learn & understand the Quantitative & Qualitative analysis of Elements Estimation • To understand the Nomenclature of various Organic Compounds • To understand the behavior and synthesis of various hydrocarbons and its end use & production in industrial scale • To understand the behavior and synthesis of various hydrocarbons and its end use & production in industrial scale • To learn and understand chemical equilibrium and electrochemistry for various applications.
6.		**ENVIRONMENTAL STUDIES-II**	• Explain various types of environmental pollutions. • Understand role of individual in abatement of environmental pollution. • Explain methods to mitigate disasters. • Learn various environmental protection laws. • Learn role of IT in environment and human health.

THIRD SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSB 301**	**GENETICS**	• Understand the concept of classical genetics including Mendelian laws is easily grasped by students. • Understand the basic microbial genetics including prokaryotic gene expression and regulation. • Understand the concept of gene in terms of recon, muton and cistron including both classical and modern concept. • Know various chemical and physical mutagens involved in causing mutation. • Understand the concept of sex determination and populations genetics.
2	**BSB 302**	**MICROBIOLOGY**	• Understand the microbiological techniques for the isolation and characterization of microbes.

			• Understand the mechanism of different metabolic processes. • Know the physiology and survival mechanism of extremophilic bacteria. • Know the concept of virus lytic and lysogenic cycle is quite clear to students. • Understand the epidemiology and microbial pathogenesis.
3	**BSB 303**	**BIOCHEMISTRY AND METABOLIC REGULATION**	• Develop knowledge of biochemical aspects of body. • Learn about important metabolic pathways and their regulation. • Deals with pathways responsible for energy production. • Study of various enzymatic reactions and their role in body. • Develops collaborative and research approach.
4	**BSB 304**	**ANATOMY & PLANT PHYSIOLOGY**	• The students will be conceptually integrated to plant internal structure & their functions • Will further reveal the relationship between the structure, function, taxonomy, ecology and developmental genetics in plants. • The contents of this course will help the students to relate crop physiological processes with water-plant interaction, mineral absorption, transportation & assimilation. • The concept of photosynthesis in plant, the role & significance of pigment system in photosynthesis, components of light and dark reaction, C3 & C4 pathways for carbon fixation & the influence of environmental factors on photosynthesis will be understood by the students. • The students will acquire an understanding of the concept of respiration: mechanisms, factors & its importance.
5	**BSB 305**	**ANIMAL PHYSIOLOGY - I**	• Learn about anatomical and physiological aspects of animal body. • Gain knowledge about functioning of systems of body. • Generate path for further research and innovation. • Enhance new collaborative approaches with

			modern fields of biotechnology.
6	**BSB 306**	**CHEMISTRY - III**	• To understand the very basic Structure, Bonding mechanism and application of materials in different field • To learn & understand the acid and basic concept • To understand the concepts of Coordination Chemistry • To understand the synthesis, properties and application of various inorganic acids in various field • To understand Phase Equilibria law and its application in various field like purification, precipitation, and understanding temperature behavior, and various states of any system

FOURTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSB 401**	**BIOINFORMATICS**	• Understand and explain the structural organization and characteristics of computers and its parts. • Describe the concept of use of internet in bioinformatics. • Explain the concept and organization of biological databases. • Understand and explain the structure and functions of the phylogenetic analytic tools. • Interrogate major database sources and be able to integrate this information with clinical data.
2	**BSB 402**	**MOLECULAR CELL BIOLOGY**	• Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication. • Understand Genetic Codes and Transposable elements • Understand mechanism of transcription and translation in prokaryotes and eukaryotes. • Enhance fine molecular understanding of operon gene regulation ion in prokaryotes. • Understand the mechanism of Oncogenes and Tumor suppressor genes.
3	**BSB 403**	**IMMUNOLOGY & IMMUNOTECHNOLOGY**	• Understand and explain the phylogeny of immune system, types of immunity, immune

			response. • Describe the concept of clonal selection theory, humoral and cell mediated immunity. • Understand and explain the structure and functions of the organs and cells of the immune system. • Understand the mechanism of antigen-antibody interaction. • Describe the structure of antibodies, their types and functions in immunity.
4	**BSB 404**	**PLANT BREEDING, EMBRYOLOGY, PATHOLOGY & ECONOMIC BOTANY**	• The students will develop modern approach to experimental plant embryology from developmental, structural and molecular point of view. • The course will provide in depth information on developmental cycles, regulation of the flowering process, of micro- and macrosporogenesis, on self-incompatibility & on embryo formation. • The students will be able to analyse the historical evolution of plant breeding. Will be able to understand the basic Mendelian genetics, plant reproduction systems and breeding products. • The students will develop an understanding of the four interacting factors necessary for disease to occur: the pathogen, the host, the environment, and time. With knowledge of these factors they will begin to understand the nature of plant disease epidemics and how to manage them. • The students will develop an understanding of the vast economic importance of angiosperms with reference to their use as source of food, fuel, fibers & medicine.
5	**BSB 405**	**ANIMAL PHYSIOLOGY-II**	• Learn about anatomical and physiological aspects of animal body. • Understands functioning of important systems of body. • Develops knowledge about endocrinology and developmental biology. • Leads to enhance interest in research in advanced biotechnology.

			• Exposure with other interdisciplinary subjects of biology.
6	**BSB 406**	**CHEMISTRY – IV**	• To understand the very basic structure, bonding, reaction mechanism and application of various organic compounds like carbohydrates, aromatic compounds, aromatic hydrocarbons • To understand Chemical Thermodynamics, Electrochemistry & Photochemistry concepts

FIFTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSB 501**	**PLANT BIOTECHNOLOGY**	• Handle the basic instruments used in plant biotechnology. • Learn Preparation of stocks for culture media. • Learn surface sterilization of different explants • Understand *in-vitro* germination of seeds, seed viability and their maintenance in lab. • Get training of problems related to germination, callus induction and propagation.
2	**BSB 502**	**ANIMAL BIOTECHNOLOGY**	• Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications. • Understand scale up production of monoclonal antibodies and hybridoma technology. • Understand the structure and function of variety of hormones and growth factors. • Understand the technology and concept behind *invitro* fertilization and embryo transfer, and development of superior live stocks. • Understand the concept of ethical value regarding the use of animal biotechnology.
3	**BSB 503**	**GENOMICS& PROTEOMICS**	• Gain understanding of basic structure of protein and its separation by using various techniques. • Get insight of modeling and *in silico* protein

			structure building. • Get understanding of study of protein – protein interaction using various methods.
4	**BSB 504**	**RECOMBINANT DNA TECHNOLOGY**	• Learn the procedure of DNA isolation from bacteria, plant and animal cell and its purification and modification. • Know various methods of introducing DNA into living cells. • Learn the technique of gene cloning, tools used in it and different vectors used for transforming host cells. • Know the procedure of producing proteins from cloned genes, its uses in medicines with examples and gene therapy. • Learn the theoretical aspects of DNA amplification using PCR and analysis of DNA by various molecular markers.

SIXTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSB 601**	**ENVIRONMENTAL BIOTECHNOLOGY**	• Understand the delicate interrelationship of different components of environment. • Understand conventional fuels, their impact and concept of clean fuel technology. • Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining. • Learn the concept of municipal solid and liquid wastes management and EIA. • Understand the concept and assessment of environmental quality.
2	**BSB 602**	**INDUSTRIAL BIOLOGY**	• Develop an understanding of the various aspects of Bioprocess Technology. • Develop skills associated with screening of Industrially Important Strains and media formulation for industry. • Understand principles underlying design of fermentor, fermentation process and downstream processing • Develop an understanding of the various aspects of dairy Technology.

			• Understand principles underlying immobilization and their application.
2	**BCH 623**	**PRINCIPLES OF MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT**	• Understand the concepts of Management functions and Entrepreneurship development. • Analyze various skills required for Entrepreneurial Development. • Identify, implement and evolve managerial and entrepreneur skills. • Evaluate the learning outcomes. • Enable students to become future leaders and entrepreneurs.

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M. Sc. Biotechnology

Program Educational Objectives (PEO)

PEO1: To impart ability to pursue careers in the industry, agriculture, and applied research.

PEO2: To inculcate domain specific skills and impart knowledge in interdisciplinary areas of biotechnology.

PEO3: To instil professional skills, communication and scientific writing skills and ethics in global scenario.

PEO4: To be able to demonstrate innovative ability, entrepreneurship skills, for contributing to social and national development.

PEO5: To engage in lifelong learning with knowledge of contemporary and futuristic issues related to biotechnology.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

On completion of the course, students are able to understand about:

PO1. General Output: Programme outcome of M.Sc. Biotechnology is to develop competent human resource, the bright biotechnologist's that can cater the growing demand of global biotechnology professionals. The biotech professionals can implement their knowledge base in premium processes and applications which will profoundly influence or utilized for existing paradigm of agriculture, industry, healthcare and restoration of degraded environment to provide sustainable competitive edge to present society.

PO2. Knowledge: Students will imbibe and demonstrate most contemporary and latest knowledge in Biotechnology. This will help students to fill the growing need of professionals by various sectors of pharmaceutical and biotechnological industry.

PO3. Exposure: The sole aim of this course is to provide industrial exposure to the student pertaining to principles adopted and practices followed in industrial/ pharmaceutical sector.

PO4. Research: The sole aim of this course is to familiarize student as to how to carry out problem solution-based research experiments and also to learn skills of research based technical writing.

PO5. Effective Communication: Ability to communicate effectively and develop scientific writing.

PO6. Lifelong learning: Ability to engage in life-long learning in the context of technological change.

PO7. Independent thinking: Inculcation of ability to think independently for problem solving.

PO8. Team bonding: Ability to work in a team towards achieving a common goal and solving broad societal and national issues.

PO9. Ethics: Understanding of professional and ethical responsibility among students to conduct at their workplace.

