

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: First**  
**Course Name: *Plant and Microbial Diversity***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 100-199, and subsequent level as per NEP structure**

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
Unit 1	<b>Origin of life:</b> Theories of the Origin of Life, Concept of Kingdoms, and Tree of Life	3	4
Unit 2	<b>Bacteria and Viruses:</b> Bacteria: General features, cell structure, reproduction, conjugation, transformation, and transduction; introduction to Archaeobacteria  Viruses: General features, replication, reproduction (Lytic and Lysogenic life cycles), RNA virus (TMV), DNA virus (Cauliflower Mosaic Virus).	8	10
Unit 3	<b>Algae:</b> General features, cell structure, range of thallus structure, reproduction, and classification; a brief account on <i>Nostoc</i> , <i>Oedogonium</i> , and <i>Chara</i>	6	10
Unit 4	<b>Fungi &amp; Lichens:</b> General features, distribution of fungi and its current status in the living world, reproduction, and classification (Anisworth, 1973); a brief account of <i>Mucor</i> , <i>Ascobolus</i> , and <i>Agaricus</i> ; a brief account on lichens: structure, types, and economic importance	7	12
Unit 5	<b>Bryophytes and Pteridophytes:</b> Bryophytes: General features, adaptation to land habits, classification, and evolutionary trends; a brief account on <i>Marchantia</i> and <i>Polytrichum</i>  Pteridophytes: General features, classification, reproduction, evolutionary trends (stellar evolution), and affinities; a brief account on <i>Lycopodium</i> , <i>Selaginella</i> , and <i>Pteris</i>	10	12
Unit 6	<b>Gymnosperms and Angiosperms:</b> Gymnosperms: General features, classification, reproduction, evolutionary trends, and affinities; a brief account on <i>Cycas</i> , and <i>Gnetum</i>	11	12

	Angiosperms: General features, Concept of an artificial, natural, and phylogenetic system of classification. Floral parts and inflorescence; Brief accounts on Lamiaceae and Orchidaceae		
<b>PRACTICAL [Credit: 01]</b>			
<ol style="list-style-type: none"> <li>1. Study of structure of TMV and Bacteriophage (electron micrographs/models).</li> <li>2. Study of morphology of <i>Nostoc</i>, <i>Oedogonium</i>, <i>Chara</i> (Temporary preparation of slides).</li> <li>3. Study of <i>Mucor</i>, <i>Ascobolus</i>, <i>Agaricus</i> (Temporary preparation of slides)</li> <li>4. Study of vegetative and reproductive parts of <i>Marchantia</i> and <i>Polytrichum</i>(preparation of slides).</li> <li>5. Study of <i>Lycopodium/ Selaginella</i> (morphology, strobilus, and spores), <i>Adiantum/ Pteris</i> (morphology).</li> <li>6. Study of <i>Cycas/ Pinus</i> and <i>Gnetum</i> (morphology, leaf/ needle, megasporophyll and microsporophyll)</li> <li>7. Study of leaf venations in dicots and monocots (at least two specimens each)</li> <li>8. Study of different types of inflorescences and fruits.</li> </ol>	30	40	

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Second**  
**Course Name: Cell Biology and Biomolecules**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 100-199, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Introduction to cell:</b> Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory); Cytoskeleton, Cell division: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle.	8	12
<b>Unit 2</b>	<b>Cell wall and plasma membrane:</b> Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport.	6	12
<b>Unit 3</b>	<b>Cell organelles:</b> Nucleus: Structure-nuclear envelope, Organization of chromatin, Nucleolus, Ribosome, Chloroplast, Mitochondria, Peroxisomes, Endoplasmic Reticulum, Golgi Apparatus, and Lysosomes.	9	8
<b>Unit 4</b>	<b>Carbohydrates and Lipids:</b> Carbohydrates: Nomenclature and classification. Lipids: Definition and major classes of storage and structural lipids; Structure, properties and functions of Essential fatty acids.	9	8
<b>Unit 5</b>	<b>Aminoacids and Proteins:</b> Structure and classification of amino acids; Levels of protein structure (primary, secondary, tertiary, and quaternary); Protein denaturation and biological roles of proteins.	8	10
<b>Unit 6</b>	<b>Nucleic acids:</b> Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA;	5	10

	Types of RNA.		
<b>PRACTICAL</b> [Credit: 01]			
<ol style="list-style-type: none"> <li>1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.</li> <li>2. Study of plant cell structure with the help of epidermal peel mount of Onion/ <i>Rhoeo</i>/ <i>Crinum</i>.</li> <li>3. Demonstration of the phenomenon of protoplasmic streaming in <i>Hydrilla</i> and <i>Vallisnaria</i> leaf.</li> <li>4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/ pollen grains).</li> <li>5. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.</li> <li>6. Study different stages of mitosis and meiosis.</li> </ol>	30	40	

