

ACADEMIC SESSION-2017-2018

SEM-I

PAPER	TEACHER	DETAILED SYLLABUS
CC1T	MANIKLAL PATI (M.P)	<p><b>C1T: Phycology and Microbiology Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Introduction to microbial world</b>            Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).  <b>Unit 2: Viruses</b>            Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).  <b>Unit 3: Bacteria</b>            Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).</p>
	RACHANA BERA(R.B)	<p><b>Unit 4: Algae</b>            General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups) and Van – den Hoek et.al(1982); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry.</p>
	BISWAJIT PRADHAN(B.P)	<p><b>Unit 5: Cyanophyta and Xanthophyta</b>            Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of <i>Nostoc</i> and <i>Vaucheria</i>.  <b>Unit 6: Chlorophyta and Charophyta</b>            General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of <i>Chlamydomonas</i>, <i>Volvox</i>, <i>Oedogonium</i>, <i>Coleochaete</i>, <i>Chara</i>. Evolutionary significance of <i>Prochloron</i>.  <b>Unit 7: Phaeophyta and Rhodophyta</b>            Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of <i>Ectocarpus</i>, <i>Fucus</i> and <i>Polysiphonia</i>.</p>

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PAPER	TEACHER	DETAILED SYLLABUS
<b>C1P</b>	PROF.MANIKLAL PATI (M.P)	<p><b>C1P: Phycology and Microbiology ( Practical) Credits 02 (Practical)</b>  <b>Microbiology</b>                      1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.</p> <p>2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.</p> <p>3. Gram staining.</p> <p>4. Endospore staining with malachite green using the (endospores taken from soil bacteria).</p> <p>5. Study of bacteria from root nodules/Curd sample.</p>
	PROF.BISWAJIT PRADHAN(B.P)	<p><b>Phycology</b>                      Study of vegetative and reproductive structures of <i>Nostoc</i>, <i>Chlamydomonas</i> (electron micrographs), <i>Volvox</i>, <i>Oedogonium</i>, <i>Coleochaete</i>, <i>Chara</i>, <i>Vaucheria</i>, <i>Ectocarpus</i>, <i>Fucus</i> and <i>Polysiphonia</i>, <i>Prochloron</i> through electron micrographs, temporary preparations and permanent slides.</p>
<b>CC2T</b>	PROF.MAMTAJ KHATUN(M.K)	<p><b>C2T : Bio-molecules and Cell Biology Credits 04</b>  <b>Course Contents:</b>  <b>Unit-1: Biomolecules</b>                      Types and significance of chemical bonds; Structure and properties of water; pH and buffers.  <b>Carbohydrates:</b> Nomenclature and classification; Monosaccharides ; Disaccharides; Oligosaccharides and polysaccharides.</p> <p><b>Lipids:</b> Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.  <b>Proteins:</b> Structure of amino acids; Levels of protein structure- primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins.  <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; Types of RNA; Structure of tRNA.</p> <p><b>Unit- 2: Bioenergetics</b>                      Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.</p> <p><b>Unit- 3: Enzymes</b>                      Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.</p>

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CC2T	PROF.SHAMBHU RANA(S.R)	<p><b>Unit-4: The cell</b> Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).</p> <p><b>Unit- 5: 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, endocytosis and exocytosis.</p> <p><b>Unit- 6: Cell organelles</b> <b>Nucleus:</b> Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. <b>Cytoskeleton:</b> Role and structure of microtubules, microfilaments and intermediary filament. <b>Chloroplast, mitochondria and peroxisomes:</b> Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. <b>Endomembrane system:</b> Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes</p> <p><b>Unit -7: Cell division</b> Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.</p>
C2P	PROF.MAMTAJ KHATUN(M.K)	<p><b>C2P : Bio-molecules and Cell Biology Credits 02 (Practical )</b></p> <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/Crinum</i>.</li> <li>3. Demonstration of the phenomenon of protoplasmic streaming in <i>Hydrilla</i> leaf.</li> <li>4. Measurement of cell size by the technique of micrometry.</li> <li>5. Counting the cells per unit volume with the help of haemocytometer. (Yeast / pollen grains).</li> <li>6. Study of cell and its organelles with the help of electron micrographs.</li> <li>7. Cytochemical staining of : DNA- Feulgen Acto carmin and Aceto Orcrin stain and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.</li> <li>8. Study the phenomenon of plasmolysis and deplasmolysis.</li> <li>9. Study the effect of organic solvent and temperature on membrane permeability.</li> <li>10. Study different stages of mitosis and meiosis.</li> </ol>