PO10. Interpretation: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM SPECIFIC OUTCOMES OF M.Sc. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of advanced biochemistry, advanced microbial technology, biophysics and bioanalytical techniques, advanced cell biology and genetics, advanced biostatistics for biologist, advanced molecular biology, advances in genetic engineering, bioprocess technology, advanced genomics and proteomics, computational biology, environmental biotechnology, advanced immunology, enzyme technology, advanced animal biotechnology, advanced plant biotechnology, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop computer application skills to be applied in biotechnology.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

COURSE OUTCOMES

FIRST SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**MSB 101**	**ADVANCED BIOCHEMISTRY**	• Learn carbohydrate metabolism in detail by analyzing all the pathways. • Learn the various aspects of lipid metabolism and their regulation. • Understand the metabolism of Nitrogen and excretion of urea from body. • Learn Nucleotide metabolism and clinical disorders of purine metabolism. • Develop advanced knowledge of action of major hormones and principles and application of primary and secondary metabolites.
2	**MSB 102**	**ADVANCED MICROBIAL TECHNOLOGY**	• Recognize and explain the significant role that microbes play in the world around us. • Explain the similarities and differences of microbes as compared to higher forms of life. • Identify microbes and explain methods of growth and cultivation as well as structural and biochemical differences. • Understand the microbial structure, function, metabolism, growth, genetics, and control - including antibiotic usage. • Explain the basic principles of immunology relating to host resistance. • Evaluate the physical and chemical methods of microbial control. • Recognize microbial diseases and their control.
3	**MSB 103**	**BIOPHYSICS AND BIOANALYTICAL TECHNIQUES**	• Know about membrane biophysics, nerve impulse conduction and measurement of membrane potential. • Learn about the radiation biophysics and its uses such as tracer techniques etc. • Learn about various spectroscopic techniques and X –ray crystallography. • Learn the various electrophoresis techniques for the separation of DNA/RNA/Protein. • Learn different chromatography and centrifugation techniques for separation of

			bio-molecules.
4	**MSB 104**	**ADVANCED CELL BIOLOGY AND GENETICS**	• Analyse hereditary data and apply fundamental knowledge in genetic calculations and chromosomal aberrations. • Understand various cellular organelles, its structure, function, phenomenon of protein sorting and targeting and also the transport across these organelles. • Understand molecular mechanisms of how and why cells move. • Understand the molecular structure and function of various receptors and mechanism of cell signaling. • Understand different molecular mechanisms that bring about cell death or factors that lead to cancer.
5	**MSB 105**	**ADVANCED BIOSTATISTICS FOR BIOLOGISTS**	• Fundamental knowledge of basic statistical Techniques. • Various Statistical Tools used in data presentation and interpretation • Probability and various distributions. • Formulation and testing of hypothesis • Correlation & Regression analysis. • Analysis of variance(ANOVA) • Applications of various statistical methods using statistical softwares like SPSS, SAS etc.
6	CSE 103	COMPUTER APPLICATIONS	• Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • A basic idea of computer programs and its database.

SECOND SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**MSB 201**	**ADVANCEDMOLECULAR BIOLOGY**	• Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes. • Learn the advanced mechanism of transcription in prokaryotes and eukaryotes. • Develop understanding of various post-transcriptional processes in cell. • Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes. • Understand about the advances of gene expression regulation and various mechanisms of gene silencing.
2	**MSB 202**	ADVANCES IN GENETIC ENGINEERING	• Know the description of different types of cloning vectors. • Understand the cDNA and genomic DNA library preparation. • Understand the identification of gene and a complete genome done by conventional and next generation sequencing. • Understand the characterization of genes and genomes. • Know the different types of dominant and co-dominant molecular markers • Understand the applications of genetic engineering in agriculture, industries and allied sectors.
3	**MSB 203**	**BIOPROCESS TECHNOLOGY**	• Develop an understanding of the various aspects of bioprocess technology and their basic principles. • Develop skills associated with controlling of various parameters of bioprocess monitoring. • Understand principles underlying design of fermentor, fermentation Process and downstream processing. • Get knowledge of industrial productions of various primary and secondary metabolites.
4	**MSB 204**	**ADVANCED GENOMICS AND PROTEOMICS**	• Develop knowledge of fundamental techniques in proteomics. • Learn various modules of MALDI TOF for analysis of proteins.

			• Understand Genome anatomy, gene expression and Post translational modification. • Understand the occurrence of disease due to misfolding of proteins. • Get detail knowledge and understanding of Protein – protein interaction.
5	**MSB 205**	**COMPUTATIONAL BIOLOGY**	• Understand and explain the development of computational biology. • Describe the fundamentals of bioinformatics databases and their application. • Understand and explain the use of various computational methods for phylogentic studies • Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modeling • Explain the applications of computational biology in different fields of sciences.

THIRD SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**MSB 301**	**ADVANCED IMMUNOLOGY**	• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies. • Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions. • Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity. • Understand the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune

			system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.
2	**MSB 302**	**ENZYME TECHNOLOGY**	• Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action. • Understand about various modes of inhibition of enzyme actions with examples. • Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc. • Learn enzyme reactors and various parameters for bio-process design. • Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.
3	**MSB 303**	**ADVANCED ANIMAL BIOTECHNOLOGY**	• Understand conventional and advanced aspec Animal biotechnology. • Learn the cell culture media, cell culture meth and their maintenance. • Identify therapeutic enzymes, strategies of eff enzyme replacement therapy methods. • Understand concept of DNA vaccines and oth vaccines using animal cell culture. • Address the concepts and technology behind therapy. • Learn molecular mechanism of transgenic ani technology., Gene knockout tech.
4	**MSB 304**	**ADVANCED PLANT BIOTECHNOLOGY**	• Understand organogenesis, micropropagation, haploid and Embryo resue. • Develop knowledge of cloning binary and expression vector, transformation in plants. • Learn molecular techniques for identification of transgenics.

			• Understand plant genome organization, gene families and delay of fruit ripening. • Get knowledge of different biotic and abiotic stress resistant plant development.
5	**MSB 305**	**DRUG DESIGN AND DEVELOPMENT**	• Know identification of drug targets, knowledge of binding site and receptors of a drug and their interaction. • Identify the candidate drugs and design drugs that could be potentially useful in cell culture or animal models. • Determine computer based selection, screening and rationale designing of drug. • Get knowledge of combinatorial library and selection of the most effective compounds that could move through preclinical studies to clinical trials. • Monitor of drug –target interaction by QSAR studies.
6	**MSB 306**	**DRUG DELIVERY SYSTEMS**	• Understand the basic concepts of bioavailability, drug absorption, pharmacokinetics and pharmacodynamics. • Analyze various routes of administration and associated evaluation parameters for oral, parenteral, topical etc. drug delivery systems. • Gain knowledge of applications of novel drug delivery systems in various routes. • Develop various novel treatments like gene therapy and antisense therapy. • Develop an understanding to new generation technologies in drug delivery and targeting.

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B. Tech. Biotechnology

Program Educational Objectives (PEO)

PEO1: To enable the students in applying the gained knowledge of biotechnology to pursue higher studies and careers in industries and research institutions.

PEO2: To prepare the students to exhibit innovative thinking ability towards different aspects of biotechnology.

PEO3: To inculcate the ability in planning and executing the experiments in state-of-the-art biotechnology laboratories.

PEO4: To develop professional attitude and ethics with effective communication and scientific writing skills, teamwork, multidisciplinary approach and apply their technical expertise to mitigate societal and technical challenges.

PEO5: To engage in lifelong learning with knowledge of contemporary and futuristic issues related to biotechnology using advanced techniques.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

Programme Outcomes:

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.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.

[PO.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 the public health and safety, and the cultural, societal, and environmental considerations.

[PO.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.

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

[PO.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.

[PO.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.

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.

[PO.9]. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with 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.
[PO.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 leaderin a team, to manage projects and in multidisciplinary environments.
[PO.12]. **Life-long learning**: Recognize the need for and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different thrust areas of cell biology, molecular biology, microbiology, biochemistry, genetics, instrumentation, chemical biology, immunology, structural biology, omic approaches, computational biology, plant and animal biotechnology, recombinant DNA technology, fundamental of biochemical engineering, bioprocess technology, biostatistics, enzymology, instrumentation, drug delivery systems, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop knowledge base of applied physics, applied chemistry, applied mathematics, computer programming, electrical sciences etc. for effective multidisciplinary implementation.

PSO.4: Enhance analytical, project management, accounting and cost control, entrepreneurship skills along with effective communication and behavioural attributes.

COURSE OUTCOMES

FIRST SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	BTB 101	APPLIED MATHEMATICS – I	• Understand the concepts of basic calculus related to engineering applications. • Eligible to identify the problems to apply the integration methods for computing area and other related concepts. • Can apply the modeling of differential equations in engineering systems having rate of change.
2	CHE 101	APPLIED CHEMISTRY	• Apply the principles chemical of sciences to understand the very basic bonding mechanism and the application to materials in different engineering situations.
3	CSE 104	PROGRAMMING FOR PROBLEM SOLVING	• To formulate simple algorithms for arithmetic and logical problems. • To translate the algorithms to programs (in C language). • To test and execute the programs and correct syntax and logical error • To implement conditional branching,

			formulate algorithms and programs. • To apply programming to solve matrix addition and multiplication problems and searching and sorting problems. • To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4	**BTB 105**	**LIFE SCIENCES-I**	• Learn about basics of animal and plant kingdom. • Learn about taxonomy and variability among different groups. • Enhance collaborative and research outlook. • Develops awareness for career options in biological sciences.
5	**EVS 142**	**ENVIRONMENTAL STUDIES-I**	• The multidisciplinary nature of environmental studies, including its definition, scope and need for public awareness. • Our natural resources including renewable and non-renewable resources comprising of forest, water, mineral, food, energy and land resources. • The ecosystem, their structure and function, energy flow, bio-geochemical cycles, community ecology, ecological succession, ecological pyramids, forest, grassland, aquatic and tundra ecosystem. • Biodiversity and its conservation. • Ecosystem diversity, species diversity and genetic diversity. • Biological classification of India. • Value of biodiversity. • Biodiversity at global national and local level. • Conservation of biodiversity. • Characteristic of ideal ecosystem. • Study of an artificial ecosystem.

SECOND SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 201**	**APPLIED MATHEMATICS – II**	• Understand the concepts of matrix theory and solution of equations using matrix theory. Can also use these methods to apply in engineering applications. • Eligible to identify the real life concepts associated to vector theory and complex theory. Besides it, can apply to solve related problems. • Can apply the statistical concepts to their experiments to get better outputs and to compute the probability related to their outcomes.
2	**PHY 101**	**APPLIED PHYSICS - I**	• Apply vector calculus to static electric-magnetic fields in different engineering situations. • Analyze andApply Maxwell's equation to diverse engineering problems. • Relate semiconductor material properties to semiconductor devices.
3	**CSE 204**	**OBJECT ORIENTED PROGRAMMING USING C++**	• To apply concepts of classes and objects in real world scenarios. • Understand object-oriented programming features in C++, • Apply these features to program design and implementation, • Understand object-oriented concepts and how they are supported by C++, • Gain some practical experience of C++.
4	**ECE 101**	**ELECTRICAL SCIENCE**	• To understand and analyze basic electric and magnetic circuits. • To study the working principles of electrical machines and power converters. • To introduce the components of low voltage electrical installations.
5	**BTB 206**	**LIFE SCIENCES - II**	• Develops knowledge of animal and plant physiological aspects. • Deals with functioning of systems in both animals and plants. • Acts as useful tool for further research and innovation. • Develops collaborative and innovative approach.