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Third**  
**Course Name: Laboratory and Field Techniques in Plant Science**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 200-299, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Laboratory safety and good practices:</b> General laboratory safety: dos and don'ts, lab safety measures, code of conduct in laboratory, safe handling of chemicals, glass apparatus, instruments, electrical appliances; First aid practices (acid spills, burns and other injuries), safety symbols, classes/ grades of chemicals, Laboratory waste management: radioactive, hazardous chemicals and biological wastes.	8	8
<b>Unit 2</b>	<b>Handling and maintenance of instruments:</b> Weighing balance, pipettes and micropipettes, magnetic stirrer, autoclave, laminar air flow, pH and conductivity meter (calibration and use), Incubator (static and shaker), Luxmeter, hemocytometer, micrometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAGE unit, centrifuge, distillation unit.	8	12
<b>Unit 3</b>	<b>Measurements and calculations:</b> Units of measurements, conversion from one unit to another, Weighing, calculations: scientific notations, powers, logarithm and fractions; measurement of volumes of liquids.	4	8
<b>Unit 4</b>	<b>Solutions and Buffers:</b> Preparation of solutions: stock solution, standard solution. Types of solutions: Normal, Molar, Molal, Percentage, ppm, ppb. Dilution and dilution factors, Acids, Bases, adjustment of pH, Buffers - phosphate, Tris- HCl and Citrate buffer.	6	8
<b>Unit 5</b>	<b>Microscopy and Culture Techniques:</b> Microscopes: working principles and types (Light and Electron microscopes), sample and slide preparation: fixation, staining, mounting, preservation (for light and electron microscopy).  Basic culture media (NA, NB, PDA, MS), selective and differential media, Culture techniques: plating (streak, spread & pour), serial dilution.	8	12

<p><b>Unit 6</b></p>	<p><b>Biostatistics, computing and field skills:</b> Datatypes- primary and secondary, methods of data collection, sample and sampling methods- merits and demerits; technical and biological replicates; Tabulation and presentation of data, Descriptive statistics - Mean, Median, Mode, Variance, Standard Deviation, Standard error, Coefficient of Variation, MS-Word, PowerPoint, Excel, concept on biological databases.</p> <p>Collection, Identification, Preparation and Preservation of Herbarium and Museum specimens.</p>	<p>11</p>	<p>12</p>
<p><b>PRACTICAL [Credit: 01]</b></p>			
<ol style="list-style-type: none"> <li>1. Preparation of solutions- molar, molal, normal, percentage, stock solution and dilution</li> <li>2. Measurement of pH of solutions using pH meter/ pH strip and preparation of buffers (Phosphate /citrate buffer)</li> <li>3. Working with instruments - Centrifuge, autoclave, laminar air flow, hot air oven, incubator, light microscope, spectrophotometer/colorimeter,</li> <li>4. Slide preparation and staining of plant materials.</li> <li>5. Determination of cell/spore size using micrometer.</li> <li>6. Preparation of PDA/NA medium for growth and maintenance of fungal/bacterial cultures.</li> <li>7. Calculation of mean, mode, median, standard deviation using data set.</li> <li>8. Drawing of tables, graphs and to carry out statistical calculation using Microsoft Excel.</li> <li>9. Preparation of herbarium specimen: Collection, processing, mounting, and labelling of plant specimen.</li> </ol>		<p>30</p>	<p>40</p>

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fourth**  
**Course Name: Mycology and Phytopathology**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 200-299, and subsequent level as per NEP structure**