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<p><b>GE-IT</b></p>	<p>PROF.SHAMBHU RANA(S.R)</p>	<p><b>GE1T: Biodiversity (Microbes, Algae, Fungi and Archegoniate) Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Microbes</b>  Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.</p> <p><b>Unit 2: Algae</b>  General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: <i>Nostoc</i>, <i>Chlamydomonas</i>, <i>Oedogonium</i>, <i>Vaucheria</i>, <i>Fucus</i>, <i>Polysiphonia</i>. Economic importance of algae.</p> <p><b>Unit 3: Fungi</b>  Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of <i>Rhizopus</i> (Zygomycota) <i>Penicillium</i>, <i>Alternaria</i> (Ascomycota), <i>Puccinia</i>, <i>Agaricus</i> (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.</p>
	<p>PROF.SASWATI ROY(S.ROY)</p>	<p><b>Unit 4: Introduction to Archegoniate</b>  Unifying features of archegoniates, Transition to land habit, Alternation of generations.</p> <p><b>Unit 5: Bryophytes</b>  General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of <i>Marchantia</i> and <i>Funaria</i>. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of <i>Sphagnum</i>.</p> <p><b>Unit 6: Pteridophytes</b>  General characteristics, classification, Early land plants (<i>Cooksonia</i> and <i>Rhynia</i>). Classification (up to family), morphology, anatomy and reproduction of <i>Selaginella</i>, <i>Equisetum</i> and <i>Pteris</i>. (Developmental details not to be included). Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.</p> <p><b>Unit 7: Gymnosperms</b>  General characteristics; Classification (up to family), morphology, anatomy and reproduction of <i>Cycas</i> and <i>Pinus</i> (Developmental details not to be included). Ecological and economical importance.</p>

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<p><b>GE-IP</b></p>	<p>PROF.BISWAJIT PRADHAN(B.P)</p>	<p><b>Practical:</b></p> <ol style="list-style-type: none"> <li>EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.</li> <li>Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.</li> <li>Gram staining.</li> <li>Study of vegetative and reproductive structures of <i>Nostoc</i>, <i>Chlamydomonas</i> (electron micrographs), <i>Oedogonium</i>, <i>Vaucheria</i>, <i>Fucus*</i> and <i>Polysiphonia</i> through temporary preparations and permanent slides. (* <i>Fucus</i> - Specimen and permanent slides).</li> <li><i>Rhizopus</i> and <i>Penicillium</i>: Asexual stage from temporary mounts and sexual Structures through permanent slides.</li> <li><i>Alternaria</i>: Specimens/photographs and tease mounts.</li> <li><i>Puccinia</i>: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.</li> </ol>
	<p>PROF.RACHANA BERA(R.B)</p>	<ol style="list-style-type: none"> <li><i>Agaricus</i>: Specimens of button stage and full grown mushroom; Sectioning of gills of <i>Agaricus</i>.</li> <li>Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)</li> <li>Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)</li> <li><i>Marchantia</i>- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemmacup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).</li> <li><i>Funaria</i>- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.</li> <li><i>Selaginella</i>- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).</li> <li><i>Equisetum</i>- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s. rhizome (permanent slide).</li> <li>Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).</li> <li><i>Cycas</i>- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. micro sporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).</li> </ol>

		<p>16. <i>Pinus</i>- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &amp;r.l.s. stem (permanent slide). seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.</p>
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**SEM-II**

PAPER	TEACHER	DETAILED SYLLABUS
CC3T	PROF.MANIKLAL PATI (M.P)	<p><b>C3 T : Mycology and Phytopathology Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit- 1: Introduction to true fungi</b> General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.</p> <p><b>Unit- 2: Chytridiomycota and Zygomycota</b> Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to <i>Synchytrium</i>, <i>Rhizopus</i> .</p> <p><b>Unit-3: Ascomycota</b> General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to <i>Saccharomyces</i>, <i>Aspergillus</i>, <i>Penicillium</i>, <i>Alternaria</i>, <i>Neurospora</i> and <i>Peziza</i>.</p> <p><b>Unit- 4: Basidiomycota</b> General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat <i>Puccinia</i> (Physiological Specialization), loose and covered smut (symptoms only), <i>Agaricus</i>; Bioluminescence, Fairy Rings and Mushroom Cultivation with special reference to Oyster Mushroom.</p>
	PROF.BISWAJIT PRADHAN(B.P)	<p><b>Unit- 5: Allied Fungi</b> General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.</p> <p><b>Unit- 6: Oomycota</b> General characteristics; Ecology; Life cycle and classification with reference to <i>Phytophthora</i>, <i>Albugo</i>.</p> <p><b>Unit -7: Symbiotic associations</b> Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.</p> <p><b>Unit- 8: Applied Mycology</b> Role of fungi in biotechnology; Application of fungi in food industry (Flavour &amp; texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.</p>
	PROF.RACHANA BERA(R.B)	<p><b>Unit- 9: Phytopathology</b> Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of 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.</p>