			• Creates verbal and written communication skills in subject.
6	**CSE 224**	**OBJECT ORIENTED PROGRAMMING USING C++ LAB**	• knowledge of the structure and model of the C++ programming language, (knowledge) • evaluate user requirements for software functionality required to decide whether the C++ programming language can meet user requirements (analysis) • design object-oriented programs for real world problems.
7	**EVS 242**	**ENVIRONMENTAL STUDIES-II**	• Explain various types of environmental pollutions. • Understand role of individual in abatement of environmental pollution. • Explain methods to mitigate disasters. • Learn various environmental protection laws. • Learn role of IT in environment and human health.

THIRD SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 301**	**CELL BIOLOGY**	• Understand and explain the cell theory origin of life, and evolution. • Understand the cell cycle, regulatation and checkpoints' in the cell-cycle. • Understand structure of cell membranes, transport of solutes across cell membranes. • Learn structure and function of the cell cytoskeleton, cilia and flagella. • Understand mechanism of signaling and receptors involved in signaling process.
2	**BTB 302**	**BIOCHEMISTRY - I**	• Learn about chemical interactions in biological system. • Develop the understanding between structure and function of carbohydrates & lipids. • Learn the concept of metabolism and energy involved in metabolic pathways. • Understand the metabolic pathways and regulations of carbohydrates metabolism. • Learn about the digestion, transport, anabolism and catabolism of lipids in the body.

3	**BTB 303**	**MICROBIOLOGY**	• Understand the microbiological techniques for the isolation and characterization of microbes. • Understand the mechanism of different metabolic processes. • Know the physiology and survival mechanism of extremophilic bacteria. • Know the concept of virus lytic and lysogenic cycle is quite clear to students. • Understand the epidemiology and microbial pathogenesis.
4	**BTB 304**	**MOLECULAR BIOLOGY**	• Learn about the mechanism of replication of DNA in prokaryotes and eukaryotes. • Learn and compare the mechanism of transcription in prokaryotes and eukaryotes. • Learn the various post-transcriptional processes in cell. • Learn about the mechanism of protein synthesis in prokaryotes and eukaryotes. • Understand about gene expression regulation and various mechanisms of gene silencing.
5	**CSE 202**	**DATA STRUCTURES THROUGH C++**	• Ability to choose appropriate data structures to represent data items in real world problems. • Ability to analyze the time and space complexities of algorithms. • Ability to design programs using a variety of data structures such as stacks, queues, hash tables, binary trees, search trees, heaps, graphs, and B-trees. • Able to analyze and implement various kinds of searching and sorting techniques.

FOURTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 401**	**BIOCHEMISTRY-II**	• Understand relationships between structure and functions Amino acids and Proteins. • Learn the concept of Enzymes, their mode of action and regulation. • Understand the structure and properties of Nucleic acids – DNA and RNA. • Learn and understand amino acid

			metabolism. • Understand the metabolism of purines and pyrimidines in the body.
2	**BTB 402**	**GENETICS**	• Develops knowledge about the basic principles of genetics. • Learn about concepts of classical, molecular and population genetics. • Develops knowledge of genes and gene interactions. • Learn about mutations and chromosomal aberrations. • Understand role of genetic techniques in pharmaceutical industries.
3	**BTB 403**	**METHODS AND INSTRUMENTATION IN BIOTECHNOLOGY**	• know electrophoresis and their different types and their application. • know chromatography techniques and their different types and their application. • Understand different types of spectroscopes and their application analysis. • Learn about the X-Ray crystallography and diffraction technique
4	**CSE 304**	**DATABASE MANAGEMENT SYSTEMS**	• Describe DBMS architecture, physical and logical database designs, database modeling, relational, hierarchical and network models. • Identify basic database storage structures and access techniques such as file organizations, indexing methods including B-tree, and hashing. • Learn and apply structured query language (SQL) for database definition and database manipulation. • Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database. • Understand various transaction processing, concurrency control mechanisms and database protection mechanisms.

FIFTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 501**	**PLANT BIOTECHNOLOGY**	• Explain the basics, methodology and applications of plant tissue culture. • Understand sterilization and Media preparation and organ culture. • Learn *invitro* germination, micropopogation and Somaclonal variation. • Understand knowledge of isolation and transformation gene in plants. • Learn various applications of GM crops.
2	**BTB 502**	**ANIMAL BIOTECHNOLOGY**	• Concepts of animal biotechnology and its commercial applicability • Understand sterilization techniques, understanding of organ culture. • Learn methods of animal cell culture and maintenance and immobilization techniques. • Understand concepts of *in-vitro* fertilization and embryo transfer for livestock improvement. • Become familiar with concept of somatic hybridization and transgenic technology.
3	**BTB 503**	**STRUCTURAL BIOLOGY**	• Understand the structure of protein emphasizing on significance of side chain. • Know the classical theories of enzyme substrate interaction, description of cell signaling. • Understand the protein denaturation, refolding and stabilization. • Understand structural parameters of DNA molecule. • Understand the protein-DNA interaction and its mechanism.
4	**BTB 504**	**CHEMICAL ENGINEERING PRINCIPLES**	• Understand the concepts of dimensional analysis • Analyze various chemical reaction mechanism • Identify, implement and evolve chemical formula • Evaluate the reaction mechanism
5	**BTB 505**	**BASIC BIOANALYTICAL TECHNIQUES**	• Get familiar with working principles, tools and methods of analytical techniques. • Understand the strengths and limitations of the basic instruments used in a biotechnology

			lab. • Get an overview of the instruments used in separation and isolation of biomolecules. • Learn the basic principle of microscopy and the concept of radioisotopes and their applications. • Learn physical, chemical and biological method of cell disruption, reverse osmosis.
6	**CSE 403**	**JAVA PROGRAMMING**	• Students can perform object oriented programming solution and develop solutions to problems demonstrating usage of control structure, modularity, classes, I/O and the scope of the class members • Students can demonstrate adeptness of object oriented programming in developing solution to problems demonstrating usage of data abstraction, encapsulation and inheritance • Students can demonstrate ability to implement one or more patterns involving dynamic binding and utilization of polymorphism in the solution of problems • Students can demonstrate ability to implement multithreading in the programming. • To learn syntax and features of exception handling • Students can demonstrate the ability to implement solution to various I/O manipulation operations and the ability to create two-dimensional graphic components using Swings. • To demonstrate the ability to handle Events in the Programming

SIXTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 601**	**RECOMBINANT DNA TECHNOLOGY**	• Learn manipulating DNA sequences with versatile DNA modifying enzymes. • Designing cloning experiments, genomic and cDNA library construction etc. • Understand PCR amplification, DNA modifying enzynes and blotting techniques.

			• Learn genomic sequences analysis by using different techniques. • Develop knowledge in conducting experiments involving genetic manipulation.
2	**BTB 602**	**ENZYMOLOGY AND ENZYME TECHNOLOGY**	• Understand the principles of enzymes therapeutic, clinical diagnosis, mechanism of action. • Understand various modes of inhibition of enzyme actions with examples. • Learn applications of immobilization of enzymes in industrial production of antibiotics etc. • Learn enzyme reactors and various parameters for bio-process design. • Learn the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.
3	**BTB 603**	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	• Understand the phylogeny of immune system, types of immunity and immune response. • Understand the organization and structure of lymphoid organs and immune cells. • Understand and explain the concept of antibody and antigen. • Understand and explain the concept and types of hypersensitivity and vaccination. • Understand the mechanism of autoimmune disorders, transplantation and immune response against tumor.
4	**BTB 604**	**COMPUTATIONAL BIOLOGY**	• Understand the nucleotide and protein sequence retrieval, submission, analysis through NCBI. • Understand the nucleotide and protein sequence alignment methods through different algorithm. • Understand the use of nucleotide sequence for the prediction of phylogenetic tree and evolutionary relationship are emphasized. • Know the concept of gene discovery and identification along with structural description. • Know the vast description of molecular

			modeling and protein-ligand docking.
5	**BTB 605**	**FUNDAMENTALS OF BIOCHEMICAL ENGINEERING**	• Learn the different phases of microbial growth, kinetics of substrate utilization and product formation. • Understand various sterilization techniques and its principles. • Familiarize themselves with the different parts, function and types of bioreactors and valves. • Understand the mass transfer phenomenon, principles involved in instrumentation and control of bioprocess.

SEVENTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 701**	**BIOPROCESS TECHNOLOGY**	• Know the advantages of biochemical processes and its conventions. • Develop skill of process technology for ethanol, amino acids and biomass production. • Gain understanding of production of secondary metabolites and antibiotics. • Get knowledge of industrial production of enzymes. • Develop knowledge of growth and death kinetics.
2	**BTB 702**	**DOWNSTREAM PROCESSING**	• Learn the principles and application of downstream processing. • Understand comprehensive knowledge of bio-product and their characteristics. • know protein precipitation and separation methods. • Learn basics and applications of various chromatography techniques. • Know about membrane based separation of bio-products such as dialysis, filtration etc. • Learn various crystallization and drying techniques.
3	**BTB 703**	**STATISTICS FOR BIOLOGY**	• Fundamental knowledge of basic statistical Techniques. • Relationship between Statistics and Biostatistics

			• Various Statistical Tools used in data presentation and interpretation • Correlation and Regression Techniques. • Application of statistical methods to handle biological data. • Application of Biostatistical Tools in hypothesis testing.
4	**BTB 708**	**ENVIRONMENTAL BIOTECHNOLOGY**	• Understand environmental components a their delicate interrelationship and pollutions. • Learn concepts of waste water treatment using biotechnological interventions. • Understand the concept and theory of solid waste disposal methods. • Understand microbial role in bioremediation of various xenobiotic. • Build up understanding the mechanism of microbial leaching and mining of metals from ores, wasteland and their restoration and the role of genetically modified microbes
5	**CSE 504**	**ADVANCEDJAVA PROGRAMMING**	• Can develop Java Applets, Beans programming. • Can Understand Advanced Java Networking concepts and develop server side application. • Can learn Server Side Programming Concepts and create Dynamic web Application. • Know about the JDBC Principles and can interact with back end database with java programming. • Understand the application server and also understand the enterprise level applications.

EIGHTTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BTB 801**	GENOMIC AND PROTEOMICS	• Understand the basic concept of evolution of genome in prokaryotes and eukaryotes • Understand the concept of structural organization of genome and annotation. . • Know the functional genes or coding genome and the understanding of functional genomics.

			• Understand concept of biogenesis of RNAi, molecular markers and their application. • Understand the various aspects of proteomics and protein identification.
2	**BTB 802**	**DRUG DELIVERY SYSTEMS**	• Understand concepts of bioavailability, drug absorption, pharmacokinetics and pharmacodynamics. • Analyze various routes of administration and associated evaluation parameters for oral, parenteral, topical etc. drug delivery systems. • Gain knowledge of applications of novel drug delivery systems in various routes. • Develop various novel treatments like gene therapy and antisense therapy. • Develop an understanding to new generation technologies in drug delivery and targeting.
3	**BCH 621**	**MANAGEMENT ACCOUNTING AND COST CONTROL**	• Understand the concepts cost and management accounting • Analyze and provide recommendations to improve the operations of organisations through the application of cost and management accounting techniques • Evaluate the costs and benefits of different conventional and contemporary costing systems • Enable students to demonstrate mastery of costing systems, cost management systems, budgeting systems.
4	**BCH 622**	**PROJECT MANAGEMENT**	• Understand the concepts of Project Management. • Analyze the various skills required for Project Management. • Identify, implement and evolve skills need in project management. • Enable students to become future project Managers.
5	**BCH 623**	**PRINCIPLES OF MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT**	• Understand the concepts of Management functions and Entrepreneurship development. • Analyze various skills required for Entrepreneurial Development.