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
Unit 1	<b>Introduction to Fungi:</b> General characteristics of fungi; hyphal forms; Cell and Cell wall composition; Nutrition; Origin of fungi; Classification of Fungi (Alexopoulos, 1962 & Ainsworth, 1973); General characteristics of Myxomycota and Eumycota; Symbiotic fungi (Lichen & Mycorrhiza): Structural organization and types.	10	10
Unit 2	<b>Lower Fungi: Mastigomycotina&amp;Zygomycotina:</b> Characteristic features; Reproduction; Heterothallism; Life cycle with reference to <i>Synchytrium</i> , <i>Phytophthora</i> and <i>Mucor</i>	6	8
Unit 3	<b>Higher fungi: Ascomycotina&amp;Basidiomycotina:</b> Characteristic features; Reproduction; Different fruiting bodies; Life cycle with reference to <i>Aspergillus</i> , <i>Peziza</i> , <i>Puccinia</i> and <i>Agaricus</i>	6	12
Unit 4	<b>Fungi Imperfecti: Deuteromycotina:</b> General characteristics; Thallus organization; Reproduction; Heterokaryosis & Parasexuality; Classification with special reference to <i>Alternaria</i> and <i>Colletotrichum</i>	5	8
Unit 5	<b>Phytopathology:</b> Concept of plant disease; Symptoms of plant diseases; Etiology and disease cycle; Host-pathogens interaction; Control of plant diseases and quarantine; Bacterial diseases - Citrus canker and angular leaf spot of cotton. Viral diseases - Tobacco Mosaic viruses, vein clearing. Fungal diseases - Early blight of potato, Black stem rust of wheat, White rust of crucifers	10	12
Unit 6	<b>Applied Mycology:</b> Role of fungi in biotechnology; food industry (Flavour & texture,	8	10

	Fermentation, Organic acids & Enzymes); Pharmaceutical (Secondary metabolites); Agriculture (Biofertilizers & Biological control); Mushroom cultivation; Medical mycology.		
<b>PRACTICAL [Credit: 01]</b>			
<ol style="list-style-type: none"> <li>1. Study of vegetative and reproductive structures of Mastigomycotina (<i>Phytophthora</i>) and Zygomycotina (<i>Mucor/Rhizopus</i>) by temporary mounts and through permanent slides.</li> <li>2. Study of vegetative and reproductive structures of Ascomycotina (<i>Aspergillus</i> and <i>Penicillium/Peziza</i>) and Basidiomycotina (<i>Agaricus</i> and <i>Puccinia</i>) by temporary mounts and through permanent slides.</li> <li>3. Study of vegetative and reproductive structures of Deuteromycotina (<i>Alternaria</i> and <i>Colletotrichum/Fusarium</i>) by temporary mounts and through permanent slides; Study of thallus and reproductive structures of lichen and mycorrhiza through permanent slides/photographs.</li> <li>4. Study of symptoms of locally available plant diseases caused by fungi, bacteria, and virus by preparation of disease album and bottle specimens.</li> <li>5. Applied mycology: Photographs/report on fungi used in medicine, fungi used as biological control agents, fungi used in industry, fungi causing human infections</li> </ol>	30	40	

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fourth**  
**Course Name: Morphology and Anatomy of Angiosperms**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 200-299, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Introduction to Plant Morphology and Anatomy:</b> Morphology of inflorescence, stamens and carpel, fruit; Telome theory, phyllode theory; Role of morphology in plant classification. Plant anatomy: Application in systematics, forensics and pharmacognosy.	6	10
<b>Unit 2</b>	<b>Tissue and Tissue Systems:</b> Classification of tissues; Simple and complex tissue, Tissue systems, Pits and plasmodesmata; Wall ingrowths and transfer cells, Types of vascular bundles; Endodermis, exodermis and origin of lateral root. Hydathodes, cavities, lithocysts and laticifers; Ergastic substances.	7	8
<b>Unit 3</b>	<b>Structure and Development of Plant Body:</b> Internal organization of plant body: Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development. Origin and development of leaves; Structure of dicot and monocot stem, root and leaf; Kranz anatomy.	5	8
<b>Unit 4</b>	<b>Apical meristems:</b> Concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory); Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap.	11	14
<b>Unit 5</b>	<b>Vascular Cambium and Wood:</b> Structure, function and seasonal activity of cambium; Secondary growth in stem and root. Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm,	11	12

