

DEPARTMENT OF PLANT BIOLOGY & BIOTECHNOLOGY

PROGRAM SPECIFIC OUTCOME (PSO)

&

COURSE OUTCOME (CO)

B.Sc./M.Sc/M.Phil/Ph.D.

B.Sc., Plant Biology and Plant Biotechnology

Course Outcome for Curriculum (2016 batch)

Name of the Department: **Plant Biology and Biotechnology**

UG Programme: **B.Sc., Plant Biology and Plant Biotechnology**

Program Specific Outcome

PSO 1: Gain knowledge on plant diversity, ecology and recent advances in plant sciences

PSO 2: Understand the cell structure, anatomy and physiology of plants

PSO 3: Comprehend the basics of genetics and molecular biology

PSO 4: Acquire skills related to plant tissue culture, biological techniques, mushroom cultivation, practices followed in agriculture, horticulture and formulation of herbal products

PSO 5: Gain awareness on the environmental issues, management of natural resources and conservation of plant wealth

Course Outcome for UG Program (2016 Curriculum)

Course Code/ Semester	Course Name/ Category	Cognitive Level	Course Outcome
16UPB1MC01 Semester I	ALGAE AND BRYOPHYTES (Major Core)	K1, K2, K3, K4, K5	CO1: Understand the classification, distribution, reproduction and salient features of Algae CO2: Gain knowledge on the thallus organization of Algae CO3: Comprehend current applications of Algae: Single Cell Protein (SCP) production and commercialization CO4: Describe characteristics of Bryophytes, their phylogeny, habit, distribution, classification and their economic importance CO5: Explain the external features of each class of Bryophytes

Course Code/ Semester	Course Name/ Category	Cognitive Level	Course Outcome
16UPB1MC02 Semester I	FUNGI (Major Core)	K1, K2, K3	CO1: Understand general characters, life cycle patterns and its classifications CO2: Compare the vegetative and reproductive structures of lower groups of fungi CO3: Describe the vegetative and reproductive structures of higher groups fungi, as well as lichens CO4: Understand the usefulness of fungi to human kind CO5: Analyze the clinical implications of fungi as pathogen, diagnosis, control and treatment
16UPB1MC03 Semester I	LABORATORY COURSE - I (ALGAE, BRYOPHYTES& FUNGI) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Describe the morphology of algae, Fungi and Bryophytes CO2: Gain knowledge on the techniques related to algal cultivation CO3: Identify the algal forms and fungi through field visits CO4: Gain foundation in clinical Mycology, symptoms, diagnosis and control
16UZO1AL01 Semester I	Animal Diversity (to Plant Biology and Biotechnology students) (Allied - AL)	K1, K2, K3	CO1: Describe general taxonomic rules on animal classification CO2: Classify phylum protochordates to mammalia CO3: Understand the distribution of fauna CO4: Understand animal behaviour and its response to different instincts CO5: Understand various kinds of animal adaptations
16UZO1AL02 Semester I	Animal Diversity Lab Course (to Plant Biology and Biotechnology students) (Allied Lab -AL)	K1, K2, K3, K4, K5	CO1: Understand diversity of life CO2: Appreciate interaction of animals with environment CO3: Apply system of classification CO4: Understand the role of evolution CO5: Attribute reasons for divergent evolution

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16UPB2MC01 Semester II	PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY (Major Core)	K1, K2, K3	CO1: Comprehend the general characters, classes and features of Pteridophytes CO2: Understand the morphology and reproduction of different forms of Pteridophytes CO3: Explain the general characters, classification and characters of Gymnosperms CO4: Discuss the economic importance, and characteristics of important Gymnosperms CO5: Classify and describe the different fossil forms and their mode of formation
16UPB2MC02 Semester II	PLANT ANATOMY AND EMBRYOLOGY (Major Core)	K1, K2, K3	CO1: Describe different types of tissues in plants CO2: Explain the organization of tissues CO3: Compare the anatomy of leaf, stem, root in dicots and monocots CO4: Describe the development of anther and ovule CO5: Illustrate the stages of development of embryo
16UPB2MC03 Semester II	LABORATORY COURSE - II (PTERIDO. GYMNO. AND PALEO BOT. & PLANT ANATOMY AND EMBRYOLOGY) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Identify the morphological, anatomical and organization of Pteridophytes and Gymnosperms CO2: Identify and classify different fossil forms CO3: Compare the anatomical features of stem, leaf and root in dicot and monocot. CO4: Understand the reproductive structures in plants and process of embryo development in plants