			• Identify, implement and evolve managerial and entrepreneur skills. • Evaluate the learning outcomes. • Enable students to become future leaders and entrepreneurs.
6	**CSE 804**	**ASP .NET**	• Develop dynamic web applications, create and consume web services • Use appropriate data sources and data bindings in ASP.NET web applications • Research and discover information about current topics, illustrate in an example, and present to the class.

Master of Technology Biotechnology

Program Educational Objectives (PEO)

PEO1: To apply theoretical and practical knowledge and skills to achieve greater heights in research and industry.

PEO2: To provide domain knowledge and expertise for successful career in academics, research and industry.

PEO3: To able to perform research work individually and in team in the field of biotechnology.

PEO4: To develop professional attitude with ethics and inculcate effective communication and scientific writing skills in multidisciplinary environment.

PEO5: To engage in lifelong learning with knowledge of contemporary and futuristic issues related to biotechnology.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

Programme Outcomes:

On completion of the course, students are able to understand about:

PO1: To introduce the basic concepts of Biotechnology and its recent advances.

PO2: For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.

PO3: Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.

PO4: This course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.

PO5: This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.

PO6: Provides broad exposure to various societal, ethical, and commercial issues in the various aspects of biotechnology.

PO7: Ability to demonstrate team building, project management and entrepreneurial skills through life-long learning.

PO8: Ability to communicate effectively and develop scientific writing.

PO9: Inculcation of ability to think independently for problem solving.

PO10: Ability to design and conduct experiments in biotechnology and analyze data.

PROGRAM OUTCOMES OF M. Tech. BIOTECHNOLOGY

PSO.1: Develop knowledge base and competency in different thrust areas of biochemistry and metabolic regulation, advanced microbial technology, instrumentation in biotechnology, bioinformatics, advanced biostatistics for biologist, cell and molecular biology, recombinant DNA technology, bioprocess technology, genomics and proteomics, pharmaceutical biotechnology, environmental biotechnology, immunology and immunotechnology, enzymology and enzyme technology, drug design and development, bioprocess plant design, drug delivery system, etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop advanced skills of biotechnology and provide solutions through industry-academia interface.

PSO.4: Empower the students to be effective entrepreneurs and excellent researchers.

COURSE OUTCOMES

FIRST SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**MTB 101**	**BIOCHEMISTRY AND METABOLIC REGULATION**	• Learn and understand the structure of biomolecules from their monomers to polymers. • Learn the metabolism of biomolecules at advanced level and they will be able to interconnect these pathways. • Learn about different levels of regulation of enzymes in metabolic pathways. • Develop understanding of role of energy in various biochemical reactions. • Learn regulation of various metabolic pathways and diseases due to misregulation of metabolic pathways.
2	**MTB 102**	**ADVANCED MICROBIAL TECHNOLOGY**	• Recognize and explain the significant role that microbes play in the world around us. • Explain the similarities and differences of microbes as compared to higher forms of life. • Identify microbes and explain methods of growth and cultivation as well as structural and biochemical differences. • Understand the microbial structure, function, metabolism, growth, genetics, and control - including antibiotic usage. • Explain the basic principles of immunology relating to host resistance. • Evaluate the physical and chemical methods

			of microbial control. • Recognize microbial diseases and their control.
3	MTB 103	**INSTRUMENTATION IN BIOTECHNOLOGY**	• Understand centrifugation machine and their techniques for the separation of biomolecules. • Know about electrophoresis and their different types and their application. • Know about chromatography techniques and their different types and their application • Know different types of spectroscopes and microscopes and their application analysis of different molecules. • Learn about the radioactivity and their measurement using scintillation counters.
4	**MTB 104**	**BIOINFORMATICS**	• Understand about nucleotide and protein sequence retrieval, submission through NCBI database. • Understand the nucleotide and protein sequence alignment methods through different types of algorithm used. • Predict the phylogenetic tree and evolutionary relationship • Predict the databases related to functional gene sequences and their analysis through identification and classification • Describe the molecular modeling using protein databank and molecular modeling databank.
5	**MTB 105**	**ADVANCED BIOSTATISTICS FOR BIOLOGISTS**	• Fundamental knowledge of basic statistical Techniques. • Various Statistical Tools used in data presentation and interpretation • Probability and various distributions. • Formulation and testing of hypothesis • Correlation & Regression analysis. • Analysis of variance(ANOVA) • Applications of various statistical methods using statistical softwares like SPSS, SAS etc.

SECOND SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**MTB 201**	**CELL AND MOLECULAR BIOLOGY**	• Learn various aspects of protein targeting and transportation of small molecules across the membrane by different means. • Learn and understand the cell cycle with check points and intracellular signaling mechanisms. • Learn the mechanism of replication of DNA both in prokaryotes and eukaryotes and repair mechanisms processed by the cell. • Learn in detail about the mechanism of transcription and post-transcriptional processes in prokaryotes and eukaryotes. • Learn and understand the mechanism translation, gene expression regulation in prokaryotes and eukaryotes as well as gene silencing.
2	**MTB 202**	**RECOMBINANT DNA TECHNOLOGY**	• Know the description of different types of cloning vectors. • Understand the cDNA and genomic DNA library preparation. • Understand the identification of gene and a complete genome done by conventional and next generation sequencing. • Understand the characterization of genes and genomes. • Know the different types of dominant andco-dominant molecular markers • Understand the applications of genetic engineering in agriculture, industries and allied sectors.
3	MTB 203	**BIOPROCESS TECHNOLOGY**	• Develop an understanding of the various aspects of bioprocess technology and their basic principles. • Develop skills associated with controlling of various parameters of bioprocess monitoring. • Understand principles underlying design of fermentor, fermentation Process and downstream processing. • Get knowledge of industrial productions of various primary and secondary metabolites.
4	**MTB 204**	**GENOMICS AND**	• Develop knowledge of fundamental

		PROTEOMICS	techniques in proteomics. • Learn various modules of MALDI TOF for analysis of proteins. • Understand Genome anatomy, gene expression and Post translational modification. • Understand the occurrence of disease due to misfolding of proteins. • Get detail knowledge and understanding of Protein – protein interaction.
5	**MTB 205**	**PHARMACEUTICAL BIOTECHNOLOGY**	• Prepare different strength of solutions and get a thorough knowledge of analytical chemistry. • Understand physicochemical properties of drug molecules, flow behaviour of fluids and powder. • Learn the basics of polymer science and different packaging strategies to be used for pharmaceutical compounds. • Understand the industrial processing of drugs and various transport phenomena. • Get knowledge of the materials that are used for plant construction and understand Good Manufacturing practices.

THIRD SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**MTB 301**	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies. • Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions. • Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement

			system in immunity. • Understand the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.
2	**MTB 302**	**ENZYMOLOGY AND ENZYME TECHNOLOGY**	• Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action. • Understand about various modes of inhibition of enzyme actions with examples. • Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc. • Learn enzyme reactors and various parameters for bio-process design. • Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.
3	MTB 303	**DRUG DESIGN AND DEVELOPMENT**	• Know identification of drug targets, knowledge of binding site and receptors of a drug and their interaction. • Identify the candidate drugs and design drugs that could be potentially useful in cell culture or animal models. • Determine computer based selection, screening and rationale designing of drug. • Get knowledge of combinatorial library and selection of the most effective compounds that could move through preclinical studies to clinical trials. • Monitor of drug –target interaction by QSAR studies.
4	**MTB 304**	**BIOPROCESS PLANT DESIGN**	• Understand the general design information about a bioprocess plant. • Know the concept of energy and mass

			balance is well known to students. • Understand the basic flow sheeting and design of a basic batch and continuous type of fermentor. • Understand about vessels used for the biotechnological applications. • Understand the selection and specifications of equipment and cleaning used in a bioprocess plant is well known to students.
5	**MTB 306**	**DRUG DELIVERY SYSTEMS**	• Understand the basic concepts of bioavailability, drug absorption, pharmacokinetics and pharmacodynamics. • Analyze various routes of administration and associated evaluation parameters for oral, parenteral, topical etc. drug delivery systems. • Gain knowledge of applications of novel drug delivery systems in various routes. • Develop various novel treatments like gene therapy and antisense therapy. • Develop an understanding to new generation technologies in drug delivery and targeting.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

B. Sc. M.Sc. Dual degree Biotechnology

Program Educational Objectives (PEO)

PEO1: To inculcate the scientific approach to develop deep insight through flexible, research-oriented program to meet the present and futuristic demand of academia and industry.

PEO2: To develop professional and innovative approach and its impact on human health, agriculture, and environment for sustainable development.

PEO3: To develop individual and team building ability for providing opportunities for students to manage and work on multidisciplinary projects through interaction with their peers.

PEO4: To be able to demonstrate innovative ability, entrepreneurship skills, for contributing to social and national development.

PEO5: To engage in lifelong learning with knowledge of contemporary and futuristic issues related to biotechnology.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

On completion of the course, students are able to understand about:

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

COURSE OUTCOMES

FIRST SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	BMB 101	CELL BIOLOGY	• Understand the theories given by scientists for the origin of cell along with different types of prokaryotic and eukaryotic cells. • Know the cellular structure of cell organelle and their functions. • Differentiate between chromosomal structures in different stages of a cell cycle. • Understand towards cell differentiation, malignancy and cell death. • Develop verbal and written skills of subject along with interdisciplinary approach.
2	BMB 102	MATHS AND BIOSTATISTICS	• The first outcome defines a bridge between the basic mathematical concepts to be used and to explore them regarding further study. • Can apply the concepts of matrix theory and basic calculus to their biological experiments done during the course.

