ASANSOL GIRLS' COLLEGE

Department of Botany

Programme Specific Outcome (PSO) and Course Outcome (CO)

Programme Specific Outcome (PSO):

The Programme enables the students

PSO1: To obtain strong foundation in classical botany, interdisciplinary subjects such as Agriculture microbiology, Bioinformatics, Biostatistics, Botanical pharmacy, Organic farming and Marine ecology; and advance topics in Plant Biotechnology, Cell and Molecular biology, Biochemistry and Bioinstrumentation.

PSO2: To understand the importance of plants, their diversity and its conservation.

PSO3: To achieve knowledge of pure and applied botany.

PSO4: To understand contribution of botany in increase and improve our supply of medicines, food, fibers and other plant products.

PSO5: To understand health and environmental protection and to solve the pollution problems.

Course Outcome (CO)
Department of Botany

SEMESTER	COURSE NAME	UNIT & TOPIC	UNIT SPECIFIC COURSE OUTCOME
Semester – I	**Plant Groups and Microbial World** **(Major & Minor)**	Unit: I (**Plant Groups (Basic Concepts)** a) Kingdom systems b) General Features and Classification c) Lichens d) Phytochemistry Unit: II (**Introduction to microbial world**) a) Historical development in the field of microbiology b) Bacterial taxonomy c) Microbial physiology e) Economic importance of bacteria f) Medical Microbiology Unit: III (**Bacteria and Viruses)** a) General Bacteriology b) Mechanism of gene transfer in bacteria c) Viruses d) Prions and Viroids Unit: IV (**Basic immunology)** a) General outline b) Vaccines types	Students learn about CO1: The general concepts of plants and microbes CO2: Identify and Classify plants and microbes CO3: Symbiotic association of fungi and algae CO4: Knowledge about different phytochemicals present in plants CO5: Different approaches to understand the contribution of Scientists CO6: The classification of bacteria CO7: General characteristics of bacteria CO8: Importance of bacteria for the production of commercial products CO9: Health, risk and management related to microbes CO10: General outline knowledge about bacteria CO11: Understand microbial genetics CO12: Characteristics of viruses CO13: Understand particles mediated diseases in humans, animals and plants CO14: Concept about immunology CO13: Knowledge of

			vaccines
Semester – I	**SEC** **(Skill Enhancement Course)** **Course name: Mushroom technology**	**Unit 1**: Introduction and history **Unit 2**: Methods of cultivation of edible mushrooms **Unit 3**: Storage and nutrition **Unit 4**: Food Preparation: Types of foods prepared from mushroom.	CO1: Recall various types and categories of mushrooms. CO2: Demonstrate various types of mushroom cultivating technologies. CO3: Examine various types of food technologies associated with mushroom industry. CO4: Value the economic factors associated with mushroom cultivation CO5: Device new methods and strategies to contribute to mushroom production.
	ID/MD Paper - **Course name – Introduction to local flora**	Unit1. Plants groups Unit 2. ecological interaction among different plant groups Unit 3. Economic importance and future prospects Unit 4. Survey based Field study of local flora	CO1. Study of Algae, their classification, evolution, variation in structures. CO2. Salient features of various classes and life cycles of different genera CO3. Position of Fungi in living system, salient features of fungal classes, CO4. Life cycles of different genera, Homothallism,

			Heterothallism, CO5. Parasexuality, economic importance of fungal kingdom, Bryophytes, Pteridophytes CO6. Morphological features of Angiospermic plant organs
Semester – II	**Course Name: Cryptogamic Botany & Palaeobotany Course** **(Major & Minor)**	**Unit I: Algae:** • Introduction • Criteria for algal classifications • Cell structure and reproduction • Economic importance of algae; **Unit II: Bryology:** • Origin and phylogeny of Bryophytes; • Morphology, anatomy, reproduction and evolutionary trends. • Ecological and	CO1. Habitat and distribution; thallus organization; origin and evolution CO2. Idea about Comparative account and evolutionary relationship CO3. Production of algal food. CO4. Study of Algae, their classification, evolution, variation in structures. Salient features of various classes and life cycles of different genera under each class. CO5. Life cycles of different genera, Homothallism, Heterothallism, . CO6. Origin and evolution of Bryophyta, classification and life histories of various genera.Concept of gametophyte and

		economic importance of bryophytes **Unit III: Pteridophytes- Introduction and Classification** • Introduction to Pteridophyta • Geological history and morphoanatomical and reproductive features • Distribution, morphoanatomical and reproductive features **Unit IV – Palaeobotany** • Introduc	sporophyte andtheir evolution. CO7. Concept and importance of palaeobotany, fossilization, types, Factors, geological time scale, importance of Palaeobotany.