	rhytidome and lenticels.		
<b>Unit 6</b>	<b>Adaptive and Protective Systems:</b> Epidermis, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.	5	8
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. Study of special types of inflorescences – Cyathium, Hypanthodium, Verticillaster, Hypanthium.</li> <li>2. Study of special types of fruits- Spurious fruits (<i>Dillenia</i>); Aggregate fruits (Custard apple, <i>Michelia</i>, Periwinkles, <i>Polyalthia</i>); Multiple fruits (Pineapple, Jack fruits).</li> <li>3. Study of anatomical details through permanent slides/temporary stain mounts / macerations / museum specimens with the help of suitable examples.</li> <li>4. Apical meristem of root, shoot and vascular cambium (permanent slides/ photographs)</li> <li>5. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.</li> <li>6. Root anatomy: monocot and dicot</li> <li>7. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.</li> <li>8. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).</li> <li>9. Adaptive Anatomy: xerophytes, hydrophytes.</li> <li>10. Secretory tissues: cavities, lithocysts and laticifers.</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fourth**  
**Course Name: Microbiology**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 200-299, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Introduction to microbial world:</b> History of development of Microbiology as a subject, Germ theory of diseases, Koch postulates, Major groups of microorganisms, Mode of nutrition and metabolic diversity in microbes, Growth and growth curves, Ecological importance of microorganisms.	6	6
<b>Unit 2</b>	<b>Viruses:</b> Characteristics of viruses, viroids and prions; Biomolecules and genetic materials of viruses; Baltimore system of classification; Morphological structure of TMV and Corona viruses; Life cycle and reproduction of bacteriophage; Replication of viral RNA and DNA; Viral diseases of common plants and animals	8	10
<b>Unit 3</b>	<b>Bacteria:</b> General characteristics of bacteria, shapes and sizes, ultra-cellular structure, major groups of bacteria with their general characteristics; Actinomycetes, Mycoplasma and Rickettsiae; growth and nutrition, reproduction – binary fission and endospore formation, horizontal gene transfer and genetic recombination in bacteria (conjugation, transformation and transduction). Examples of agriculturally and industrially important bacteria.	8	12
<b>Unit 4</b>	<b>Environmental Microbiology:</b> Microorganisms in different habitats: Air, soil and water; Soil microorganisms and their role in soil health; Role of microorganisms in biogeochemical cycles (C, N, P and S); Microorganisms in extreme environments (cold desert, hot water spring, marine water, hydrothermal vent, aquifers)	8	8
<b>Unit 5</b>	<b>Pathogenic microorganisms and Host Immunity:</b>	8	12

	Bacterial pathogens causing diseases in plants, animals and humans; fungal pathogens causing diseases in agriculturally important crops; host-pathogen interactions; pathogenesis; disease symptoms; host defence mechanisms; Host immunity - immune responses against pathogens; types of immunity; humoral and cell mediated immunity; hypersensitivity and autoimmunity; concept of Rh antigens.		
<b>Unit 6</b>	<b>Applied Microbiology:</b> Application of microorganisms in food industries for food fermentation and SCP production; in agriculture for biofertilizer, biopesticides, biocompost production; in pharmaceuticals for insulin and antibiotics production; in industries for alcohol and organic acid productions; citric acid and acetic acid; in genetic engineering for GMO development and other research purposes; in space and oil exploration and in pollution and waste management.	7	12
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. Slide preparation and Gram staining of bacteria (urd bacteria, nodule bacteria)</li> <li>2. Slide preparation and study of <i>Nostoc</i>, <i>Anabaena</i>, <i>Mucor</i>, <i>Rhizopus</i>, <i>Aspergillus</i>, <i>Penicillium</i>, <i>Colletotrichum</i>, <i>Cladosporium</i></li> <li>3. Pure culture isolation of soil bacteria/fungi through serial dilution plating and subsequent sub-culturing methods, population estimation by CFU and haemocytometer.</li> <li>4. Measurement of microbial cells/spores with the help of micrometers or inbuilt software in microscopic camera.</li> <li>5. Study on symptoms of plant viral diseases</li> <li>6. Endospore staining of soil bacteria with malachite green</li> <li>7. 7. Collection and study of diseases caused by virus, bacteria and fungi in crop plants</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fourth**  
**Course Name: *Plant Resources and Economic Botany***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 200-299, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Origin of Cultivated Plants:</b> Centres of Origin, their importance with reference to Vavilov's work. Introductions, domestication, and loss of crop genetic diversity; evolution of new crops/varieties, importance of germplasm diversity and conservation. Classification of plant resources on the basis of their uses.	6	8
<b>Unit 2</b>	<b>Food and Food Adjuncts:</b> Cereals and millets: Rice and wheat (origin, morphology, processing, post-harvest management & uses); Brief account of millets and their climatic and nutritional importance.  Legumes: Origin, morphology, cultivation, uses and commercial importance of Chick pea, Pigeon pea and fodder legumes. Importance of legumes to man and ecosystem.  Spices: Listing of important spices, their family and part used. Economic importance with special reference to Assam. Study of fennel, saffron, clove and black pepper.  Beverages: Tea, Coffee (morphology, processing, cultivation, Types & uses).	12	14
<b>Unit 3</b>	<b>Plants and Plant Products of Industrial Value:</b> Oils and Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, soybean, and mustard. Essential Oils: General account, extraction methods, comparison with fatty oils & their uses. Non edible oil yielding trees and importance as biofuel.  Sugar and starches: Morphology, new varieties and processing of sugarcane, products and by-products	12	14