			• Can apply the statistical concepts to their experiments to get better outputs. • Eligible to identify the applications of correlation in their experiments of lab and real-life problems.
3	**BMB 103**	**Plant Sciences - I**	• The students will be able to identify basic concepts of algal plants morphology, anatomical features, evolutionary pathways & mode of reproduction. • Understand the role of algae in freshwater, marine and soil environments as primary producers, suppliers of nutrition to animals and as resources for humans. • Study and acquire knowledge about the occurrence, distribution, structure, phylogeny, evolutionary concepts and life history of fungi, lichens & mycorrhiza. • Have a good overview of the general morphology, diversity, distribution, sexual reproduction, diversity of bryophytes, the significance of bryophytes as pioneer plants on land and their role in the origin of pteridophytes.
4	**BMB 104**	**Animal Sciences - I**	• Learn about characteristics and variations of invertebrates. • Develop scientific outlook for research and innovation. • Get knowledge of typical invertebrates and their economic importance. • Develop conservative outlook for animals. • Generate written and verbal communication skills over the subject.
5	**BMB 105**	**CHEMISTRY - I**	• To understand the very basic bonding mechanism and the application to materials in different field. • To understand the Chemical properties and basic bonding behavior of Radioactive elements • To understand the Chemical properties and basic bonding behavior of inorganic chemistry elements • To understand the Chemical Kinetics, Gas Kinetics, Gas behavior, rate of reaction

SECOND SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 201**	**INTRODUCTORY BIOCHEMISTRY AND BIOPHYSICS**	• Get familiarize with structures and functions of biomolecules like Carbohydrates, Fats and Nucleic Acids. • Understand the role of covalent and non-covalent bonds, inter-and intramolecular interactions and their contribution to the native conformation of biomolecules. • Know the molecular transport within the cell and across membranes and get familiar with the different laws of Physics that are valid in biological systems. • Calculate energy changes in biological pathways, understand mechanism of light and sound reception. • Understand how electricity can act as potent signal as well the role of neurotransmitters.
2	**BMB 202**	**BIOANALYTICAL TECHNIQUES**	• Understand the principle and instrumentation of Colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, etc. • Understand principle instrumentation of chromatographic techniques and their types. • Principle and applications of electrophoresis I.e., PAGE, Immunoelectrophoresis etc. • Understand radioisotope tracer techniques and application. • Develop broad knowledge base, deep theoretical understanding of instruments and their practical implementation in the laboratory.
3	**BMB 203**	**Plant Sciences – II**	• The students will develop an understanding of the characteristics, life cycles & interrelationships among different forms of gymnosperm. • The course content will help the students to trace the evolutionary history, diversity of gymnosperms & develop an understanding of fossils, fossilization & geological time scale and its significance in the evolution of angiosperms. • The students will develop an understanding of the basis, guiding principles & salient

			features of the various classification systems of angiosperms. • Know the economic importance of the angiosperm plants. • Systematic position, distinguishing characters and economic importance of some important families like Rutaceae, Cucurbitaceae,Rosaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Lamiaceae, Euphorbiaceae, and Poaceae.
4	**BMB 204**	**Animal Sciences – II**	• Develop knowledge about Chordates. • Learn about comparative account of vertebrates. • Learn about anatomical & physiological variability among vertebrates. • Generates interdisciplinary and collaborative approach. • Develops ethical and conservative outlook for animals.
5	**BMB 205**	**CHEMISTRY – II**	• To understand the very basic Stereochemistry, Structure, Bonding mechanism & Molar mass so that application of materials in different field can be understood. • To learn & understand the Quantitative & Qualitative analysis of Elements Estimation • To understand the Nomenclature of various Organic Compounds • To understand the behavior and synthesis of various hydrocarbons and its end use & production in industrial scale • To understand the behavior and synthesis of various hydrocarbons and its end use & production in industrial scale • To learn and understand chemical equilibrium and electrochemistry for various applications.
6		**ENVIRONMENTAL STUDIES-II**	• Explain various types of environmental pollutions. • Understand role of individual in abatement of environmental pollution. • Explain methods to mitigate disasters. • Learn various environmental protection laws.

			• Learn role of IT in environment and human health.

THIRD SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 301**	**GENETICS**	• Understand the concept of classical genetics including Mendelian laws is easily grasped by students. • Understand the basic microbial genetics including prokaryotic gene expression and regulation. • Understand the concept of gene in terms of recon, muton and cistron including both classical and modern concept. • Know various chemical and physical mutagens involved in causing mutation. • Understand the concept of sex determination and populations genetics.
2	**BMB 302**	**MICROBIOLOGY**	• Understand the microbiological techniques for the isolation and characterization of microbes. • Understand the mechanism of different metabolic processes. • Know the physiology and survival mechanism of extremophilic bacteria. • Know the concept of virus lytic and lysogenic cycle is quite clear to students. • Understand the epidemiology and microbial pathogenesis.
3	**BMB 303**	**BIOCHEMISTRY AND METABOLIC REGULATION**	• Develop knowledge of biochemical aspects of body. • Learn about important metabolic pathways and their regulation. • Deals with pathways responsible for energy production. • Study of various enzymatic reactions and their role in body. • Develops collaborative and research approach.
4	**BMB 304**	**ANATOMY & PLANT PHYSIOLOGY**	• The students will be conceptually integrated to plant internal structure & their functions • Will further reveal the relationship between the structure, function, taxonomy, ecology

			and developmental genetics in plants. • The contents of this course will help the students to relate crop physiological processes with water-plant interaction, mineral absorption, transportation & assimilation. • The concept of photosynthesis in plant, the role & significance of pigment system in photosynthesis, components of light and dark reaction, C3 & C4 pathways for carbon fixation & the influence of environmental factors on photosynthesis will be understood by the students. • The students will acquire an understanding of the concept of respiration: mechanisms, factors & its importance.
5	**BMB 305**	**ANIMAL PHYSIOLOGY - I**	• Learn about anatomical and physiological aspects of animal body. • Gain knowledge about functioning of systems of body. • Generate path for further research and innovation. • Enhance new collaborative approaches with modern fields of biotechnology.
6	**BMB 306**	**CHEMISTRY - III**	• To understand the very basic Structure, Bonding mechanism and application of materials in different field • To learn & understand the acid and basic concept • To understand the concepts of Coordination Chemistry • To understand the synthesis, properties and application of various inorganic acids in various field • To understand Phase Equilibria law and its application in various field like purification, precipitation, and understanding temperature behavior, and various states of any system

FOURTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 401**	**BIOINFORMATICS**	• Understand and explain the structural organization and characteristics of computers and its parts. • Describe the concept of use of internet in

			bioinformatics. • Explain the concept and organization of biological databases. • Understand and explain the structure and functions of the phylogenetic analytic tools. • Interrogate major database sources and be able to integrate this information with clinical data.
2	**BMB 402**	**MOLECULAR CELL BIOLOGY**	• Develop deep understanding of DNA/ RNA structure, and mechanism of DNA replication. • Understand Genetic Codes and Transposable elements • Understand mechanism of transcription and translation in prokaryotes and eukaryotes. • Enhance fine molecular understanding of operon gene regulation ion in prokaryotes. • Understand the mechanism of Oncogenes and Tumor suppressor genes.
3	**BMB 403**	**IMMUNOLOGY & IMMUNOTECHNOLOGY**	• Understand and explain the phylogeny of immune system, types of immunity, immune response. • Describe the concept of clonal selection theory, humoral and cell mediated immunity. • Understand and explain the structure and functions of the organs and cells of the immune system. • Understand the mechanism of antigen-antibody interaction. • Describe the structure of antibodies, their types and functions in immunity.
4	**BMB 404**	**PLANT BREEDING, EMBRYOLOGY, PATHOLOGY & ECONOMIC BOTANY**	• The students will develop modern approach to experimental plant embryology from developmental, structural and molecular point of view. • The course will provide in depth information on developmental cycles, regulation of the flowering process, of micro- and macrosporogenesis, on self-incompatibility & on embryo formation. • The students will be able to analyse the historical evolution of plant breeding. Will be able to understand the basic Mendelian

			genetics, plant reproduction systems and breeding products. • The students will develop an understanding of the four interacting factors necessary for disease to occur: the pathogen, the host, the environment, and time. With knowledge of these factors they will begin to understand the nature of plant disease epidemics and how to manage them. • The students will develop an understanding of the vast economic importance of angiosperms with reference to their use as source of food, fuel, fibers & medicine.
5	**BMB 405**	**ANIMAL PHYSIOLOGY-II**	• Learn about anatomical and physiological aspects of animal body. • Understands functioning of important systems of body. • Develops knowledge about endocrinology and developmental biology. • Leads to enhance interest in research in advanced biotechnology. • Exposure with other interdisciplinary subjects of biology.
6	**BMB 406**	**CHEMISTRY – IV**	• To understand the very basic structure, bonding, reaction mechanism and application of various organic compounds like carbohydrates, aromatic compounds, aromatic hydrocarbons • To understand Chemical Thermodynamics, Electrochemistry & Photochemistry concepts

FIFTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 501**	**PLANT BIOTECHNOLOGY**	• Handle the basic instruments used in plant biotechnology. • Learn Preparation of stocks for culture media. • Learn surface sterilization of different explants • Understand *in-vitro* germination of seeds, seed viability and their maintenance in lab. • Get training of problems related to

			germination, callus induction and propagation.
2	**BMB 502**	**ANIMAL BIOTECHNOLOGY**	• Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial applications. • Understand scale up production of monoclonal antibodies and hybridoma technology. • Understand the structure and function of variety of hormones and growth factors. • Understand the technology and concept behind *invitro* fertilization and embryo transfer, and development of superior live stocks. • Understand the concept of ethical value regarding the use of animal biotechnology.
3	**BMB 503**	**GENOMICS& PROTEOMICS**	• Gain understanding of basic structure of protein and its separation by using various techniques. • Get insight of modeling and *in silico* protein structure building. • Get understanding of study of protein – protein interaction using various methods.
4	**BMB 504**	**RECOMBINANT DNA TECHNOLOGY**	• Learn the procedure of DNA isolation from bacteria, plant and animal cell and its purification and modification. • Know various methods of introducing DNA into living cells. • Learn the technique of gene cloning, tools used in it and different vectors used for transforming host cells. • Know the procedure of producing proteins from cloned genes, its uses in medicines with examples and gene therapy. • Learn the theoretical aspects of DNA amplification using PCR and analysis of DNA by various molecular markers.

SIXTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 601**	**ENVIRONMENTAL BIOTECHNOLOGY**	• Understand the delicate interrelationship of different components of environment.

			• Understand conventional fuels, their impact and concept of clean fuel technology. • Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining. • Learn the concept of municipal solid and liquid wastes management and EIA. • Understand the concept and assessment of environmental quality.
2	**BMB 602**	**INDUSTRIAL BIOLOGY**	• Develop an understanding of the various aspects of Bioprocess Technology. • Develop skills associated with screening of Industrially Important Strains and media formulation for industry. • Understand principles underlying design of fermentor, fermentation process and downstream processing • Develop an understanding of the various aspects of dairy Technology. • Understand principles underlying immobilization and their application.
3	**BCH 623**	**PRINCIPLES OF MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT**	• Understand the concepts of Management functions and Entrepreneurship development. • Analyze various skills required for Entrepreneurial Development. • Identify, implement and evolve managerial and entrepreneur skills. • Evaluate the learning outcomes. • Enable students to become future leaders and entrepreneurs.

SEVENTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 701**	**ADVANCED BIOCHEMISTRY**	• Learn carbohydrate metabolism in detail by analyzing all the pathways. • Learn the various aspects of lipid metabolism and their regulation. • Understand the metabolism of Nitrogen and excretion of urea from body. • Learn Nucleotide metabolism and clinical

			disorders of purine metabolism. • Develop advanced knowledge of action of major hormones and principles and application of primary and secondary metabolites.
2	**BMB 702**	**ADVANCED MICROBIAL TECHNOLOGY**	• Recognize and explain the significant role that microbes play in the world around us. • Explain the similarities and differences of microbes as compared to higher forms of life. • Identify microbes and explain methods of growth and cultivation as well as structural and biochemical differences. • Understand the microbial structure, function, metabolism, growth, genetics, and control - including antibiotic usage. • Explain the basic principles of immunology relating to host resistance. • Evaluate the physical and chemical methods of microbial control. • Recognize microbial diseases and their control.
3	**BMB 703**	**BIOPHYSICS AND BIOANALYTICAL TECHNIQUES**	• Know about membrane biophysics, nerve impulse conduction and measurement of membrane potential. • Learn about the radiation biophysics and its uses such as tracer techniques etc. • Learn about various spectroscopic techniques and X –ray crystallography. • Learn the various electrophoresis techniques for the separation of DNA/RNA/Protein. • Learn different chromatography and centrifugation techniques for separation of bio-molecules.
4	**BMB 704**	**ADVANCED CELL BIOLOGY AND GENETICS**	• Analyse hereditary data and apply fundamental knowledge in genetic calculations and chromosomal aberrations. • Understand various cellular organelles, its structure, function, phenomenon of protein sorting and targeting and also the transport across these organelles. • Understand molecular mechanisms of how and why cells move. • Understand the molecular structure and function of various receptors and mechanism of cell signaling.

			• Understand different molecular mechanisms that bring about cell death or factors that lead to cancer.
5	**BMB 705**	**ADVANCED BIOSTATISTICS FOR BIOLOGISTS**	• Fundamental knowledge of basic statistical Techniques. • Various Statistical Tools used in data presentation and interpretation • Probability and various distributions. • Formulation and testing of hypothesis • Correlation & Regression analysis. • Analysis of variance(ANOVA) • Applications of various statistical methods using statistical softwares like SPSS, SAS etc.
6	CSE 703	COMPUTER APPLICATIONS	• Work effectively with a range of current, standard, Office Productivity software applications. • Evaluate, select and use office productivity software appropriate to a given situation. • Apply basic adult learning and assessment principles in the design, development, and presentation of material produced by office productivity applications. • Demonstrate employability skills and a commitment to professionalism. • Operate a variety of advanced spreadsheet, operating system and word processing functions. • A basic idea of computer programs and its database.

EIGHTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 801**	**ADVANCEDMOLECULAR BIOLOGY**	• Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes. • Learn the advanced mechanism of transcription in prokaryotes and eukaryotes. • Develop understanding of various post-transcriptional processes in cell. • Learn in detail about the mechanism of protein synthesis in prokaryotes and

			eukaryotes. • Understand about the advances of gene expression regulation and various mechanisms of gene silencing.
2	**BMB 802**	ADVANCES IN GENETIC ENGINEERING	• Know the description of different types of cloning vectors. • Understand the cDNA and genomic DNA library preparation. • Understand the identification of gene and a complete genome done by conventional and next generation sequencing. • Understand the characterization of genes and genomes. • Know the different types of dominant and co-dominant molecular markers • Understand the applications of genetic engineering in agriculture, industries and allied sectors.
3	**BMB 803**	**BIOPROCESS TECHNOLOGY**	• Develop an understanding of the various aspects of bioprocess technology and their basic principles. • Develop skills associated with controlling of various parameters of bioprocess monitoring. • Understand principles underlying design of fermentor, fermentation Process and downstream processing. • Get knowledge of industrial productions of various primary and secondary metabolites.
4	**BMB 804**	**ADVANCED GENOMICS AND PROTEOMICS**	• Develop knowledge of fundamental techniques in proteomics. • Learn various modules of MALDI TOF for analysis of proteins. • Understand Genome anatomy, gene expression and Post translational modification. • Understand the occurrence of disease due to misfolding of proteins. • Get detail knowledge and understanding of Protein – protein interaction.
5	**BMB 805**	**COMPUTATIONAL BIOLOGY**	• Understand and explain the development of computational biology. • Describe the fundamentals of bioinformatics

			databases and their application. • Understand and explain the use of various computational methods for phylogentic studies • Use and apply the knowledge of different softwares and programs for sequence comparison, molecular modeling • Explain the applications of computational biology in different fields of sciences.

NINTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BMB 901**	**ADVANCED IMMUNOLOGY**	• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies. • Understand the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions. • Understand the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity. • Understand the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.
2	**BMB 902**	**ENZYME TECHNOLOGY**	• Learn the principles and application of

			enzymes therapeutic applications and clinical diagnosis and their mechanism of action. • Understand about various modes of inhibition of enzyme actions with examples. • Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc. • Learn enzyme reactors and various parameters for bio-process design. • Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.
3	**BMB 903**	**ADVANCED ANIMAL BIOTECHNOLOGY**	• Understand conventional and advanced aspec Animal biotechnology. • Learn the cell culture media, cell culture meth and their maintenance. • Identify therapeutic enzymes, strategies of eff enzyme replacement therapy methods. • Understand concept of DNA vaccines and oth vaccines using animal cell culture. • Address the concepts and technology behind therapy. • Learn molecular mechanism of transgenic ani technology., Gene knockout tech.
4	**BMB 904**	**ADVANCED PLANT BIOTECHNOLOGY**	• Understand organogenesis, micropropagation, haploid and Embryo resue. • Develop knowledge of cloning binary and expression vector, transformation in plants. • Learn molecular techniques for identification of transgenics. • Understand plant genome organization, gene families and delay of fruit ripening. • Get knowledge of different biotic and abiotic stress resistant plant development.
5	**BMB 905**	**DRUG DESIGN AND DEVELOPMENT**	• Know identification of drug targets, knowledge of binding site and receptors of a drug and their interaction. • Identify the candidate drugs and design drugs that could be potentially useful in cell culture or animal models.

			• Determine computer based selection, screening and rationale designing of drug. • Get knowledge of combinatorial library and selection of the most effective compounds that could move through preclinical studies to clinical trials. • Monitor of drug –target interaction by QSAR studies.
6	**BMB 906**	**DRUG DELIVERY SYSTEMS**	• Understand the basic concepts of bioavailability, drug absorption, pharmacokinetics and pharmacodynamics. • Analyze various routes of administration and associated evaluation parameters for oral, parenteral, topical etc. drug delivery systems. • Gain knowledge of applications of novel drug delivery systems in various routes. • Develop various novel treatments like gene therapy and antisense therapy. • Develop an understanding to new generation technologies in drug delivery and targeting.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

Bachelor of Science Biology

Program Educational Objectives (PEO)

PEO1: To create a foundation of concepts of biology and phenomena among the students through theoretical and practical knowledge.

PEO2: To keep students updated with advancements in life sciences and inculcate continuous learning and self-improvement.

PEO3: To make students able to develop problem-solving and critical thinking ability associated with biological sciences.

PEO4: To prepare students with lateral thinking, communication, and scientific writing skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.

PEO5: To make students understand interdisciplinary nature of research in biological sciences through various research projects.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

Programme Outcomes

PO1. Knowledge: Dealing with developing knowledge and effective implementation of basic and advanced sciences for understanding and improvement of biological system.

PO2. Critical Thinking: Take informed actions after identifying the assumptions that frame research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.

PO3. Problem analysis: Identify, formulate, research literature, and analyse problems reaching substantiated conclusions using first principles of basic sciences.

PO4. Application and use of conventional and Modern tools and techniques: Create, select, and apply appropriate techniques, resources, and modern biological tools with an understanding of complex biological activities.

PO.5. Communication and comprehension: Communicate and comprehend effectively in person and other means and being able to write effective reports and design documents, make effective presentations, and give and receive clear instructions.

PO.6. Social Interaction: Apply basic and applied sciences to assess and improve health, safety, social and cultural issues towards societal benefits.

PO.7. Ethics: Recognize different value systems, ethical issues, moral concerns and adhere to them.

PO.8. Environment and Sustainability: Understand the environmental issues and demonstrate the knowledge for mitigation strategies and sustainable development.

PO.9. Self-driven and Life-long Learning: Recognize the need and develop the ability to engage independent and life-long learning in the broad context to technological advancement.

PO.10. Individual and teamwork: Function effectively as an individual, and as a member or leader in multidisciplinary settings. Having a good management skill related to project.

Programme Specific Outcomes:

PSO.1: Develop knowledge base and competency in different biological thrust areas of cell and molecular biology, microbiology, genetics, biochemistry and metabolic regulation, immunology, bioinformatics, plant and animal biotechnology, recombinant DNA technology, omic approaches, instrumentation, environmental and industrial biotechnology etc.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Enhance analytical, management, entrepreneurship skills along with effective communication and behavioural attributes.

COURSE OUTCOMES

FIRST SEMESTER

S. No.	Course Code	Course Title	Course Outcome

1	**BSC 101**	**Plant Sciences - I**	• Understand the concepts of algal plants morphology, anatomical features, evolutionary pathways & mode of reproduction. • Analyze various role of algae in freshwater, marine and soil environments as primary producers, suppliers of nutrition to animals and as resources for humans. • Identify, implement and evolve the occurrence, distribution, structure, phylogeny, evolutionary concepts and life history of fungi, lichens & mycorrhiza • Evaluate the general morphology, diversity, distribution, sexual reproduction, diversity of bryophytes, the significance of bryophytes as pioneer plants on land and their role in the origin of pteridophytes • Enable students to classification, morphology, reproduction and economic importance plants.
2	**BSC 102**	**Animal Sciences - I**	• Learn about characteristics and variations of invertebrates.
			• Develop scientific outlook for research and innovation. • Get knowledge of typical invertebrates and their economic importance. • Develop conservative outlook for animals. • Generate written and verbal communication skills over the subject. • Enable students to classification, morphology, reproduction and economic importance animal.
3	**BSC 103**	**Chemistry– I**	• After successful completion of the course students will have the knowledge and skill to understand the very basic concepts of analytical chemistry and calculations. Understand the very basic bonding mechanism and the application to materials in different field, periodicity and periodic table. • Understand different properties of the elements with reference to s & p-block elements in periodic table, Understand the chemical kinetics and rate of reaction. Understand fundamentals of organic chemistry including structure and electron delocalization effects.