		tion to Palaeobotany • Nomenclature, Conditions suitable for fossilization; • Importance of fossils and their study; Stratigraphy – assemblages.	
Semester – II	**SEC (Skill Enhancement Course)** **Course name: Biofertilizer** **Course code – BSCBOTSE201**	**Unit-1**: • General account about the microbes used as biofertilizer; • **Unit -2**: • General idea about Plant growth promoting rhizobacteria (PGPR) • **Unit- 3**: Cyanobacteria	CO1. Develop their understanding on the concept of bio-fertilizer CO2. Identify the different forms of biofertilizers and their uses CO3. Compose the Green manuring and organic fertilizers CO4. Develop the integrated management for better crop production by using both

		• **Unit -4**: Mycorrhizal association, Organic farming	nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM). CO5. Interpret and explain the components, patterns, and processes of bacteria for growth in crop production
Semester – II	**ID/MD Paper -** **Course name – Plant Health and Plant Protection**	U1. General idea about the common plant diseases U2. Post harvest and storage related losses U3. Integrated approach in controlling diseases during cultivation and also post harvest time. U4. Definitions and examples of common weeds,	CO1. CAUSING AGENTS fungi, bacteria, virus, mycoplasmas and nematodes; Its economy and management. CO2. identification of the host plant, name of the disease caused and name of the associated causal organisms only). CO3. Idea about activities of fungi, bacteria, and other organisms. Economy and management. CO4. Gain idea about alien species and

			invasive species; Adverse effects and control measures.
Semester – III	**Course name: Anatomy of Angiosperms** **(Hons.)**	Unit I: Introduction to plant anatomy and plant body Unit II: Adaptive and Protective Systems Unit III: Apical meristems Unit IV: Vascular Cambium and Wood	CO1. Develop an understanding of concepts and fundamentals of plant anatomy CO2. Examine the internal anatomy of plant systems and organs CO3. Develop critical understanding on the evolution of concept of organization of shoot and root apex. CO4. Analyze the composition of different parts of plants and their relationships CO5. Evaluate the adaptive and protective systems of plants
Semester – III	Course name: Morphology and Reproductive Biology of Angiosperms (Hons.)	Unit I - Morphology of Angiosperm Unit – II - Advance Morphology Unit III - Embryology Unit IV - Palynology – .	CO1. To know about different plants organ like root, stem and leaves and their importance. CO2. To learn about various plants parts, embryonic development, breeding activity and conservation techniques. CO3. Recall the history of reproductive biology of angiosperms & recognize the importance of genetic and molecular aspects of flower development CO4. Understand structure and functions of anther wall and pollen wall

			CO5. Evaluate the special structures of Ovule CO6. Solve Self-incompatibility in Pollination and fertilization & relate between Embryo, Endosperm and Seed CO7. Comprehend the causes of Polyembryony and apomixes with its classification CO8. To learn structure and function of pollen and its role in fertilization, forensic science, melissopalynology.
Semester – III	Course name: Plant Systematics (Hons.)	Unit I: Significance of Plant systematics and Taxonomic hierarchy • Introduction to systematics • Plant classification - • Taxonomic Hierarchy: Unit II: Botanical Nomenclature and System of Classification Unit III: Biometrics, Numerical Taxonomy and Cladistics Unit IV: Phylogenetic Systematics Unit V: Salient features of the angiospermous families	CO1. Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium CO2. Evaluate the Important herbaria and botanical gardens CO3. Interpret the rules of ICN in botanical nomenclature CO4. Assess terms and concepts related to Phylogenetic Systematics CO5. Generalize the characters of the families according to different system system of classification
Semester – III	SEC- Skill Enhancement Course - Semester - III	Unit-1: General account about the microbes used as	CO1. Develop their understanding on the concept of bio-fertilizer

	Course name: Biofertilizers	biofertilizer, Rhizobium Unit -2: General idea about Plant growth promoting rhizobacteria (PGPR) and Phosphate solubilizing bacteria (PSB) . Unit- 3: Cyanobacteria and *Azolla* in rice cultivation. Unit -4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution .	CO2. Identify the different forms of biofertilizers and their uses CO3. Compose the Green manuring and organic fertilizers CO4. Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM). CO5. Interpret and explain the components, patterns, and processes of bacteria for growth in crop production
Semester – III	Course name: Ethnobotany	Unit 1: Major and minor ethnic groups Unit 2: Methodology of Ethnobotanical studies Unit 3: Role of ethnobotany in modern Medicine Unit 4: Ethnobotany and legal aspects	CO1. Conceptualize ethnobotany as an interdisciplinary science CO2. Restate the established methodology of ethnobotany studies CO3. Categories various indigenous ethnic groups and their environmental practices. CO4. Understand the legalities associated with ethnobotany.