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC3P</b>	MANIKLAL PATI (M.P)	<b>Practical</b> 1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps). 2. <i>Rhizopus</i> : study of asexual stage from temporary mounts and sexual structures through permanent slides. 3. <i>Aspergillus</i> and <i>Penicillium</i> : study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs. 4. <i>Peziza</i> : Ascobolus sectioning through ascocarp. 5. <i>Alternaria</i> : Specimens/photographs and temporary mounts. 6. <i>Puccinia</i> : Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts. 7. <i>Agaricus</i> : Specimens of button stage and full grown mushroom; sectioning of gills of <i>Agaricus</i> , fairy rings and bioluminescent mushrooms to be shown. 8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of <i>Stemonitis</i> sporangia. 9. <i>Albugo</i> : Study of symptoms of plants infected with <i>Albugo</i> ; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
	BISWAJIT PRADHAN(B.P)	10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs) 11. Phytopathology : Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

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PAPER	TEACHER	DETAILED SYLLABUS
CC4T	PROF.MAMTAJ KHATUN(M.K)	<p><b>C4T: Archegoniate Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Introduction</b>                      Unifying features of archegoniates; Transition to land habit; Alternation of generations.  <b>Unit 2: Bryophytes</b>                      General characteristics; Adaptations to land habit; Classification; Range of thallus organization.  <b>Unit 3: Type Studies- Bryophytes</b>                      Classification (up to family), morphology, anatomy and reproduction of <i>Riccia</i>, <i>Marchantia</i>, <i>Pellia</i>, <i>Porella</i>, <i>Anthoceros</i>, <i>Sphagnum</i> and <i>Funaria</i>; Pogonatum, Reproduction and evolutionary trends in <i>Riccia</i>, <i>Marchantia</i>, <i>Plagichasma</i> <i>Anthoceros</i> and <i>Funaria</i> (developmental stages not included). Ecological and economic importance of bryophytes with special reference to <i>Sphagnum</i>.  <b>Unit 4: Pteridophytes</b>                      General characteristics; Classification; Early land plants (<i>Cooksonia</i> and <i>Rhynia</i>).  <b>Unit 5: Type Studies- Pteridophytes</b>                      Classification (up to family), morphology, anatomy and reproduction of <i>Psilotum</i>, <i>Selaginella</i>, <i>Equisetum</i> and <i>Pteris</i> (Developmental details not to be included). Apogamy, and apospory, heterospory and seed habit, telome theory, stellar evolution; Ecological and economic importance.</p>
	PROF.RACHANA BERA(R.B)	<p><b>Unit 6: Gymnosperms</b>                      General characteristics, classification (up to family), morphology, anatomy and reproduction of <i>Cycas</i>, <i>Pinus</i> and <i>Gnetum</i> (Developmental details not to be included); Ecological and economic importance.</p>

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CC4P	PROF.MAMTAJ KHATUN(M.K)	<p><b>Practical</b></p> <ol style="list-style-type: none"> <li><b><i>Riccia</i></b> – Morphology of thallus.</li> <li><b><i>Marchantia</i></b>- Morphology of thallus, whole mount of rhizoids Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).</li> <li><b><i>Anthoceros</i></b>- Morphology of thallus, dissection of sporophyte (show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).</li> <li><b><i>Pellia, Porella</i></b>- Permanent slides.</li> <li><b><i>Sphagnum</i></b>- Morphology of plant, whole mounts of leaf (permanent slide only).</li> <li><b><i>Funaria</i></b>- Pogonatum/ Polytrichum Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.</li> <li><b><i>Psilotum</i></b>- Study of specimen, transverse section of synangium (permanent slide).</li> <li><b><i>Selaginella</i></b>- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).</li> <li><b><i>Equisetum</i></b>- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).</li> <li><b><i>Pteris</i></b>- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).</li> <li><b><i>Cycas</i></b>- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).</li> <li><b><i>Pinus</i></b>- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of</li> </ol>

female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide).