4	**BSC 120**	**Plant Sciences Lab - I**	• Understand the concepts of plants.
5	**BSC 121**	**Animal Sciences Lab- I**	• Understand the various invertebrates • Analyse various microorganism • Identify, implement and evolve of various system of invertebrtaes.
6	**BSC 122**	**CHEMISTRY LAB – I**	• After completion of this course the students will understand the importance of best practices of chemical safety and lab safety while performing experiments in laboratory. • Calibration of different weights and glass apparatus such as measuring cylinder, burette, pipette, volumetric flasks shall be known to the students for systematic initiation of their chemical lab experiments.
7	**BCU 141**	**Communication Skills– I**	• Identify Common Errors and Rectify Them • Develop and Expand Writing Skills Through Controlled and Guided Activities • To Develop Coherence, Cohesion and Competence in Oral Discourse through

			Intelligible Pronunciation.
8	**EVS 142**	**ENVIRONMENTAL STUDIES-I**	• The multidisciplinary nature of environmental studies, including its definition, scope and need for public awareness. • Our natural resources including renewable and non-renewable resources comprising of forest, water, mineral, food, energy and land resources. • The ecosystem, their structure and function, energy flow, bio-geochemical cycles, community ecology, ecological succession, ecological pyramids, forest, grassland, aquatic and tundra ecosystem. • Biodiversity and its conservation. • Ecosystem diversity, species diversity and genetic diversity. • Biological classification of India. • Value of biodiversity. • Biodiversity at global national and local level. • Conservation of biodiversity. • Characteristic of ideal ecosystem. • Study of an artificial ecosystem.
9	**BCU 143**	**Behavioural Science - I**	• Student will Develop accurate sense of self • Student will nurture a deep understanding of personal motivation • Student will develop thorough understanding of personal and professional responsibility • Student will able to analyse the emotions of others for better adjustment.

SECOND SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSC 201**	**PLANT SCIENCES - II**	• The students will develop an understanding of the characteristics, life cycles & interrelationships among different forms of gymnosperm. • The course content will help the students to trace the evolutionary history, diversity of gymnosperms & develop an understanding of fossils, fossilization & geological time scale and its significance in the evolution of

			angiosperms. • The students will develop an understanding of the basis, guiding principles & salient features of the various classification systems of angiosperms. • Know the economic importance of the angiosperm plants. • Systematic position, distinguishing characters and economic importance of some important families like Rutaceae, Cucurbitaceae,Rosaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Lamiaceae, Euphorbiaceae, and Poaceae.
2	**BSC 202**	**Animal Sciences - II**	• Develop knowledge about Chordates. • Learn about comparative account of vertebrates. • Learn about anatomical & physiological variability among vertebrates. • Generates interdisciplinary and collaborative approach. • Develops ethical and conservative outlook for animals.
3	**BSC 203**	**Chemistry– II**	• After successful completion of the course students will have the knowledge and skill to apply the principles of chemical sciences: • To understand the basic stereochemistry, structure, bonding mechanism & molar mass, so that application of materials in different field can be understood. • To understand the nomenclature of various organic compounds • To understand chemical equilibrium and its applications. • To understand ionic equilibrium and its applications. • To learn and understand principles of chromatography and its applications.
4	**BSC 220**	**Plant Sciences Lab - II**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
5	**BSC 221**	**Animal Sciences Lab- II**	• Laboratory instructions • Methodology discussion • Hands on experiments

6	**BSC 222**	**CHEMISTRY LAB – II**	• The course will enable the students to understand the topics of chemical analysis of inorganic and organic salts and mixtures. The students will get clarity of understanding of the theoretical principles included in their parallel theory syllabus. • Elementary separation techniques have been included in the lab syllabus to introduce the concept of separation of components from mixtures.
7	**BCU 241**	**Communication Skills– II**	• The students should be able to apply Verbal and Non-Verbal Communication Techniques in the Professional Environment
8	**EVS 242**	**ENVIRONMENTAL STUDIES-II**	• Explain various types of environmental pollutions. • Understand role of individual in abatement of environmental pollution. • Explain methods to mitigate disasters. • Learn various environmental protection laws. • Learn role of IT in environment and human health.
9	**BCU 243**	**Behavioural Science – II**	• Student will be able to identify, understand, and apply contemporary theories of leadership to a wide range of situations and interactions • Student will be able to understand and respect individual difference, so to enhance the relationship • Learn social responsibility and develop a sense of citizenship • Student will be able to identify and understand the impact of culture on one's leadership style

THIRD SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSC 301**	**ANATOMY & PLANT PHYSIOLOGY**	• The students will be conceptually integrated to plant internal structure & their functions • Will further reveal the relationship between the structure, function, taxonomy, ecology and developmental genetics in plants. • The contents of this course will help the students to relate crop physiological processes with water-plant interaction, mineral absorption, transportation &

			assimilation. • The concept of photosynthesis in plant, the role & significance of pigment system in photosynthesis, components of light and dark reaction, C3 & C4 pathways for carbon fixation & the influence of environmental factors on photosynthesis will be understood by the students. • The students will acquire an understanding of the concept of respiration: mechanisms, factors & its importance.
2	**BSC 302**	**ANIMAL PHYSIOLOGY – I**	• Learn about anatomical and physiological aspects of animal body. • Gain knowledge about functioning of systems of body. • Generate path for further research and innovation. • Enhance new collaborative approaches with modern fields of biotechnology
3	**BSC 303**	**Chemistry– III**	• The students will learn about the various laws and conditions which govern the behaviour of liquid and solution and the phases in which they exist under different conditions.
4	**BSC 320**	**ANATOMY & PLANT PHYSIOLOGY LAB**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
5	**BSC 321**	**Animal Physiology LAB – I**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
6	**BSC 322**	**CHEMISTRY LAB – III**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
7	**BCU 341**	**Communication Skills– III**	• The students should be able to write correctly and properly with special reference to Letter writing.
8	**BCU 343**	**Behavioural Science – III**	• Students will be able to understand and solve the problems effectively in their personal and professional life. • Students will outline multiple divergent solutions to a problem, • Student will be able to create and explore

			risky or controversial ideas, and synthesize ideas/expertise to generate innovations.
9	**BSC 330**	**TERM PAPER**	• The students will develop modern approach to experimental plant embryology from developmental, structural and molecular point of view. • The course will provide in depth information on developmental cycles, regulation of the flowering process, of micro- and macrosporogenesis, on self-incompatibility & on embryo formation. • The students will be able to analyse the historical evolution of plant breeding. Will be able to understand the basic Mendelian genetics, plant reproduction systems and breeding products. • The students will develop an understanding of the four interacting factors necessary for disease to occur: the pathogen, the host, the environment, and time. With knowledge of these factors they will begin to understand the nature of plant disease epidemics and how to manage them. • The students will develop an understanding of the vast economic importance of angiosperms with reference to their use as source of food, fuel, fibers & medicine.

FOURTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSC 402**	**ANIMAL PHYSIOLOGY-II**	• Learn about anatomical and physiological aspects of animal body. • Understands functioning of important systems of body. • Develops knowledge about endocrinology and developmental biology. • Leads to enhance interest in research in advanced biotechnology. • Exposure with other interdisciplinary subjects of biology.
2	**BSC 403**	**CHEMISTRY - IV**	• Students are encouraged to engage in active interaction during lecture through discussion and questions. • Power point presentation and classroom lecture.
3	**BSC 420**	**PLANT BREEDING,**	• Laboratory instructions

		EMBRYOLOGY, PATHOLOGY & ECONOMIC BOTANY LAB	• Methodology discussion • Hands on experiments • Data collection
4	**BSC 421**	**Animal Physiology LAB – II**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
5	**BSC 422**	**CHEMISTRY LAB – IV**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
6	**BCU 441**	**Communication Skills– IV**	• Develop a resume for oneself • Ability to handle the interview process confidently • Learn the subtle nuances of an effective group discussion
7	**BCU 443**	**Behavioural Science – IV**	• Able to answer the question: What do I stand for? • Ability to apply a coherent set of moral principles within professional and specialized context • Willing to make unpopular but right decision • Committed to working for justice and peace locally and globally.

FIFTH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSC 501**	**PLANT BIOTECHNOLOGY**	• Handle the basic instruments used in plant biotechnology. • Learn Preparation of stocks for culture media. • Learn surface sterilization of different explants • Understand *in-vitro* germination of seeds, seed viability and their maintenance in lab. • Get training of problems related to germination, callus induction and propagation.
2	**BSC 502**	**GENETICS & ANIMAL BIOTECHNOLOGY**	• Understand the concept of gene in terms of recon, muton and cistron including both classical and modern concept. • Know various chemical and physical mutagens involved in causing mutation. • Understand theory of animal cell culture, culture media, methods to develop cell lines. and their maintenance for commercial

			applications. • Understand scale up production of monoclonal antibodies and hybridoma technology. • Understand the structure and function of variety of hormones and growth factors, concept behind *invitro* fertilization and embryo transfer, and development of superior live stocks.
3	**BSC 503**	**CHEMISTRY - V**	• To understand the very basic bonding mechanism and the application to materials in different field. • To understand the concept of Quantum Chemistry and its application • To understand Hard & Soft Acid and Base concepts and its application • To understand Organometallic & Bioorganic Concept
4	**BSC 520**	**PLANT BIOTECHNOLOGY**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
5	**BSC 521**	**GENETICS & ANIMAL BIOTECHNOLOGY LAB**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
6	**BSC 522**	**CHEMISTRY LAB – V**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
7	**BCU 541**	**Communication Skills– V**	• Communicate fluently and sustain comprehension of an extended discourse. • Demonstrate ability to interpret texts and observe the rules of good writing. • Prepare and present effective presentations aided by ICT tools.
8	**BCU 543**	**Behavioural Science – V**	• Students will Develop critical and reflective thinking abilities • Students will Demonstrate an understanding of group dynamics and effective teamwork • Student will develop a range of leadership skills and abilities such as effectively leading change, • resolving conflict, and motivating others • Student will Gain knowledge and understanding of organization resources,

			policies, and involvement • opportunities. • Student will Develop strategies to recruit, retain, and continually motivate contributing members to the organization

SIXH SEMESTER

S. No.	Course Code	Course Title	Course Outcome
1	**BSC 601**	**PLANT ECOLOGY**	• The students will develop an understanding of modern ecological concepts through holistic approach about populations, communities and ecosystems • Would provide information about various ecological processes and factors affecting growth and distribution of vegetation, principles of management of natural resources • Identify the significance of plant cover as an indicator of change in the environment, and as an active participant in the formation of environmental conditions or habitat types. • The course content will help the students to analyse the interrelationships of all the biotic and abiotic components with the environmental conditions, with independent recognition and classification of taxa. • The students will develop the expertise in differentiating properties of terrestrial, aquatic and marine ecosystems and the accompanying communities
2	**BSC 602**	**APPLIED ZOOLOGY**	• Employ scientific methodologies to understand and apply relevant scientific principles. • Understand the culture techniques of prawn, pearl and fish. • Understand silkworms & lac rearing and their products. • Understand the Bee keeping and Apiary management. • Understand the process of preparation of buffer, fixatives, stains and reagent. • Learn the techniques of Microtomy, chromatography and taxidermy.