	<p>of sugarcane industry. Potato: morphology, propagation, post-harvest management, uses of potato and starches.</p> <p>Natural Rubber: Para-rubber: tapping, processing and uses.</p> <p>Fibres: Classification based on the origin of fibres; Cotton, Coir and Jute (morphology, extraction and uses).</p>		
<b>Unit 4</b>	<b>Drug-yielding plants:</b> Therapeutic and habit-forming drugs with special reference to <i>Cinchona</i> , <i>Digitalis</i> , <i>Aloe vera</i> and <i>Cannabis</i> ; Tobacco (Morphology, processing, uses and health hazards).	5	8
<b>Unit 5</b>	<b>Forest Products:</b> Forest and forest products. Timber and Non-Timber Forest Products (NTFP), Forest types of Assam and their conservation strategies; Community forestry.	5	8
<b>Unit 6</b>	<b>Ethnobotany Hours:</b> Definition, concept and scope; relevance of ethnobotany in the present context; Traditional knowledge and IPR.	5	8
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. Cereals: Study of useful parts: Rice/Bean (habit sketch, study of paddy and grain, starch grain, micro-chemical test).</li> <li>2. Legumes: Bean, (habit, fruit, seed structure, micro-chemical tests).</li> <li>3. Beverages: Tea (plant specimen, tea leaves).</li> <li>4. Oils and fats: Coconut and Mustard, Groundnut,</li> <li>5. Rubber: Specimen, photograph/model of tapping, samples of rubber products.</li> <li>6. Test for alkaloids: Neem, <i>Vinca rosea</i>.</li> <li>7. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin).</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fifth**  
**Course Name: *Genetics***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Mendelian genetics and its extension:</b> Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance.	13	14
<b>Unit 2</b>	<b>Extrachromosomal Inheritance:</b> Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial inheritance in yeast; Maternal effects-shell coiling in snail; Infective heredity-Kappa particles in <i>Paramecium</i>	4	6
<b>Unit 3</b>	<b>Linkage, crossing over and chromosome mapping:</b> Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numerical based on gene mapping; Sex Linkage.	8	10
<b>Unit 4</b>	<b>Variation in chromosome number and structure:</b> Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy.	6	8
<b>Unit 5</b>	<b>Fine structure of gene and Gene mutations:</b> Classical vs molecular concepts of gene; Ciston, Racon, Muton, rII locus; Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms	10	12

<b>Unit 6</b>	<b>Unit 6. Population and Evolutionary Genetics:</b> Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.	4	10
<b>PRACTICAL [Credit: 01]</b>			
<ol style="list-style-type: none"> <li>1. Mendel's laws through seed ratios.</li> <li>2. Chromosome mapping using point test cross data.</li> <li>3. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).</li> <li>4. Permanent Slides showing Translocation Ring, Photograph showing Laggards and Inversion Bridge.</li> </ol>		30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fifth**  
**Course Name: *Molecular Biology***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
<b>Unit 1</b>	<b>Nucleic acids: Carriers of genetic information:</b> Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.	3	4
<b>Unit 2</b>	<b>The Structures of DNA and RNA / Genetic Material:</b> DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, denaturation and renaturation, cot curves; Organization of DNA- Prokaryotes, Viruses, Eukaryotes. Organelle DNA - mitochondria and chloroplast DNA. The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.	8	12
<b>Unit 3</b>	<b>The replication of DNA, Central dogma and genetic code:</b> Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi- conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, $\theta$ (theta) mode of replication, replication of linear ds-DNA; Enzymes involved in DNA replication.  Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)	10	12
<b>Unit 4</b>	<b>Transcription:</b> Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in <i>E.coli</i> . Eukaryotes: transcription factors, heat shock proteins, steroids	10	12