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6UZO2AL01 Semester II	AGRICULTURAL ENTOMOLOGY (TO PLANT BIOLOGY AND BIOTECHNOLOG Y) (Allied - AL)	K1, K2, K3,	CO1: Understand insect morphology, anatomy and behaviour CO2: Understand the agro-forestry environment and management of insects CO3: Apply principles of pest management CO4: Understand the economic importance of insects CO5: Understand the ecological importance of IPM and green pesticides
16UZO2AL02 Semester II	AGRICULTURAL ENTOMOLOGY LAB (TO PLANT BIOLOGY AND BIOTECHNOLOG Y) (Allied Lab- AL)	K1, K2, K3, K4, K5	CO1: Understand Insect biodiversity CO2: Understand the Population dynamics of insects CO3: Apply biological and microbiological control CO4: Understand mechanical, physical and agronomical control CO5: Infer chemical control and side effects of pesticides
16UPB3MC01 Semester III	MICROBIOLOGY (Major Core)	K1, K2, K3	CO1: Understand the different types of microbes and its classification CO2: Explain the structure, growth of bacteria and their isolation CO3: Comprehend aspects of microbial physiology, and microbial genetics CO4: Distinguish different types of virus types and cultivation methods CO5: Elucidate the roles of microbes in different industries and environment
16UPB3MC02 Semester III	CELL BIOLOGY AND EVOLUTION (Major Core)	K1, K2, K3	CO1: Discuss the principle and types of microscopy and cell types CO2: Comprehend the structure and function of different cell organelles CO3: Describe the structure of chromosomes and their types CO4: Explain the fundamental aspects of cell division and the significance in disease prevention CO5: Compare the fundamental theories in evolution and speciation
16UPB3MC03 Semester III	LABORATORY COURSE - III (MICROBIOLOGY, CELL BIOLOGY AND EVOLUTION (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Explain the principle of microscopy and measurement of cell dimensions CO2: Perform squash preparations for mitotic and meiotic observations CO3: Understand the structural and functional aspects of cell organelles CO4: Perform sterilization technique, media preparation, isolation of bacteria, staining technique CO5: Prepare clay models to understand bacterial shapes

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16UCH3AL03 Semester III	GENERAL CHEMISTRY FOR BIOLOGY-I (Allied - AL)	K1, K2, K3	CO1: Follow the rules to handle chemicals safely and eliminate errors in data analysis CO2: Identify the chemical bonding and intramolecular interactions present in the chemical compounds CO3: Illustrate the principle of volumetric analysis CO4: Explain the fundamentals of chemical kinetics and differentiate homogeneous and heterogeneous catalysis CO5: Discuss the chemistry of fats, vitamins and hormones
16UCH3AL04 Semester III	CHEMISTRY PRACTICAL FOR BIOLOGY-I (Allied Lab- AL)	K1, K2, K3	CO1: Perform preliminary test to identify the chemical nature of the given organic substance CO2: Classify the given organic substance as an aromatic or aliphatic CO3: Categorize the given organic substance as saturated or unsaturated CO4: Identify the presence of characteristic elements nitrogen and Sulphur CO5: Perform confirmatory tests to identify the functional group present in the given organic substance
16UPB4MC01 Semester IV	ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY (Major Core)	K1, K2, K3, K5	CO1: Gain knowledge on the classification of angiosperms (classical and advanced) CO2: Comprehend the rules and regulations for giving scientific names to plants CO3: Describe the characteristic features and economic importance of fifteen families CO4: Gain skills on the identification of higher plants CO5: Knowledge on the Brief history, botanical name, family, uses (nutritional aspects, active compounds and importance) and morphology of day to day useful plants
16UPB4MC02 Semester IV	LABORATORY COURSE - IV (ANG. TAXON AND ECO. BOT) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Describe plants using technical terms CO2: Knowledge on the scientific names, vernacular names, useful parts and uses of economically important plant products CO3: Identify plants through field trips and prepare herbarium