Semester – IV	**Course name: Plant Ecology and Phytogeagraphy** **(Hons.)**	Unit I: Basic Principles of ecology and ecological factors - Ecology Unit II: Ecological adaptations, Population ecology Ecological adaptation: Population ecology: Unit III: Plant Communities and Ecosystem Community characteristics Ecosystem Unit IV: Functional Aspects of Ecosystem and Phytogeography Biodiversity Pollution Phytogeography	CO1. Understand core concepts of biotic and abiotic CO2. Classify the soils on the basis of physical, chemical and biological components CO3. Analysis the phytogeography or phytogeographical division of India CO4.Evaluate energy sources of ecological system CO5.Assess the adaptation of plants in relation to light, temperature, water, wind and fire. CO 6.Conduct experiments using skills appropriate to subdivisions
	Course name: Economic Botany and Pharmacognosy Course Code: BSCHBOTC402	Unit I – Utilization of Plant Wealth (fibre and Sugar; Timber, oil, pulse and biofuel) Unit II – Utilization of Plant (Essential oil) Unit III – Introduction to Pharmacognosy Unit IV – Utilization of plant wealth (Drug yielding plants)	CO1. Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems CO2. Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership CO3. Develop a basic knowledge of taxonomic diversity and important

			families of useful plants CO4. Increase the awareness and appreciation of plants & plant products encountered in everyday life. CO5. Appreciate the diversity of plants and the plant products in human use. CO6. To know about medicinal properties and uses of plants by folklore and ayurveda system. CO7.Ability of conserve rare and threatened plant species both in in-vivo and in-vitro conditions
	Course name: Agronomy (Hons.)	Unit I: Principles of crop production Unit II Fundamentals of soil science Unit III Agricultural Metereology Unit IV Agricultural management and cultivation of some important crops – Soil and water management	CO1. Understand the concept of agronomy and sustainable agriculture. CO2. Analyze different aspects diversified agriculture and farm enterprises, production technology of vegetation and flowers. CO3. Examine the implications integrated farming system along with production economics and farm management CO4.Evaluate the IT communication and diffusion of agricultural innovation
	Course name: Plant Diversity and Human welfare	Unit -1: - Plant diversity and its scope	CO1.Develop understanding of the concept and scope of plant

	(Hons.)	Unit -2: Loss of Biodiversity Unit -3: Management of Plant Biodiversity: Unit-4: Conservation of Biodiversity:	biodiversity CO2. Identify the causes and implications of loss of biodiversity CO3. Apply skills to manage plant biodiversity CO4. Utilize various strategies for the conservation of biodiversity CO5.Conceptualize the role of plants in human welfare with special reference to India
	Course name: Mushroom culture technology (Hons.)	Unit 1: Introduction and history. Types of edible mushrooms available in India Unit 2: Methods of cultivation of edible mushrooms Unit 3: Storage and nutrition : Unit 4: Food Preparation: Types of foods prepared from mushroom.	CO1. Can recall various types and categories of mushrooms. CO2. Demonstrate various types of mushroom cultivating technologies. CO3.Examine various types of food technologies associated with mushroom industry. CO4. Value the economic factors associated with mushroom cultivation CO5. Device new methods and strategies to contribute to mushroom production
Semester – V	Course name: Plant Physiology and Metabolism (Hons.)	Unit I: Water Potential and Other Potential Physiological Aspect of Plant Unit II: Photosynthesis and Photorespiration Unit III:	CO1. Understand Water relation of plants with respect to various physiological processes. CO2. Explain chemical properties and deficiency symptoms in plants CO3. Classify aerobic and anaerobic respiration CO4. Explain the significance of

		Phytochrome, Phytohormone and Plant Cycle Unit IV: Metabolism	Photosynthesis and respiration CO5. Assess dormancy and germination in plants CO6. Students acquire the adequate knowledge of metabolism in plants. CO7. Explain the ATP-Synthesis CO8. To acquire adequate knowledge about translocation in plants, carbon dioxide concentrating mechanisms, growth regulators and flowering of plants.
Semester – V	Course name: Cytology and Genetics (Hons.)	Unit I: Principles of genetics and Biology of Inheritance Unit II: Extra-nuclear Inheritance, Linkage, crossing over and chromosome mapping Unit III: Variation in Chromosome Number and Structure, Mutations Unit IV: Fine Structure of Gene, Gene Interaction, Population and Evolutionary Genetic .	CO1. Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage. CO2. Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders. CO3. Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels. CO4. Analyze the effect of mutations on gene functions and dosage. CO5. Examine the structure, function and replication of DNA.
Semester – V	Course Name: Analytical Techniques in Plant	Unit I: Cellular Fractionation and	CO1. Develop conceptual understanding of cell wall