13. *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)

14. **Botanical excursion.**

**SEM-II**

PAPER	TEACHER	DETAILED SYLLABUS
GE-2T	PROF.SASWATI ROY(S.ROY)	<p><b>GE-2: Plant Ecology and Taxonomy Credits 06</b>  <b>GE2T: Plant Ecology and Taxonomy Credits 04</b>  <b>Course Contents:</b>  <b>Unit- 1: Introduction</b>  <b>Unit- 2: Ecological factors</b>                      Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes  <b>Unit -3: Plant communities</b>                      Characters; Ecotone and edge effect; Succession; Processes and types  <b>Unit- 4: Ecosystem</b>                      Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Bio-geochemical cycling; Cycling of carbon, nitrogen and Phosphorous  <b>Unit- 5: Phytogeography</b>                      Principle of Biogeographical zone; Endemism.</p>
	PROF.SHAMBHU RANA (S.R)	<p><b>Unit- 6: Introduction to plant taxonomy</b>                      Identification, Classification, Nomenclature.  <b>Unit- 7 : Identification</b>                      Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access  <b>Unit 8 : Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.</b>  <b>Unit 9 : Taxonomic hierarchy</b>                      Ranks, categories and taxonomic groups  <b>Unit 10: Botanical nomenclature</b>                      Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.  <b>Unit 11: Classification</b>                      Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).  <b>Unit 12: Biometrics, numerical taxonomy and cladistics</b>                      Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).</p>
GE-2P	PROF.BISWAJIT PRADHAN(B.P)	<p><b>GE2P: Practical Credit 02</b>  <b>Practical:</b>                      1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.                      2.Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.                      3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.                      4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b) Study of biotic interactions of the following: Stem parasite (<i>Cuscuta</i>), Root parasite (<i>Orobanche</i>), Epiphytes, Predation (Insectivorous plants).</p>

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PAPER	TEACHER	DETAILED SYLLABUS
GE-2P	PROF.SHAMBHU RANA (S.R)	<p>5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)</p> <p>6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law</p> <p>7. Study of vegetative and floral characters of 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): Brassicaceae - <i>Brassica, Alyssum / Iberis</i>; Asteraceae - <i>Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax</i>; Solanaceae - <i>Solanum nigrum, Withania</i>; Lamiaceae - <i>Salvia, Ocimum</i>; Liliaceae - <i>Asphodelus / Lilium / Allium</i>.</p> <p>8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).</p>

## SEM-III

PAPER	TEACHER	DETAILED SYLLABUS
CC5-T	PROF.MAMTAJ KHATUN(M.K)	<p><b>C5T: Anatomy of Angiosperms Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Introduction and scope of Plant Anatomy:</b> Applications in systematics, forensics and pharmacognosy.</p> <p><b>Unit 2: Structure and Development of Plant Body</b>                      Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: polarity, cytodifferentiation and organogenesis during embryogenic development, Root-stem transition, Nodal anatomy – Basic concept.</p> <p><b>Unit 2: Tissues</b>                      Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.</p> <p><b>Unit 3: Apical meristems</b>                      Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermises and origin of lateral root.</p>
	PROF.RACHANA BERA(R.B)	<p><b>Unit 4: Vascular Cambium and Wood</b>                      Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth in Bignonia, Boerhaavia , <i>Aristolochia</i> and Dracaena. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.</p> <p><b>Unit 5: Adaptive and Protective Systems</b>                      Epidermal tissue system, 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. Mechanical tissue – distribution and significance.</p>

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC5-P</b>	<b>PROF.MAMTAJ KHATUN(M.K)</b>	<b>C5P: Anatomy of Angiosperms Credits 02</b> <b>Practical</b> 1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/museum specimens with the help of suitable examples. 2. Apical meristem of root, shoot and vascular cambium. 3. Distribution and types of parenchyma, collenchyma and sclerenchyma. 4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres. 5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood. 6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres. 7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular. 8. Root: monocot, dicot, secondary growth. 9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels. 10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy). 11. Adaptive Anatomy: xerophytes, hydrophytes. 12. Secretory tissues: cavities, lithocysts and laticifers