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16UPB4ES01 Semester IV	BIOLOGICAL TECHNIQUES (Elective Subject)	K1, K2, K3	CO1: Elucidate the steps in microtechniques, photography and staining CO2: Prepare whole mounts, sections and herbarium materials CO3: Explain the principle and working of pH meter and centrifuges CO4: Discuss the different spectroscopic methods and their applications CO5: Apply chromatographic method as separation tool for biomolecules
16UPB4ES02 Semester IV	BIOLOGICAL TECHNIQUES LAB (Elective Subject Lab)	K1, K2, K3, K4, K5	CO1: Perform the procedures related to processing and preservation of plant material CO2: Operate various biological instruments for various experiments CO3: Prepare whole mounts, smear and squash preparations of plant samples
16UPB4ES03 Semester IV	HORTICULTURE AND LANDSCAPING (Elective Subject)	K1, K2, K3, K4, K5	CO1: Gain knowledge on the horticultural crop propagation techniques, export, import and marketing value of horticultural crops CO2: Understand the principles of plant growth, quality, nutritional value, yield and resistance to insects, diseases, and environmental stresses CO3: Elucidate the importance of Kitchen garden, horticultural crops, gardening and organic farming CO4: Acquire knowledge on entrepreneurship related to horticulture CO5: Aware of job opportunities in the fields of horticulture, seed production, fertilizers, landscaping and gardening
16UPB4ES04 Semester IV	HORTICULTURE AND LANDSCAPING LAB (Elective Subject Lab)	K1, K2, K3	CO1: Understand techniques involved in the horticultural crop propagation CO2: Gain knowledge the common food and ornamental crops CO3: Understand importance of gardening and landscaping by field based study
16UCH4AL03 Semester IV	GENERAL CHEMISTRY FOR BIOLOGY – II (Allied)	K1, K2, K3, K4, K5	CO1: Discuss the chemistry of biomolecules and natural molecules CO2: Outline the importance of lipids and steroids in the living system CO3: Assess the biochemical concept of glycolysis CO4: Evaluate the biological significance of alkaloids, terpenes, flavones CO5: Explain the importance of fertilizers and pesticides for the growth of plants

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16UCH4AL04 Semester IV	CHEMISTRY PRACTICAL FORBIOLOGY-II (Allied Lab)	K1, K2, K3, K4, K5	CO1: Acquire basic principle of volumetric analysis. CO2: Utilize the titration skill for quantitative analysis CO2: Estimate the amount of calcium, ascorbic acid, glucose, glycine, acetic acid and lactose present in a food products CO3: Estimate the strength of an unknown solution CO4: Compare the use of indicators in different types of titrations
16UPB5MC01 Semester V	PLANT PHYSIOLOGY (Major Core)	K1, K2, K3, K4, K5	CO1: Understand the relations of soil – plant - air continuum CO2: Describe the mechanism of various anabolic (Photosynthesis) and catabolic (Respiration) processes in plants CO3: Acquire basic knowledge on role of hormones in growth and development of plants CO4: Design and perform experiments related to functioning of plant system against climate change CO5: Describe the physiological mechanism involved in nitrogen fixation
16UPB5MC02 Semester V	GENETICS AND PLANT BREEDING (Major Core)	K1, K2, K3, K4, K5	CO1: State the Mendelian laws of genetics CO2: Illustrate the concepts of incomplete dominance, codominance, heterodominance, lethal genes and pleiotropism CO3: Explain patterns of sex-linked inheritance, chromosomal disorders, cytoplasmic inheritance and genetic recombination CO4: Describe DNA replication, gene expression and protein synthesis and discuss the types of mutations, DNA damage and repair mechanisms CO5: Outline the principle of plant breeding, clonal selection and hybridization
16UPB5MC03 Semester V	ECOLOGY, PHYTOGEOGRAPHY AND FORESTRY (Major Core)	K1, K2, K3, K4, K5	CO1: Understand the various plant ecosystems and ecological factors CO2: Comprehend the structure and function of various ecosystems, energy flow CO3: Understand and differentiate the various plant ecological adaptations CO4: Distinguish plant distribution, vegetation pattern of world, continental, state level, forest biodiversity management and its conservation strategies CO5: Gain knowledge on forest products and various policies on forest protection

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16UPB5MC04 Semester V	LABORATORY COURSE- V (PLANT PHYSIOLOGY) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Determine the water potential and osmotic pressure of a plant cell CO2: Understand the importance of light and water in photosynthesis CO3: Acquire skill to perform extraction, separation, identification and quantification of pigments and metabolites in plants
16UPB5MC05 Semester V	LABORATORY COURSE-VI (GENETICS AND PL. BREEDING & ECOLOGY, PHYTOGEOGRAP HY AND FORESTRY) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Solve the given data for arithmetic mean, standard error and standard deviation. CO2: Perform Chi square analysis CO3: Solve problems on monohybrid and dihybrid cross CO4: Demonstrate mapping of chromosomes. CO5: Understand vegetation analysis techniques and softwares CO6: Identify the plant communities of particular ecosystem CO7: Comprehend and distinguish the morphological and anatomical features of plants from various ecosystems CO8: Understand and get exposure on the phytogeographical regions of India and forestry management by field based study CO9: Understand the economic importance and commercial value of Timber and Non timber Forest Products (NTFP)
16UPB5ES01 Semester V	PRINCIPLES OF AGRICULTUR E (Elective Subject -ES)	K1, K2, K3	CO1: Gain knowledge on agriculture, modern method of cultivation, cropping pattern CO2: Explain the types of soil, climatic factors, use of fertilizers and organic farming CO3: Comprehend the scheduling of irrigation and types of irrigation CO4: Gain knowledge on Agricultural implements and practices CO5: Describe methods on weed control, pest management and agricultural extension
16UPB5ES02 Semester V	PRINCIPLES OF AGRICULTURE LAB. (Elective Subject Lab -ES)	K1, K2, K3, K4, K5	CO1: Understand the physical and chemical parameters of the soil CO2: Gain knowledge on Agricultural implements, preparation of compost, organic manure, soil preparation and crop management CO3: Distinguish between effects of organic and inorganic pesticides