	Sciences (Hons.)	Separation Techniques Unit II: Characterization of Biomolecules Unit III: Visualization Molecules in Living Cells . Unit IV: Radiobiology, Colorimetry and Spectroscopy	degradation enzymes and cell fractionation. CO2. Classify different types of chromatography techniques. CO3. Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and confocal microscopy CO4. Apply suitable strategies in data collections and disseminating research findings.
Semester – V	Course Name: Bioinformatics (Hons.)	Unit I - Introduction Unit II – Homology Search and Pair-wise and Multiple Alignment Unit III – Protein Structure Prediction and Phylogenetic analyses Unit IV – Molecular Docking and Drug Design	CO1. Understand the concept of databases and use of different public domain for DNA and proteins sequence retrieval. CO2. Understand the concept of pairwise alignment of DNA sequences using algorithms. CO3. Explain the structure of proteins homology modeling approach using SWISS MODEL and SWISS-PDB. CO4.Reflect upon the role of various models in molecular evolution. CO5. Analyze the role of (QSAR) techniques in Drug Design.
Semester – V	Course Name: Stress Biology	Unit I: Defining Plant Stress	CO1. Develop the understanding of concept of stress, stress factors and

	(Hons.)	Unit II: Abiotic and Biotic Stress Factors Unit III: Stress Sensing Mechanisms in Plants Unit IV: Developmental and Physiological Mechanisms that Protect Plants Against Environmental Stress Reactive oxygen species	resistance mechanisms. CO2. Explain different types of stress with examples. CO3. Develop the ability for critical appraisal of various physiological mechanisms that protect the plant from environmental stress i.e. adaptation, avoidance and tolerance. CO4. Analyze the role of production and scavenging mechanisms
Semester – V	Course Name: Plant Breeding (Hons.)	Unit I: General Introduction Unit II: Methods of crop improvement Unit III: Quantitative inheritance Unit IV: Inbreeding depression, heterosis and Crop Improvement	CO1. Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool. CO2. Familiarize with genetic basis of heterosis. CO3. Classify Sexual and Asexual modes of reproduction. CO4. Explain monogenic and polygenic inheritance CO5. Reflect upon the role of various non-conventional methods used in crop improvement.
Semester – VI	Course name: Molecular Biology (Hons.)	Unit I: Nucleic Acids: Carriers of Genetic Information and Structure Unit II: Central dogma and The replication of DNA	CO1. Analyse the structures and chemical properties of DNA and RNA through various historic experiments. CO2. Differentiate the main types of prokaryotes

		Unit III: Genetic code and transcription Unit IV: Processing and modification of RNA and translation Translation	through their grouping abilities and their characteristic CO3. Evaluate the experiments establishing central dogma and genetic code. CO4. Gain an understanding of various steps in transcription, protein synthesis and protein modification.
	Course name: Plant Biotechnology and Genetic Engineering (Hons.)	Unit I: Plant Tissue Culture Unit II: Enzymes and Vectors for Genetic Manipulations Unit III: Gene Cloning and Methods of Gene Transfer Unit IV: Major Concerns and Applications of Transgenic Technology	CO1. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering CO2. Develop their competency on different types of plant tissue culture CO3. Analyze the enzymes and vectors for genetic manipulations CO4. Examine gene cloning and evaluate different methods of gene transfer CO5. Critically analyze the major concerns and applications of transgenic technology CO6. To learn about gene cloning, recombinant DNA technology and bioinformatics includes recent biotechnological advancement related to genomics and proteomics. CO7. Acquire the knowledge about gene transfer and applications of biotechnology.

			CO8. Acquire the knowledge about tissue culture techniques, restriction digestion, isolation and electrophoresis of plasmid DNA.
	Course Name: Research Methodology (Hons.)	Unit I: Basic Concepts of Research Unit II: Data Collection and Documentation of Observations Unit III: Overview of Biological Problems Unit IV: Ethics and Good Practical's and Art of Scientific Writing	CO1. Understand the concept of research and different types of research in the context of biology CO2. Develop laboratory experiment related skills. CO3. Develop competence on data collection and process of scientific documentation CO4. Analyze the ethical aspects of research CO5. Evaluate the different methods of scientific writing and reporting
	Course Name: Biostatistics (Hons.)	Unit I: Biostatistics Unit II: Data Summarization and Visualization Unit III: Descriptive Statistics Unit IV: Correlation, Regression and Statistical inference	CO1. Comprehend the fundamental concepts related to descriptive and inferential biostatistics. CO2. Develop skills in data tabulation, its treatment, analysis, interpretation and graphical representation of data. CO3. Analyze the implications of inferential statistics in biology. CO4.Develop their competence in hypothesis