	and peptide hormones; Gene silencing.		
<b>Unit 5</b>	<b>Processing and modification of RNA:</b> Split genes- concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' poly A tail); Ribozymes; RNA editing and mRNA transport.	7	10
<b>Unit 6</b>	<b>Translation:</b> Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.	7	10
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. DNA isolation from any plant material.</li> <li>2. DNA estimation by diphenylamine reagent/UV Spectrophotometry (Demonstration).</li> <li>3. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).</li> <li>4. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.</li> <li>5. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I &amp; group II introns; Ribozyme and Alternative splicing.</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fifth**  
**Course Name: *Plant Ecology, Phytogeography and Climate Change***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Ecology and Ecosystem:</b> Ecology: Basic concepts, Levels of organization, Inter-relationships between the living world and the environment. Ecosystem: Structure, functions, and types, trophic organisation, food chains and food webs, ecological pyramids, homeostasis.	8	8
<b>Unit 2</b>	<b>Ecological Factors:</b> Climatic, Edaphic and Biotic Factors, Factorial interactions, Plant adaptation to environmental factors (light, temperature, wind, and fire); autotrophy, heterotrophy; symbiosis, commensalism, ammensalism, parasitism, parasitoidism. Aquatic ecology- concept.	8	8
<b>Unit 3</b>	<b>Population ecology:</b> Population characteristics, Growth curve, Lotka-Volterra model, population regulation, <i>r</i> and <i>k</i> -selection. Types of ecological speciation, Ecological equivalents.	7	12
<b>Unit 4</b>	<b>Plant communities:</b> Plant Community: Basic concept, types, characters (analytical and synthetic), Dynamics: succession – processes, types, models; climax concepts, Habitat and Niche: concept & types.	7	12
<b>Unit 5</b>	<b>Functional Ecology:</b> Principles and models of energy flow; Production and productivity; Ecological efficiencies; Ecological energetics; Biogeochemical cycles (C, N and P) and water cycle.	7	10
<b>Unit 6</b>	<b>Phytogeography and Climate Change:</b> Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra);	8	10

	<p>Phytogeographical division of India;Vegetation types of NE India with special reference to Assam.</p> <p>Climate change: Basic concepts; global warming, causes and consequences (Rise in Sea levels, Glacier melting, Biodiversity Loss), Adaptation, Mitigation, Global and National Efforts, Concept on Sustainable Development, Sustainable Development Goals (SDGs).</p>		
<b>PRACTICAL [Credit: 01]</b>			
<ol style="list-style-type: none"> <li>1. Determination of minimal quadrat size and number for the study of herbaceous vegetation in the college campus by species area curve method (species to be listed).</li> <li>2. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.</li> <li>3. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.</li> <li>4. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.</li> <li>5. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.</li> <li>6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. <ol style="list-style-type: none"> <li>a) Study of morphological adaptations of hydrophytes and xerophytes (four each).</li> <li>b) Study of biotic interactions of the following: Stem parasite, Root parasite, Epiphytes, Predation (Insectivorous plants).</li> </ol> </li> <li>7. Local field visit to nearby areas to familiarise students with various plant communities.</li> <li>8. Soil respiration study in two agricultural systems to determine the CO<sub>2</sub> evolution.</li> </ol>	30	40	

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Fifth**  
**Course Name: *Plant Systematics***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Significance of Plant systematics:</b> Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Functions and importance of Herbarium and botanical garden; Important herbaria and botanical gardens of the world and India; Virtual herbarium; Categories and taxonomic hierarchy; Concept of taxa (family, genus, species).	8	8
<b>Unit 2</b>	<b>Botanical nomenclature:</b> History, Principles and Rules (ICN); Ranks and names; Typification, Author citation, Effective and Valid publication, Rejection of names, Principle of priority and its limitations.	5	8
<b>Unit 3</b>	<b>Systems of classification:</b> Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker, Engler and Prantl, Takhtajan; Brief account of Angiosperm Phylogeny Group (APG) classification.	9	12
<b>Unit 4</b>	<b>Numerical taxonomy and cladistics:</b> OTUs, characters, character weighting and coding; Cluster analysis; Phenograms & Cladograms (definitions and differences).	6	8
<b>Unit 5</b>	<b>Phylogeny of Angiosperms:</b> Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating	6	10

	evolutionary relationship (phylogenetic tree, cladogram).		
<b>Unit 6</b>	<p><b>Angiospermic Families:</b> Detail study of the following families:</p> <p>Magnoliaceae, Fabaceae, Asteraceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Musaceae, Zingiberaceae, Poaceae.</p>	11	14
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. Study of vegetative and floral characters of locally available angiospermic plants belonging to the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham &amp; Hooker's system of classification): Fabaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Musaceae, Orchidaceae.</li> <li>2. Field visits to familiarise students with vegetation of an area and identification of plant species / Visit to Academic or Research Institutions.</li> <li>3. Mounting of properly dried and pressed specimens of at least 10 (ten) wild plant species with herbarium labels (to be submitted with the record book).</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Sixth**  
**Course Name: Reproductive Biology of Angiosperm**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Introduction to reproductive biology of Angiosperms:</b> History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope.	4	4
<b>Unit 2</b>	<b>Reproductive development:</b> Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.	4	6
<b>Unit 3</b>	<b>Anther and pollen biology:</b> Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure; Palynology and scope (a brief account); NPC system; Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.	10	14
<b>Unit 4</b>	<b>Ovule:</b> Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte- megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of <i>Polygonum</i> type); Organization and ultrastructure of mature embryo sac.	6	10
<b>Unit 5</b>	<b>Pollination and fertilization:</b> Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization. Basic concept of Self incompatibility (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud	12	12