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16UPB5ES03 Semester V	BIOINFORMATICS AND BIOSTATISTICS (Elective Subject -ES)	K1, K2, K3	CO1: Knowledge on the protein structure, internet basics and databases CO2: Perform sequence alignment and phylogenetic analysis CO3: Identify genes, motifs and perform molecular modeling CO4: Solve basic statistical operations in biological data CO5: Carry out statistical applications in the analysis of biological data
16UPB5ES04 Semester V	BIOINFORMATICS AND BIOSTATISTICS LAB (Elective Subject Lab -ES)	K1, K2, K3, K4, K5	CO1: Carry out sequence similarity searches, retrieve data from different databases and analyse them CO2: Perform sequence alignment and phylogenetic analysis CO3: Carry out statistical analysis of data using the SPSS software
16UPB5SK01 Semester V	PRODUCTION OF MUSHROOM, BIOFERTILIZER S AND SINGLE CELL PROTEIN (Skill-based - SK)	K1, K2, K3, K4, K5	CO1: Acquire skills on Mushroom cultivation, bio-composting and Biofertilizer (algal and bacterial) production CO2: Prepare for self –employment/ entrepreneur CO3: Cultivation of Single Cell Protein (SCP)-Spirulina/ Chlorella
16UPB6MC01 Semester VI	PLANT DISEASES AND MANAGEMENT (Major Core)	K1, K2, K3, K4	CO1: Explain the process of disease development and plant microbe interactions CO2: Understand innate and induced plant defense mechanisms CO3: Distinguish different pathogens, symptoms and control of various diseases CO4: Compare different pathogens, symptoms and control of fungal and insect diseases CO5: Analyze different methods of disease control by chemicals, microbes and genetic engineering

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16UPB6MC02 Semester VI	HERBAL SCIENCES AND ETHNOBOTANY (Major Core)	K1, K2, K3, K5	CO1: Knowledge on the morphological, anatomical, physico-chemical characteristics of medicinal plants and their uses CO2: Understand drug adulteration CO3: Gain knowledge on preparation of drugs for commercial market and export potential of medicinal plants CO4: Acquire skills on herbal preparations CO5: Knowledge on the methodology of Ethnobotanical research
16UPB6MC03 Semester VI	MICROBIAL TECHNOLOGY (Major Core)	K1, K2, K3	CO1: Explain the principles and fundamentals of microbial technology CO2: Elucidate the structure of fermentor CO3: Understand the formulation of culture media CO4: Describe the microbial processing in food and pharmaceutical industries CO5: Summarize the methods used in industrial products such as microbial enzymes, organic acids etc.,
16UPB6MC04 Semester VI	ENVIRONMENTAL BIOTECHNOLOGY (Major Core)	K1, K2, K3	CO1: Identify the different components of the atmosphere CO2: Describe the different types of pollutants and pollution CO3: Explain the process of bioremediation, factors associated and methods of bioremediation CO4: Illustrate biological treatment of sewage and describe the pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation CO5: Review the role of bioplastics, biofuels, biopesticides in sustaining a clean environment
16UPB6MC05 Semester VI	LABORATORY COURSE- VII (PLT. DIS.AND MANG.,& HERBAL SCIENCES AND ETHNOBOTANY) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Acquire skills on identification of various Plant diseases caused by bacteria, fungi and viruses CO2: Investigate the anatomical changes due to pathogenesis CO3: Identify various primary and secondary phytochemicals CO4: Acquire skills on Herbal preparations CO5: Gain practical knowledge on the identification of common medicinal plants

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16UPB6MC06 Semester VI	LABORATORY COURSE-VIII (MICROBIAL TECH. & ENV. BIOTECH) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Understand the principles of microbial fermentation and types of fermentors CO2: Demonstrate production of wine, citric acid, ethanol and glutamic acid CO3: Estimate the amount of Dissolved oxygen, BOD, acidity, alkalinity, hardness in water CO4: Evaluate the microbial quality and potability of water
16UPB6MS01 Semester VI	PLANT BIOTECHNOLOGY (Major Core)	K1, K2, K3, K5	CO1: Understand the concepts, principles and application of plant tissue culture CO2: Comprehend the basics of rDNA technology, concept and principle and application of genetic engineering CO3: Describe the principles and methods involved in rDNA technology such as Gel Electrophoresis, Blotting techniques, PCR and DNA finger printing CO4: Acquire knowledge on importance of plant tissue culture and molecular biology in transgenic production CO5: Gain understanding on biosafety measures in laboratories
16UPB6MS02 Semester VI	LABORATORY COURSE- IX (PLANT BIOTECHNOLOGY) (Major Core Lab)	K1, K2, K3, K4, K5	CO1: Understand the principle and types of sterilization methods used in plant tissue culture CO2: Prepare stock solutions and different media for plant tissue culture CO3: Acquire skills in shoot tip culture of medicinal plants CO4: Produce callus from the explants of medicinal plants