			testing and interpretation.
	Course Name: Natural Resource Management (Hons.)	Unit I: Natural Resources and Sustainable Utilization Unit II: Land, Water and Biological Resources Unit III: Forests and Energy Unit IV: Contemporary Practices in Resource Management	CO1. Understand the concept of different natural resources and their utilization. CO2. Critically analyze the sustainable utilization land, water, forest and energy resources. CO3. Evaluate the management strategies of different natural resources. CO4. Reflect upon the different national and international efforts in resource management and their conservation
	Course Name: Horticultural Post-harvest (Hons.)	Unit I: Horticultural Crops - Conservation and Management Unit II: Horticultural Practices Unit III– Ornamental plants, fruits and vegetables, Medicinal and Aromatic plants Unit IV: Post-harvest Technology	CO1. Understand the concept of different types of horticultural practices for value addition CO2. Visualize the post-harvest problems likely to be confronted CO3. Know the tricks of the trade and how to increase the longevity of the product. CO4. Can gather knowledge about post harvest losses and crop mnagements

Semester	Unit and Topic	Unit specific CO
Semester – I **GE-1** **Course Name: ALGAE, FUNGI AND BRYOPHYTA** **Course Code – BSCHBOTGE101**	Unit: I (Algae) Introduction: Classification: Morphology and life cycles: Unit: II (Fungi) Introduction: Classification: Morphology and life cycles: Mycorrhiza: Unit: III (Lichens) General account: Unit: IV (Bryophytes) Introduction: General account:	Students learn about CO1: General characteristics, distribution, thallus organization and reproduction in algae CO2:Outline classification of algae (Fritsch – 1935) CO3: Morphology and life cycles of *Nostoc, Chlamydomonas, Zygnema, Vaucheria, Fucus, Polysiphonia* CO4: General characteristics, cell wall composition, nutrition, reproduction of fungi CO5: Outline classification of fungi as per Gwyenne-Vaughan and Barnes (1937) CO6: Characteristics and life cycle of *Mucor, Penicillium, Agaricus* and Deuteromycetes. CO7: Ectomycorrhiza and endomycorrhiza and their significance CO8:General account, reproduction, and significance of lichens CO9: General characteristics and Classification (Proskauer, 1957) of bryophytes CO10: Morphology,anatomy and reproduction of *Marchantia* and *Funaria*, economic importance of bryophytes

Semester	Unit and Topic	Unit specific CO
Semester – II **Course Name: PTERIDOPHYTA, GYMNOSPERMS AND PALAEOBOTANY** **Course Code: BSCHBOTGE201**	Unit: I (Pteridophyta) Introduction: General account: Unit: II (Seed Habit) Heterospory and Seed habit: Unit: III (Gymnosperms) Introduction: Classification: General account: Unit: IV (Palaeobotany) Palaeobotanical studies:	Students learn about CO1: General characteristics of pteridophytes CO2:Outline classification (PichiSermolli 1977) of pteridophytes and study of *Cooksonia* and *Rhynia* CO3:Morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris* CO4: Concept on heterospory and seed habit; stelar evolution and Economical importance of Pteridophytes CO5:General characteristics of gymnosperms CO6: Outline classification of gymnosperms (Stewart and Rothwell, 1993) CO7:Morphology, anatomy and reproduction of *Cycas* and *Pinus*, *Ginkgo*and economical importance CO8: Terminologies and definitionrelated to palaeobotanical studies
MESTER – III **GE-III** **Semester – III** **Course Name: PLANT MORPHOLOGY, TAXONOMY, ANATOMY AND ECOLOGY** **Course Code – BSCHBOTGE301**	Unit I –(Morphology)– Leaf Inflorescences Flower Pollination and General structure of dicot and monocot embryo; endosperm types. Fruits – Types with example. Unit II – (Plant Taxonomy) Introduction to plant taxonomy , natural and phylogenetic classification Taxonomic hierarchy – Ranks, Categories and Taxonomic Groups Unit III – (Plant Anatomy)	CO1 Examine the internal anatomy of plant systems and organs CO 2 To know about different plants organ like root, stem and leaves and their importance. CO3 Evaluate the special structures of Ovule CO4 Solve Self-incompatibility in Pollination and fertilization & relate between Embryo, Endosperm and Seed CO5 Evaluate the Important herbaria and botanical gardens CO6 Interpret the rules of ICN in botanical nomenclature CO7 Generalize the characters of the families according to Bentham & Hooker's system of classification CO8 Understand core concepts of biotic and abiotic CO 9 Classify the soils on the basis of physical, chemical and biological