3	**BSC 603**	**CHEMISTRY – VI**	• To understand the very basic bonding mechanism and the application to materials in different field. • To understand the spectroscopic concept like NMR, IR, UV, Photochemistry • To understand polymer synthesis, properties and application in various field • To understand synthesis and applications of carbohydrates, fatty acids & oils • To understand synthesis and applications of amino acids, peptides, proteins
4	**BSC 620**	**PLANT ECOLOGY & APPLIED ZOOLOGY LAB**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
5	**BSC 621**	**CHEMISTRY LAB – VI**	• Laboratory instructions • Methodology discussion • Hands on experiments • Data collection
6	**BCU 641**	**Communication Skills– VI**	• To communicate contextually in specific personal and professional situations with courtesy. • To inject humour in their regular interactions. • To strengthen their creative learning process through individual expression and collaborative peer activities.
7	**BCU 643**	**Behavioural Science – VI**	• Student will able demonstrate thorough understanding of stress and its effects • Student will able to learn various coping strategies to deal stress effectively so to overcome the consequences and impact of stress on their health and wellbeing, ultimately it will enhance their performance.
8	**BSC 660**	**PROJECT**	• Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

			• Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student. • Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage. • The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

AMITY UNIVERSITY MADHYA PRADESH, GWALIOR
AMITY INSTITUTE OF BIOTECHNOLOGY

PEO1: To educate an interdisciplinary group of students with backgrounds in biology, microbiology, biochemistry and biotechnology in the applied biological sciences of biotechnology for careers in academia, government and industry.

PEO2: To experience research in close relation to biotechnology students, while working in the field of biotechnology.

PEO3: To prepare students for careers of constructive service to society in academia, government, industry and health related fields.

PEO4: To bring students to a baseline that will allow them to conduct translational research, from conceptual design through in vivo testing with an eye towards application.

PEO5: To provide interdisciplinary research and educational opportunities to solve problems that will improve the quality of life for those suffering from health-related diseases and disorders.

PROGRAMME OUTCOMES & PROGRAMME SPECIFIC OUTCOMES

PROGRAMME OUTCOMES OF Ph.D BIOTECHNOLOGY

PROGRAMME OUTCOMES OF Ph.D. BIOTECHNOLOGY

PO1. Knowledge: Applying the mechanisms and principles learnt to solve the problems in agriculture by using biotechnological techniques and tools.

PO2. Understanding the problems and finding out solutions: Identifying the research gaps in the agricultural field by practical exposure and working out the methodology for solving the problems through literature collection and experimentation.

PO3. Conducting research for solving the problems: After identifying a research problem, formulation of a research proposal by collecting literature and deriving the methodologies for implementing the research through several experiments, collection of data, analysis of data and finally interpreting the data for getting a solution to the research problem.

PO4. Gaining knowledge on modern tools and techniques: While solving new research issues methodologies will be optimized, new tools may be developed, undergoing the usage of sophisticated equipment's and valuable software / tools to attain the solutions scientifically.

PO5. Work efficiency: Students' working efficiency will be improved either individually or working under team environment. Understanding the value of time, productivity will be increased.

PO6. Professional Ethics: Apply ethical principles and commit to follow professional ethics

and norms and guidelines in the practice of biotechnology responsibly.

PO7. Communication skills: Solutions found out for the research problems will be effectively communicated by way of writing research articles and presentations.

PO8. Biotechnology and society: Apply reasoning for the issues, informed by the contextual knowledge of the problems in hand and assess the risk associated with the societal, health, safety, legal and cultural issues of the problems and the consequent responsibilities relevant to the professional practice of the discipline.

PO9. Environment and sustainability: Understand the impact of technological solutions developed through biotechnology in contexts of society and environment, and demonstrate the knowledge need for sustainable development in judicious use of biotechnology tools.

PO10. Life-long learning: Understanding the dynamism of biological sciences, technological changing needs are to be felt, positive attitude are to develop so as to prepare and engage in adapting to such changes through the process of life-long learning.

PROGRAM SPECIFIC OUTCOMES OF Ph.D BIOTECHNOLOGY

PSO.1: Develop research base and competency in different thrust areas of biotechnology and allied disciplines.

PSO.2: Achieve the scientific acumen and ability to identify research-based problems and develop suitable approach by designing protocols and their effective interpretation and implementation.

PSO.3: Develop hands on skills to be applied in biotechnology.

PSO.4: Empower the scholars to be effective entrepreneurs and excellent researchers.

COURSE OUTCOMES

S. No.	Course Code	Course Title	Course Outcome
1	**PRM 101**	**RESEARCH METHODOLOGY**	• Critically analyse research methodologies identified in existing literature. • Propose and distinguish appropriate research designs and methodologies to apply to a specific research work/area/project. • Develop a comprehensive research methodology for a research problems. • Apply the understanding of feasibility and practicality of research methodology for a proposed research work.

2	**PRP 102**	**RESEARCH & PUBLICATION ETHICS**	• To be able to describe and apply theories and methods of ethics into research • To be able to understand philosophy and its relation with research • To acquire an overview of important issues in research ethics and utilize these ethics to avoid research and scientific misconduct. • To be able to identify fake and predatory Journals • To be able to understand different indexing agencies and how the impact factor is calculated.
3	**PRL 103**	**REVIEW OF LITERATURE**	• Identify the most relevant textbooks, reviews articles, research papers and journals for their research topics/area. • learn how to critically read and assess research papers and reviews. • The review should point to research gaps that can be opertionalised into feasible research questions. • Develop advanced understanding and deeper knowledge of the related field. • Develop the ability to synthesize and apply disciplinary principles and practices to new or complex environments.

			• Develop depth understanding of research-based learning and the ability to plan, analyse, present implement and evaluate complex activities. • Develop critical thinking and problem solving skills.
4	**PBT 104**	**GENOMICS AND PROTEOMICS**	• Develop knowledge of fundamental techniques in proteomics. • Learn various modules of MALDI TOF for analysis of proteins. • Understand Genome anatomy, gene expression and Post translational modification. • Understand the occurrence of disease due to misfolding of proteins. • Get detail knowledge and understanding of Protein – protein interaction.
5	**PBT 105**	**IPR, BIOSAFETY AND BIOETHICS**	• Students get an adequate knowledge on patent and copyright for their innovative research works • • During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. • This provide further way for developing their idea or innovations. • Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur etc.
6	**PBT 106**	**INSTRUMENTATION IN BIOTECHNOLOGY**	• Understand centrifugation machine and their techniques for the separation of biomolecules. • Know about electrophoresis and their different types and their application. • Know about chromatography techniques and their different types and their application • Know different types of spectroscopes and microscopes and their application analysis of different molecules. • Learn about the radioactivity and their

			measurement using scintillation counters.
7	**PBT 107**	**ENZYMOLOGY AND ENZYME TECHNOLOGY**	• Learn the principles and application of enzymes therapeutic applications and clinical diagnosis and their mechanism of action. • Understand about various modes of inhibition of enzyme actions with examples. • Learn basics and applications of immobilization of enzymes, which includes; industrial production of antibiotics, beverages etc. • Learn enzyme reactors and various parameters for bio-process design. • Learn about the non-conventional sources of biocatalysts which include thermophilic and extremophilic microbes.
8	**PBT 108**	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	• Know the cellular ontogeny and organ involvement in immunity, know the difference between innate and adaptive immunity, understand what antigens are and how they interact specifically with antibodies. • Explain the molecular biology of antibodies synthesis, immune cells generation, structure of MHC molecules and their roles in immune response. Students will be able to understand the concept of transplantation and role of immunity in transplantation reactions. • Explain the mechanisms of cell mediated immunity and hypersensitivity reactions. Students will be able to explain the concept of MHC restriction and role of complement system in immunity. • Explain the mechanism and principle of self-tolerance and autoimmunity. Students will be able to know how the immune system can fight infections and cancer, including examples of immunotherapy to harness host immunity and role of immune system in fighting against infectious diseases. Describe the principles and applications of various techniques involved in studying antigen antibody interactions. Students will also be able to understand the concept of vaccines.

9	**PBT 109**	ENVIRONMENTAL BIOTECHNOLOGY	• Understand the delicate interrelationship of different components of environment. • Understand conventional fuels, their impact and concept of clean fuel technology. • Learn approaches and concepts behind bioremediation xenobiotic compounds, mechanism of microbial leaching and mining. • Learn the concept of municipal solid and liquid wastes management and EIA. • Understand the concept and assessment of environmental quality.
10	**PBT 110**	**ADVANCED BIOCHEMISTRY**	• Learn carbohydrate metabolism in detail by analyzing all the pathways. • Learn the various aspects of lipid metabolism and their regulation. • Understand the metabolism of Nitrogen and excretion of urea from body. • Learn Nucleotide metabolism and clinical disorders of purine metabolism. • Develop advanced knowledge of action of major hormones and principles and application of primary and secondary metabolites.
11	**PBT 111**	**ADVANCED MICROBIAL TECHNOLOGY**	• Recognize and explain the significant role that microbes play in the world around us. • Explain the similarities and differences of microbes as compared to higher forms of life. • Identify microbes and explain methods of growth and cultivation as well as structural and biochemical differences. • Understand the microbial structure, function, metabolism, growth, genetics, and control - including antibiotic usage. • Explain the basic principles of immunology relating to host resistance. • Evaluate the physical and chemical methods of microbial control. • Recognize microbial diseases and their control.
12	**PBT 112**	**ADVANCED MOLECULAR BIOLOGY**	• Learn and develop advanced understanding of mechanism of DNA replication in prokaryotes and eukaryotes.

			• Learn the advanced mechanism of transcription in prokaryotes and eukaryotes. • Develop understanding of various post-transcriptional processes in cell. • Learn in detail about the mechanism of protein synthesis in prokaryotes and eukaryotes. • Understand about the advances of gene expression regulation and various mechanisms of gene silencing.
13	**PBT 113**	**BIOPROCESS TECHNOLOGY**	• Develop an understanding of the various aspects of bioprocess technology and their basic principles. • Develop skills associated with controlling of various parameters of bioprocess monitoring. • Understand principles underlying design of fermentor, fermentation Process and downstream processing. • Get knowledge of industrial productions of various primary and secondary metabolites.
14	**PBT 114**	**ADVANCED PLANT BIOTECHNOLOGY**	• Understand organogenesis, micropropagation, haploid and Embryo resue. • Develop knowledge of cloning binary and expression vector, transformation in plants. • Learn molecular techniques for identification of transgenics. • Understand plant genome organization, gene families and delay of fruit ripening. • Get knowledge of different biotic and abiotic stress resistant plant development.