Course Outcome for Curriculum (2016 batch)

Department: **Plant Biology and Biotechnology**

PG Programme: **M.Sc., Biotechnology**

Program Specific Outcome

- PSO 1: Gain knowledge on fundamental processes like growth, metabolism, molecular transportation, cell-cell communications, energy conversions and cell death in prokaryotes and eukaryotes
- PSO 2: Gather knowledge on biologically important molecules like sugars, amino acids, fatty acids, nucleotides and amplify their understanding on the structure, function and networking
- PSO 3: Gain familiarity on the biology of infectious diseases, defective metabolic pathways, genetic disorders and advocate appropriate methods for diagnosis and treatment
- PSO 4: Acquire laboratory skills in Fermentation technology, Environmental Biotechnology, Food technology and biosafety
- PSO 5: Apply skills to formulate a research problem, survey literature, design experiments, gather data, employ suitable test statistic, interpret the results and draw objective conclusions independently
- PSO 6: Demonstrate and uphold ethical principles in their career and contribute to social, health, safety and legal issues and practice his / her responsibilities as a Biotechnologist

Course Outcome for PG Program (2016 Curriculum)

Course Code/ Semester	Course Name	Cognitive Level	Course Outcome
<p>16PBT1MC01 Semester I</p>	<p align="center">CELL AND DEVELOPMENTAL BIOLOGY (Major Core)</p>	<p align="center">K1, K2, K3, K4, K5</p>	<p>CO1: Describe the components of the cell, their subcellular organelles, structure and function. Identify the different aspects of cell division and cell cycle CO2: Relate to cell- cell signaling systems in a cell. Analyse various developmental processes which would establish the body plan of vertebrates CO3: Explain the process of organogenesis in <i>Caenorhabditis elegans</i> CO4: Examine the methods for identification of sexual phenotypes CO5: Evaluate the various developmental studies using model plant <i>Arabidopsis</i> and <i>Acetabularia</i>. CO6: Analyse the different stages of development in Angiosperms</p>
<p>16PBT1MC02 Semester I</p>	<p align="center">BIOCHEMISTRY (Major Core)</p>	<p align="center">K1, K2, K3, K4, K5</p>	<p>CO1: Explain the exclusive properties of water, action of biological buffers, and solve problems related to pH and pKa CO2: Relate to concepts of entropy, enthalpy and Gibbs free energy CO3: Classify the biomolecules such as carbohydrates, amino acids, fatty acids and nucleotides based on structure and functional groups CO4: Employ electrophoretic and chromatographic techniques for separation of biomolecules CO5: Sketch the metabolic pathways and the regulatory mechanisms. CO6: Derive the Michaelis Menten equation and extrapolate it to enzyme inhibitions</p>

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16PBT1MC03 Semester I	MICROBIOLOGY (Major Core)	K1, K2, K3, K4, K5	CO1: Recognize the extent of microbial diversity and the importance of microbial diversity in different habitats including extreme environments CO2: Relate to conventional and molecular methods used for studying microbial diversity and problems and limitations in microbial diversity studies CO3: Investigate microbial classification schemes and methods used for taxonomy and understand the structural similarities and differences among various physiological groups of bacteria CO4: Describe about microbial transport systems, modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy CO5: Discuss the essential concepts of virology, the structure of viruses, properties, replication, types of infection, immune response to infection, treatment and the inhibitory action of the antiviral chemotherapy and laboratory diagnosis CO6: Classify fungi, parasites and discuss mechanisms of host entry, survival, and disease progression
16PBT1MC04 Semester I	IMMUNOLOGY (Major Core)	K1, K2, K3, K4, K5	CO1: Describe the fundamental elements of immune system CO2: Elucidate the genetic basis for immunological diversity CO3: Relate to clinical manifestations of immune dysfunction with respect to transplantation, tumour immunology, immunodeficiency disorders, autoimmune diseases CO4: Classify types of hypersensitivity reactions and associate clinical manifestations CO5: Understand and relate the types of vaccines CO6: Explain hybridoma technology and apply immunotechniques for clinical diagnosis