	Tissue meristems Tissue system Organs Unit IV – (Ecology) Definition pyramids of biomass, energy and numbers. Ecological Succession - Hydrosere Ecological adaptations Concept of endemism. Pollution – Air and water – Causes, effects and Remedies	components
SEMESTER GE-IV **PLANT PHYSIOLOGY AND CYTOGENETICS** **Course Code – BSCPBOTC401**	**Unit I – (Plant Physiology)-** Plant-water relations, transpiration; Mineral nutrition- Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; **Unit II – (Plant Metabolism)** Photosynthesis Outline of C3, C4 and CAM pathways of carbon fixation; Photorespiration. **Unit – III – (Enzymology)** Enzymes - Definition and properties; Mechanism of enzyme catalysis and enzyme inhibition. Nitrogen metabolism - Biological nitrogen fixation – symbiotic and asymbiotic examples, mechanism of symbiotic N_2 fixation. **Unit IV – (Cytogenetics)** The Cell Theory Structure and Functions of : Mitochondria, Chloroplast, ER, Golgi body & Lysosomes Selective permeability of the membranes. Mitosis and Meiosis	CO1 Explain chemical properties and deficiency symptoms in plants CO2 Classify aerobic and anaerobic respiration CO3 Explain the significance of Photosynthesis and respiration CO4 Students acquire the adequate knowledge of metabolism in plants. CO5 Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage. CO6 Analyze the effect of mutations on gene functions. CO7 Examine the structure, function of DNA.

	Mendel's laws of inheritance; Monohybrid and dihybrid cross; Test cross; Gene interactions aberrations	
Semester – I **Course Name:Phycology &Microbiology (PROGRAM)**	Unit: I (**Introduction to microbial world**) a) Historical development in the field of microbiology b) Bacterial taxonomy c) Microbial nutrition d) Economic importance of bacteria e) Economic importance of virus	Students learn about CO1: Different approaches to understand the contribution of Scientists CO2: The classification of bacteria CO3: Nutritional types, growth and metabolism CO4: Importance of bacteria for the production of commercial products CO5: Economic importance of virus for the production of vaccine, role in research, medicine and diagnosis and disease related to plants
	Unit: II (**Viruses and Bacteria)** a) Viruses b) Virus multiplication c) Prions and Viroids d) Bacterial structure and function e) Recombination in bacteria f) Basic immunology	CO6: General outline knowledge about virus CO7: Lytic and Lysogenic cycle CO8: Understand particles mediated diseases in humans, animals and plants CO9: Chemical composition and characteristics of bacterial capsule, flagella, cell wall and structure of cell organelles CO10: Understand microbial genetics CO11: Understand innate, acquired, active and passive, and antibody mediated, cell mediated
	Unit: III (**Algae, Cyanophyta and Xanthophyta)** a) Algal introduction: b) Classification: c) Algal classes: d) Cyanophyceae and diatoms: e)Life history of algae:	CO12: Habitat, distribution, thallus organization and evolution of sex in algae CO13: Outline classification of algae by Fritsch (1935) CO14: Comparative study of few classes of algae CO15: Cell structure and reproduction of cyanophyceae and diatoms CO16: Life history of few algal genera
	Unit: IV (**Algal Biotechnology)** a) Economic importance: b) Algae and environment:	CO17: Algal cultivation method, economic importance of green algae, brown algae and red algae CO18: Algae in pollution control and production of biofertilizer and single cell production

Semester – II **Course Name:Mycology &Phytopathology** **Course Code:BSCPBOTC201**	Unit: I (**Introduction to fungi and classification**) a) Fungi salient features: b) Classification: c) Phycomycetes: d) Ascomycetes:	Students learn about CO1: Tissue organization, fungal ecology, cell wall, nutrition and parasexuality of fungi CO2: Broad outline classification of Gwyne-Vaughan and Barnes (1926) and Ainsworth andBisby (1983) CO3: Salient features of phycomycetes and Life cycle of few fungal genera. CO4: Salient features of ascomycetes and Life cycle of few fungal genera.
	Unit: II (**Basidiomycota, Allied fungi, and Oomycota)** a) Basiodiomycetes b) Deuteromycetes	CO5: Salient features of Basidiomycetes along with basidium development and life cycle of Agaricus and Polyporus CO6: Salient features with special reference to conidial fruit body types
	Unit: III (**Symbiotic association and applied mycology)** a) Lichen: b) Mycorrhiza:	CO7:Classification, thallus organization, reproduction and economic significance of lichen CO8: Types of Mycorrhiza and their role in agriculture and forestry
	Unit: IV (**Phytopathology)** a) Plant diseases: b) Classification and symptoms:	CO9: Definition, concept of parasitism and Koch's postulates in the understanding of plant diseases CO10: Classification of plant disease based on the symptoms