	pollination, stub pollination; Intra-ovarian and <i>in vitro</i> pollination; Modification of stigma surface, parasexual hybridization; Cybrids, <i>in vitro</i> fertilization.		
<b>Unit 6</b>	<b>Embryo, Endosperm and Seed:</b> Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in <i>Paeonia</i> . Seed structure, importance, and dispersal mechanisms. Polyembryony and apomixis: Introduction; Classification; Causes and applications.	9	14
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. <b>Anther:</b> Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bi-celled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.</li> <li>2. <b>Pollen grains:</b> Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test for germination: Calculation of percentage germination in different media using hanging drop method.</li> <li>3. <b>Ovule:</b> Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).</li> <li>4. <b>Female gametophyte through permanent slides/photographs:</b> Types, ultrastructure of mature egg apparatus.</li> <li>5. Intra-ovarian pollination; Test tube pollination through photographs.</li> <li>6. <b>Endosperm:</b> Dissections of developing seeds for endosperm with free-nuclear haustoria.</li> <li>7. <b>Embryogenesis:</b> Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages.</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Sixth**  
**Course Name: *Plant Physiology***  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Plant-water relations:</b> Water Potential and its components; Water absorption by roots: aquaporins; Pathway of water movement: symplast, apoplast, transmembrane pathways; Ascent of sap: Mechanisms, cohesion-tension theory, root pressure, guttation; Transpiration: Factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.	5	8
<b>Unit 2</b>	<b>Mineral nutrition and nutrient uptake:</b> Criteria for essentiality of mineral elements, macro and micronutrients, nutrient solutions for plant growth experiments, roles of essential elements, mineral deficiency symptoms, chelating agents, Ion antagonism and toxicity. Soil as a nutrient reservoir; Transport of ions across cell membrane: Passive and active absorption, electrochemical gradient, facilitated diffusion, carrier systems, proton ATPase pump and ion flux, uniport, symport, antiport, co-transport.	10	10
<b>Unit 3</b>	<b>Translocation of organic solutes:</b> Phloem as the path of organic solute translocation: Experimental evidences, Mechanisms of solute transport, Pressure-Flow Model and Munch's hypothesis, Phloem loading and unloading, Source - sink relationship.	4	8
<b>Unit 4</b>	<b>Plant growth regulators (PGRs):</b> Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid; Synthetic PGRs; Application of PGRs in agriculture and horticulture.	10	14

<p><b>Unit 5</b></p>	<p><b>Physiology of flowering and seed dormancy:</b> Photoperiodism: SDPs and LDPs, flowering stimulus, florigen concept; Vernalization; Photoreceptors: Phytochrome, crytochrome and phototropin; Discovery, chemical nature, mechanism of action, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR); Seed dormancy: Significances, causes of dormancy, mechanisms to break dormancy.</p>	<p>8</p>	<p>12</p>
<p><b>Unit 6</b></p>	<p><b>Plant stress physiology:</b> Abiotic and biotic stress: Plants' responses to drought, water logging, salinity, heavy metals, freezing, heat stress and pathogen attack. Oxidative stress: Generation of reactive oxygen species (ROS); Effect of ROS on metabolism; ROS detoxification mechanisms in plants; Stress mitigation strategies (Enzymatic and non-enzymatic).</p>	<p>8</p>	<p>8</p>
<p><b>PRACTICAL [Credit: 01]</b></p>			
<ol style="list-style-type: none"> <li>1. Determination of osmotic potential of plant cell sap by the method of plasmolysis.</li> <li>2. Determination of water potential of given tissue (e.g., potato tuber) by weight method.</li> <li>3. Study of the effect of sunlight on the rate of transpiration in excised twig/leaf.</li> <li>4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of mesophyte/xerophyte.</li> <li>5. Effect of carbon dioxide concentration on the rate of photosynthesis.</li> <li>6. To study the effect of different concentrations of IAA on Gram/Pea/Moong root (IAA Bioassay).</li> <li>7. Determination of seed germination percentage in different physical conditions (Demonstration)</li> <li>8. To demonstrate water stress by application of PEG/ water withdrawal in germinating seeds /growing plants (Demonstration)</li> <li>9. Fruit ripening/Rooting from cuttings (Demonstration).</li> </ol>		<p>30</p>	<p>40</p>