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16PBT1MC05 Semester I	LAB - I (Cell & Dev. / Biochem.) (Major Core Lab)	K1, K2, K3, K4, K5, K6	CO1: Perform biochemical calculations and prepare standard solutions CO2: Analyse sugars and amino acids qualitatively CO3: Identify and estimate the amino acids, proteins & sugars CO4: Extract and evaluate the kinetic properties of enzymes CO5: Separate the cellular components of a cell. CO6: Visualize and infer the cellular structures and processes
16PBT1MC06 Semester I	LAB - II (Microbiology/Immu nology) (Major Core)	K1, K2, K3, K4, K5	CO1: Operate equipment and instruments used in this laboratory course CO2: Demonstrate theoretical and practical skills in microscopy, handling techniques and staining procedures CO3: Perform aseptic techniques and routine culture handling tasks and examine biochemical and microbiological protocols CO4: Investigate immunoassays, including immunoelectrophoresis, dot Blotting, western blotting and ELISAs CO5: Measure the amount of Ag and Ab levels that present in infectious conditions CO6: Summarize, integrate and organize information and relate it to disease outcomes
16PBT2MC01 Semester II	MOLECULAR BIOLOGY & GENETIC ENGINEERING (Major Core)	K1, K2, K3, K4, K5, K6	CO1: Explain the mechanisms of transformation, conjugation, transduction and estimate the recombination frequency. CO2: Differentiate between A, B and Z conformations of DNA CO3: Evaluate the DNA repair mechanisms, flp/frt, Cre recombinase and operons CO4: Explain the process of replication, transcription and protein synthesis CO5: Select restriction enzymes based on the genome size of the organism CO6: Employ a suitable vector system based on the size of the cloned fragment and Investigate sequencing technologies across history

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16PBT2MC02 Semester II	FERMENTATION TECHNOLOGY (Major Core)	K1, K2, K3, K4, K5	CO1: Discuss the principles of fermentation technology - Isolation, Culture maintenance and inoculum development of industrially important strains CO2: Describe the components of a fermentor CO3: Compare main types of bioreactors and types of fermentation CO4: Distinguish between Upstream processing and Downstream processing and discuss effluent treatment CO5: Apply fermentation principles for the production of microbial products primary metabolites, antibiotics, organic acids and ethanol, industrially significant enzymes CO6: Integrate principles of fermentation technology for the production of Biofertilizers
16PBT2MC03 Semester II	ENVIROMENTAL BIOTECHNOLOGY (Major Core)	K1, K2, K3, K4, K5, K6	CO1: Elaborate microbial diversity in environmental systems, processes and biotechnology as well as the importance of molecular approaches in environmental microbiology and biotechnology CO2: Relate to existing and emerging technologies important to the area of environmental biotechnology CO3: Interpret the principles and techniques underpinning the application of biosciences to the environment CO4: Generate biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling CO5: Examine commonly applied methods, and steps in waste water and effluent treatment process CO6: Understand the various bioremediation process

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16PBT2MC04 Semester II	LAB - III (Mol.Bio & Gen. Eng. / Fer.Tech/ Envir.Biotech.) (Major Core Lab)	K1, K2, K3, K4, K5, K6	CO1: Prepare 1x solutions from varying concentration CO2: Extract DNA, RNA and to quantify CO3: Optimize Restriction digestion of DNA and ligation of fragment CO4: Optimize and detect citric acid production CO5: Analyze soil and water samples for different parameters CO6: Investigate biodegradation of hydrocarbons by bacteria
16PBT2ES01 Semester II	HUMAN GENETICS (Elective Subject)	K1, K2, K3, K4, K5	CO1: Explain structural mutations, numerical mutations and large translocations CO2: Solve problems on selected disease inheritance patterns CO3: Discuss gene therapies and cell therapies CO4: Outline the principles of Genetic Counselling and discuss ethical issues CO5: Suggest techniques for prenatal and preimplantation screening and diagnosis CO6: Discuss techniques for trace analysis and kinship testing
16PBT2ES02 Semester II	BIOANALYTICAL TECHNIQUES (Elective Subject)	K1, K2, K3, K4, K5	CO1: Discuss the functioning, maintenance and safety aspects of basic apparatus used in a Biotechnology lab CO2: Explain the principles and applications of different types of centrifuges. CO3: Describe the separation techniques used in biotechnology. CO3: Apply the theory and various applications of electrophoresis in research. CO4: Analyze separation of proteins/peptides using separation techniques. CO5: Describe the properties of electromagnetic waves and electromagnetic spectrum. Characterize certain functionalities of biomolecules using spectroscopic techniques. CO6: Explain the theoretical principles of elementary crystallography and appreciate the scope of their applications