Semester	Unit and Topic	Unit specific CO
Semester – III **Course Name: Archegoniatae: Bryophytes, Pteridophytes and Gymnosperms** **Course Code:BSCPBOTC301**	Unit: I (**Introduction**) a) Archegoniates:	Students learn about CO1: Characteristic features, habitat, alternation and generation of archegoniates
	Unit: II (**Bryophytes)** a) Origin of bryophytes: b) Economic importance:	CO5: Origin, habitat, distribution, classification, divisions, morphology, anatomy, reproductive and evolutionary trends among few genera of bryophytes CO6: Economic importance of bryophytes with special reference to *Sphagnum*

	Unit: III (Pteridophytes**)** a) Palaeobotany: b) Introduction to pteridophytes: c) Classification: d) Fossil and present day:	CO7: Definitions, Fossils and fossilization process, Geological time scale and important event in plant life. CO8: Concept of vascular cryptogams, stelar organization, general features of pteridophytes; theories on pteridophytes CO9: Outline study of Sporne (1975) classification CO10: Comparative study of fossil members (*Rhynia* and *Zosterophyllum*) and living members of pteridophytes
	Unit: IV (**Gymnosperms)** a) General features: b) Comparative study of livingmembers:	CO9: Characteristic features; Evolution of seed habit, classification (Stewart and Rothwell, 1993) and economic importance of gymnosperms CO10: Morphoanatomical and comparative account and life cycle, and distribution of *Cycas*, *Pinus*, *Ginkgo*, and *Gnetum.*
Semester -IV	Unit and Topic	Unit specific CO
Semester – IV **Course name: Plant Systematics** **Course Code: BSCPBOTC401**	Unit: I (**Significance of Plant systematics and Taxonomic hierarchy**) a) Introduction to systematics b) Phytochemistry c) Herbarium d) Plant classification	Students learn about CO1: Plant identification, Classification, Nomenclature CO2: Phytochemicals CO3: Knowledge about Herbarium and to evaluate botanical gardens CO4: Assess terms and concepts related to Phylogenetic Systematics
	Unit: II: **Botanical Nomenclature and System of Classification** a) Principles and rules b) Outline of the system of classification	CO5: Interpret the rules of ICN in botanical nomenclature CO6: Linnaeus and Bentham and Hooker
	Unit: III: **Biometrics, Numerical Taxonomy and Cladistics** a) Cluster analysis; Phenograms b) Cladograms	CO7:Characters; Variations; OTUs, character weighting and coding CO8: What is Cluster analysis and phenograms CO9: What is cladogram

	Unit: IV**: Phylogenetic Systematics** a) Terms and concepts b) Origin and evolution of angiosperms	CO10: Algal cultivation method, economic importance of green algae, brown algae and red algae CO11: phylogenetic tree, cladogram
	Unit: Unit: IV **(Salient features of the following families with examples from common Indian speciesand economic importance)** a) Dicotyledons b) Monocotyledons	CO10: Salient features of Malvaceae, Leguminosae, Apocynaceae, Solanaceae, Scrophulariaceae,Lamiaceae, Verbinaceae, Acanthaceae, Rubiaceae, Asteraceae CO11: Salient features of Poaceae and Orchidaceae CO12:Economic importance of Dicotyledons and Monocotyledons
Semester – V **Course name: Anatomy of Angiosperms** **Course Code: BSCPBOTC501**	**Unit I: Introduction to plant anatomy and plant body** Cell wall Tissue Tissue system	Students learn about CO1: Structure, growth and thickenings; Adcrustation and incrustation; Pits andPlasmodesmata CO2: Meristematic and permanent tissues, types of simpleand complex tissues CO3: Epidermal, vascular, ground tissue System, Stele types
	Unit II: Adaptive and Protective Systems a) Vascular bundles, b) Stele c) Root-stem d) Cuticle, Stomata, Hydathodes, Cavities anatomy	CO4: Types of Vascular bundles, Stele, Root stem transition and mechanical tissue CO5: General knowledge about Cuticle, Stomata, Hydathodes, Cavities, Laticifers, Kranz anatomy
	Unit III: Apical meristems a) Evolution of shoot apex b) Organization of shoot apex c) Quiescent centre d) Root cap	CO6:Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation CO7: Apical cell theory, Histogen theory, Korper-Kappe theory CO8:Knowledge ofQuiescent centre CO9: Structure of root cap
	Unit IV: Vascular Cambium and Wood a) Cambium b) Secondary growth c) Wood d) Periderm, rhytidome and lenticels	CO10: Structure, function and seasonal activity of cambium CO11: Secondary growth in root and stem CO12: Types of Wood CO13:Composition of periderm, rhytidome and lenticels