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Sixth**  
**Course Name: Plant Metabolism and Biochemistry**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Concepts of metabolism:</b> Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes; classification, nomenclature, and importance of enzyme; Concept of coenzyme, apoenzyme and prosthetic group; Enzyme inhibition (allosteric, covalent modulation); Isozymes.	6	8
<b>Unit 2</b>	<b>Carbon assimilation:</b> Role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centers, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q-cycle, CO <sub>2</sub> reduction: C <sub>3</sub> , C <sub>4</sub> -pathways, Crassulacean acid metabolism; Photorespiration.	8	12
<b>Unit 3</b>	<b>Carbon oxidation and ATP Synthesis:</b> Glycolysis and its regulation, oxidative decarboxylation of pyruvate, TCA cycle and regulation, amphibolic role, anaplerotic reactions, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, pentose phosphate pathway; Factors affecting respiration; ATP synthesis: substrate level phosphorylation, chemiosmotic mechanism, ATP synthase, Boyer's conformational model, Racker's experiment, Jagendorf's experiment, role of uncouplers.	10	12
<b>Unit 4</b>	<b>Carbohydrate, Lipid and Nitrogen metabolism:</b> Synthesis and catabolism of sucrose, starch and cellulose, Synthesis and breakdown of triglycerides, $\beta$ -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, $\alpha$ -oxidation. Nitrogen assimilation: biological nitrogen fixation (examples of legumes and non-legumes), biochemistry of nitrogen	12	14

	fixation, ammonia assimilation and transamination.		
<b>Unit 5</b>	<b>Mechanisms of Signal Transduction:</b> Receptor-ligand interactions, Second messenger concept, Calcium-calmodulin, MAP kinase cascade, two-component system.	5	8
<b>Unit 6</b>	<b>Secondary Metabolites:</b> Shikimate Pathway: Role in biosynthesis of secondary metabolites; Biosynthesis and physiological roles of terpenes, phenols and nitrogenous compounds.	4	6
<b>PRACTICAL [Credit: 01]</b>			
	<ol style="list-style-type: none"> <li>1. Chemical separation of photosynthetic pigments by solvent method/paper chromatography</li> <li>2. Estimation of sugar content by DNSA method</li> <li>3. Determination of titratable acid number (TAN) in plant materials</li> <li>4. Quantification of chlorophyll a, b and total chlorophyll and determination of chlorophyll a/b ratio</li> <li>5. Estimation of phenol/tannin/flavonoid by colorimetric method</li> <li>6. Estimation of protein in plant sample by Lowry's method/Biuret method</li> <li>7. Separation of amino acids by paper chromatography</li> <li>8. Demonstration of Thin layer chromatography (TLC)/Column chromatography</li> <li>9. To compare the rate of respiration by Ganong's respirometer in different parts of plant (Demonstration)</li> </ol>	30	40

**Four-year Undergraduate Programme**  
**Subject: Botany**  
**Semester: Sixth**  
**Course Name: Applied Plant Biology**  
**Existing Base Syllabus: UG CBCS Syllabus**  
**Course Level: 300-399, and subsequent level as per NEP structure**

<b>THEORY</b> [Total marks: 60] Credit: 03; Total No. of classes: 45			
<b>Unit no.</b>	<b>Unit content</b>	<b>No. of classes</b>	<b>Marks</b>
<b>Unit 1</b>	<b>Plant Tissue Culture:</b> Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion.	8	10
<b>Unit 2</b>	<b>Application of tissue culture:</b> Micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm conservation.	4	6
<b>Unit 3</b>	<b>Recombinant DNA technology:</b> Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).	8	10
<b>Unit 4</b>	<b>Gene Cloning:</b> Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR- mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR	9	12
<b>Unit 5</b>	<b>Methods of gene transfer:</b> <i>Agrobacterium</i> -mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics - selectable marker and reporter genes (Luciferase, GUS, GFP).	6	10

<b>Unit 6</b>	<b>Applications of genetic engineering:</b> Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug).	10	12
<b>PRACTICAL [Credit: 01]</b>			
<ol style="list-style-type: none"> <li>1. (a) Preparation of MS medium. (b) Demonstration of <i>in vitro</i> sterilization and inoculation methods using leaf and nodal explants of any plant species.</li> <li>2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis &amp; artificial seeds through photographs.</li> <li>3. Isolation of protoplasts.</li> <li>4. Construction of restriction map of circular and linear DNA from the data provided.</li> <li>5. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.</li> <li>6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.</li> <li>7. Isolation of plasmid DNA.</li> <li>8. Restriction digestion and gel electrophoresis of plasmid DNA.</li> </ol>		30	40