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16PBT3MC01 Semester III	ANIMAL BIOTECHNOLOGY (Major Core)	K1, K2, K3, K4, K5	CO1: Explain the basic concepts of maintenance of animal cell culture and cryopreservation CO2: Discuss the characteristics of a contaminated culture and prevention of contamination CO3: Evaluate the relevance of stem cells and tissue engineering in regenerative medicine CO4: Outline the production of transgenic animals and its applications CO5: Examine the use of animals as disease models for diabetes, cancer and neurodegenerative disorders CO6: Integrate principles of Animal Biotechnology for assisted reproduction and discuss ethical and legal issues in Animal Biotechnology
16PBT3MC02 Semester II	PLANT BIOTECHNOLOGY (Major Core)	K1, K2, K3, K4, K5	CO1: Explain different techniques like organogenesis, somatic embryogenesis, protoplast isolation and fusion. CO2: Describe the applications of genetic engineering techniques and production of transgenic crops. CO3: Explain the various molecular markers and marker assisted selection applied in plant breeding. CO4: Discuss the recent developments in plant biotechnology (RNAi technology and its applications). CO5: Identify and address the different problems posed in plants by biotic and abiotic stress and also the ways to overcome through genetic engineering technology. CO6: Apply recombinant DNA technology in agriculture and also for production of therapeutic proteins. Understand IPR and patents in agricultural biotechnology. Discuss the biosafety and ethical implications.
16PBT3MC03 Semester III	RESEARCH METHODOLOGY & BIOINFORMATICS (Major Core)	K1, K2, K3, K4, K5, K6	CO1: Identify a research problem and develop a testable hypothesis. CO2: Classify different literature sources and explain the steps in the process of literature review, sampling and data collection CO3: Apply the concepts of experimental design to specific research questions. CO4: Describe the various biological data types, data formats, databases and data retrieval systems CO5: Examine the conventional methods for gene discovery and sequence alignment. CO6: Understand the fundamentals of molecular phylogenetics and employ tools to analyse.

Course Code/ Semester	Course Name	Cognitive Level	Course Outcome
16PBT3MC04 Semester III	LAB - IV (Animal Biotech/ Plant Biotech) (Major Core Lab)	K1, K2, K3, K4,K5	CO1: Prepare media for animal cell culture. Establish a primary cell culture. CO2: Calculate concentration of cells in a given sample using a haemocytometer CO3: Calculate viability of a given sample (single cell suspension of animal cells) using dye exclusion assay CO4: Prepare cells for Subculture and cryopreserve myeloma cells. Isolate DNA from mammalian blood and spleen CO5: Apply skills in plant tissue culture and molecular techniques CO6: Demonstrate Agrobacterium mediated gene transformation technique and demonstrate protoplast isolation in plants
16PBT3ES01 Semester III	NANOTECHNOLOGY (Elective Subject)	K1, K2, K3, K4,K5	CO1: Explain the basic concepts of nanotechnology. Describe the types of nanomaterials and their synthesis CO2: Discuss the nanocomposites and their applications. Describe the successive steps in building important electronic nanodevices CO3: Identify nanoparticles used in food packaging and the risks posed by them CO4: Explain developments of products that have been introduced into the market using nanotechnology CO5: Analyze the methods of optical lithography, electron beam. CO6: Explain the principle, theory and applications of nanotechnology in various sectors
16PBT3ES02 Semester III	CANCER BIOLOGY (Elective Subject)	K1, K2, K3, K4, K5	CO1: Comprehend the fundamentals of cancer biology and classify cancers CO2: Outline the role of cell cycle regulation in cancer biology CO3: Describe the epidemiology of common human cancers CO4: Discuss the key principles of carcinogenesis and tumour immunology CO5: Illustrate the role of oncogenes and tumour suppressor genes in tumourigenesis CO6: Compile techniques for cancer diagnosis and treatment

Course Code/ Semester	Course Name	Cognitive Level	Course Outcome
16PBT3ID01 Semester III	PRINCIPLES OF FOOD PROCESSING (Inter Disciplinary)	K1, K2, K3, K4, K5	CO1: Apply preventive measures and control methods to minimize the food hazards CO2: Describe the principles of HACCP and approaches to identify food safety hazards in food processing CO3: Illustrate the role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods CO4: Recognize spoilage mechanisms in foods, identify methods to control spoilage CO5: Identify ways to control microorganisms in foods and the principles of food preservation and understand the basis of food safety regulations CO6: List out the commercially important enzyme used in food industries and explain techniques involved in the production of enzymes
16PBT4PJ01 Semester IV	PROJECT (Major Core)	K1, K2, K3, K4, K5, K6	CO1: Appreciate the scientific, ethical and social issues associated with applications of Biotechnology CO2: Construct a summative project or paper that draws on current research CO3: Formulate a research problem and hypothesis CO4: Employ suitable experimental methods to the research problem CO5: Select a suitable model for data collection and analysis, interpret results and discuss in oral and in writing CO6: Scientifically reason and evaluate discoveries in Biotechnology to improve or solve challenges in human health, animal sciences and plant biology for the benefit of society and environment