Semester	**Unit and Topic**	**Unit specific CO**

Semester – V **Course name: Plant Physiology** **Course Code: BSCPBOTC502**	**Unit I: Water Potential and Other Potential Physiological Aspect of Plant**a a) Water Potential b) Essential and beneficial elements c) Transport systems	Students learn about CO14: water absorption by roots, transpiration, mechanism of stomatal movement CO15: Macro and micronutrients, essential elements, Phytoremediation CO16: Transport of ions, passive, absorption andactive absorption of ions, carrier mediated transport, uniport, co-transport, symport, antiport
	Unit II: Photosynthesis and Photorespiration a) Photosynthesis b) Photorespiration	CO17: photosynthetic pigments, lightdependent, and light independent reactions, C 3 -, C4 - and CAM pathways CO18: definition, sites, mechanism and significance
	Unit III: Phytochrome, Phytohormone and Plant Cycle a) Phytohormone b) Phytochrome c) Plant Cycle	CO19:Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene CO20: Nature and role of phytochrome CO21:Seed germination and seed dormancy

Semester	Unit and Topic	Unit specific CO
Semester – VI **Course name: Cytogenetics** **Course Code: BSCPBOTC601**	**Unit I: The cell structure and function:** a) The Cell structure b) Cell organelle c) DNA packaging	Students learn about CO1: rokaryotic and eukaryotic cells; Cell size and shape. Fluid Mosaic Models of membrane structure CO2: Mitochondria, Chloroplast, ER, Golgi body & Lysosomes CO3: DNA packaging in eukaryotes, euchromatin and heterochromatin

	Unit II: Photosynthesis and Photorespiration a) Cell cycle b) cell division	CO4: Phases of cell cycle CO5: mitosis and meiosis
	Unit III: Mendelian genetics and its extension a) Mendel's laws of inheritance b) Gene interactions c) Linkage	CO6:Monohybrid and dihybrid cross; Test cross CO7: Incomplete dominance, codominance, complementary genes CO8: Coupling andRepulsion hypothesis, Crossing over
	Unit IV: Numerical and structural aberration of chromosomes and mutation **a)** Structural aberrations **b)** Numericalaberrations **a)** Mutations **b)** Mutagenic agents	CO9:Deletion, Duplication, Inversion and Translocation CO10:Euploidy and aneuploidy – types and definition CO11:Definition, Types – spontaneous and induced; point mutation, Frame Shift Mutation CO12: Base analogues, alkylating agents

Semester	Module and Topic	Module specific CO
Semester – VI **Course name: Plant Ecology and Phytogeagraphy** **Course Code: BSCPBOTC602**	**Unit I: Basic Principles of ecology and ecological factors** a) Ecology b) Abiotic and biotic Components	Students learn about CO13: Definition, Basic concepts; Levels of organization, Concept of Autecology and Synecology CO14: Abiotic and biotic Components and their interrelationships and dynamism, homeostasis
	Unit II: Ecological adaptations, Population ecology a) Ecological adaptation b) Population ecology	CO15: Morphological, anatomical and physiological adaptations of xerophytes,hydrophytes and halophytes. CO16: Characteristics and population growth, population regulation, growth curves, lifehistory strategies; *r* and *k* selection. Ecological Speciation

	Unit III: Plant Communities and Ecosystem a) Community characteristics b) Ecosystem	CO17:analytical and synthetic; Concept of ecological amplitude; Habitat andniche; Ecotone and edge effect; Succession: processes, types (Hydrosere, Xerosere); climax concept, Primary vs Secondary succession. CO18: Structure; Processes; Trophic organization; Food chains and Food webs; Ecologicalpyramids. Ecosystems of India
	Unit IV: Functional Aspects of Ecosystem and Phytogeography a) Biodiversity b) Pollution c) Phytogeography	CO19:hot spots, megadiversity zones, IUCN threatened species), conservation (*in-situ-*, *exsitu*conservation and cryopreservation CO20:Definition causes and remedies with respect to air, water and noise pollution CO21: Principles; Continental drift; Theory of tolerance; Endemism; Brief description ofmajor terrestrial biomes (one each from tropical, temperate & tundra); Phyto-geographical division ofIndia (After Independence); Vegetation characteristic of Eastern Himalayas and Sunderbans.