M.Phil., Plant Biology and Biotechnology

Course Outcome for Curriculum (2016 batch)

Department: **Plant Biology and Biotechnology**

M.Phil Programme: **M.Phil. Plant Biology and Biotechnology**

Program Specific Outcome

PSO 1: Understand the fundamental and advanced techniques in Biotechnology and their applications in Plant Sciences

PSO 2: Acquire set of research skills necessary to pursue research project in Plant, Microbial and Environmental Biotechnology

PSO 3: Apply best practices in research data management and understand scientific publishing process

Course Code/ Semester	Course Name/ Category	Cognitive Level	Course Outcome
MBT 1501 Semester I	Research Methodology (Major Core)	K1, K2, K3, K4, K5	CO1: Understand the methodology of research writing CO2: Gain in-depth knowledge on various techniques in biological research CO3: Carry out simple bioinformatics searches for research purpose CO4: Use statistical packages to analyze scientific data CO5: Acquire skill to design methodology and to perform research on plant science
MBT 1502 Semester I	Advances in Plant Science (Major Core)	K1, K2, K3, K4, K5	CO1: Gain knowledge on biotechnological application of algae and fungi CO2: Understand the methodology of transgenic plant production CO3: Acquire skill to develop plantlet under in vitro condition CO4: Explain the process of bioremediation, factors associated and methods of bioremediation CO5: Gain in-depth knowledge on various techniques in plant sciences and apply them in their research

Course Code/ Semester	Course Name/ Category	Cognitive Level	Course Outcome
MBT 1601 Semester I	Microbial Diversity (Elective Subject)	K1, K2, K3	CO1: Gain knowledge on different types, structure and function of microbe in the environment CO2: Acquire skill to pursue research on microbes in industrial use
MBT 1602 Semester I	Plant Microbe Interactions (Elective Subject)	K1, K2, K3	CO1: Understand the principle and mechanism involved in plant – microbe interaction CO2: Acquire skills to develop research on positive and negative interactions between plants and microbes
MBT 1603 Semester I	Environmental Biotechnology (Elective Subject)	K1, K2, K3	CO1: Understand the principle and mechanism involved in biodegradation of effluents and industrial waste CO2: Equip skill to carryout research on biodegradation
MBT 1604 Semester I	Medicinal Plants (Elective Subject)	K1, K2, K3	CO1: Understand the importance of plants in healthcare CO2: Able to do research on phytochemicals and its antimicrobial activity
MBT 1605 Semester I	Plant Tissue Culture and Photochemistry (Elective Subject)	K1, K2, K3	CO1: Gain knowledge on techniques involved in plant regeneration under in vitro condition CO2: Equip research skill to carry out research on extraction and characterization Of phytochemicals and its production under <i>in vitro</i> condition
MBT 1606 Semester I	Plant Tissue Culture & Molecular Biology (Elective Subject)	K1, K2, K3	CO1: Understand the in vitro culture techniques for plant regeneration and molecular techniques used in genetic engineering CO2: Acquire skill to do research on plant gene transformation

Course Code/ Semester	Course Name/ Category	Cognitive Level	Course Outcome
MBT 1607 Semester I	Biology of Actinomycetes (Elective Subject)	K1, K2, K3	CO1: Gain knowledge on biology and importance of actinomycetes CO2: Able to do research on isolation, characterization of economically important metabolites
MBT 2701 Semester II	Project Dissertation and Viva-voce	K1, K2, K3, K4, K5	CO1: Able to design and construct research proposal CO2: Examine the core concepts, methods or assumptions in the research area through literature survey CO3: Apply the practical knowledge to demonstrate the required response in research CO4: Employ suitable experimental methods to the research problem CO5: Select a suitable model for data collection and analysis, interpret results and discuss in oral and in writing CO6: Scientifically reason and evaluate discoveries in biotechnology to improve or solve challenges in human health, animal sciences and plant biology for the benefit of society and environment

Course Outcome for Curriculum (2016 batch)

Department: **Plant Biology and Biotechnology**

Ph.D. Programme: **Ph.D. Botany/Plant Biology and Biotechnology**

Program Specific Outcome

PSO 1: Develop biofortified millets through genetic engineering and genome editing.

PSO 2: Identify active metabolites from plants and microbes against Diabetes, Cancer, Tuberculosis and other infectious diseases.

PSO 3: Optimize culture condition for maximizing microbial enzyme production for industrial and environmental applications.

PSO 4: Develop methods to propagate plants using plant tissue culture.