## SEM-III

PAPER	TEACHER	DETAILED SYLLABUS
C6T	PROF.BISWAJIT PRADHAN(B.P)	<p><b>C6T: Economic Botany Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit 1: Origin of Cultivated Plants</b> Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.</p> <p><b>Unit 2: Cereals</b> Wheat and Rice (origin, morphology, cultivation, management processing &amp; uses); Brief account of millets.</p> <p><b>Unit 3: Legumes</b> Origin, morphology cultivation, management and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.</p> <p><b>Unit 4: Sources of sugars and starches</b> Morphology cultivation, management and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation &amp; uses.</p> <p><b>Unit 5: Spices</b> Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper</p> <p><b>Unit 6: Beverages</b> Tea, Coffee (morphology, processing &amp; uses)</p> <p><b>Unit 7: Sources of oils and fats</b> General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family &amp; uses). Essential Oils: General account, extraction methods, comparison with fatty oils &amp; their uses.</p> <p><b>Unit 8: Natural Rubber</b> Para-rubber: tapping, processing and uses.</p> <p><b>Unit 9: Drug-yielding plants</b> Therapeutic and habit-forming drugs with special reference to <i>Cinchona</i>, <i>Digitalis</i>, <i>Papaver</i> and <i>Cannabis</i>; Tobacco (Morphology, processing, uses and health hazards).</p> <p><b>Unit 10: Timber plants</b> General account with special reference to teak and pine.</p> <p><b>Unit 11: Fibers</b> Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).</p>
C6-P	PROF.BISWAJIT PRADHAN(B.P)	<p><b>C6P: Economic Botany Credits 02</b></p> <p><b>Practical</b></p> <ol style="list-style-type: none"> <li><b>Cereals:</b> Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests) Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).</li> <li><b>Legumes:</b> Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).</li> <li><b>Sources of sugars and starches:</b> Sugarcane ( habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).</li> <li><b>Spices:</b> Black pepper, Fennel and Clove (habit and sections).</li> </ol>

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC6-P</b>	PROF.BISWAJIT PRADHAN(B.P)	<p>5. <b>Beverages:</b> Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).</p> <p>6. <b>Sources of oils and fats:</b> Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.</p> <p>7. <b>Essential oil-yielding plants:</b> Habit sketch of <i>Rosa</i>, <i>Vetiveria</i>, <i>Santalum</i> and <i>Eucalyptus</i> (specimens/photographs).</p> <p>8. <b>Rubber:</b> specimen, photograph/model of tapping, samples of rubber products.</p> <p>9. <b>Drug-yielding plants:</b> Specimens of <i>Digitalis</i>, <i>Papaver</i> and <i>Cannabis</i>.</p> <p>10. <b>Tobacco:</b> specimen and products of Tobacco.</p> <p>11. <b>Woods:</b> <i>Tectona</i>, <i>Pinus</i>: Specimen, Section of young stem.</p> <p>12. <b>Fiber-yielding plants:</b> Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).</p>

## SEM-III

PAPER	TEACHER	DETAILED SYLLABUS
CC7-T	PROF.MANIKLAL PATI (M.P)	<p><b>C7T: Genetics Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit 1: 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.</p> <p><b>Unit 2: Extra-chromosomal Inheritance</b></p> <p><b>Unit 3: Bacteria</b>                      Discovery, general characteristics; Types-archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in <i>Paramecium</i>.</p> <p><b>Unit 3: Linkage, crossing over and chromosome mapping</b>                      Linkage and crossing over-Cytological and molecular basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.</p> <p><b>Unit 4: Variation in chromosome number and structure</b>                      Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy</p> <p><b>Unit 5: Gene mutations</b> 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.</p>
	PROF.SASWATI ROY(S.ROY)	<p><b>Unit 6: Fine structure of gene</b>                      Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.</p> <p><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.</p>

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC7-P</b>	PROF.MANIKLAL PATI (M.P)	<b>C7P: Genetics Credits 02</b> <b>Practical</b> 1. Demonstration on pretreatment, fixation, staining and squash and smear preparation. 2. Study of Mitosis from Onion / Garlic / Lentil root. 3. Study of Meiosis with pollen mother cell (PMC) of Onion / Solanum / Datura by smear preparation. 4. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square. 5. Chromosome mapping using point test cross data. 6. Pedigree analysis for dominant and recessive autosomal and sex linked traits. 7. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). 8. Blood Typing: groups & Rh factor. 9. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes. 10. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge. 11. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe.

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>SEC1T</b>	PROF.RACHANA BERA(R.B)	<p><b>SEC1T: Biofertilizers Credits 02</b></p> <p><b>Course Contents:</b></p> <p><b>Unit- 1:</b> General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.</p> <p><b>Unit- 2:</b> <i>Azospirillum</i>: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. <i>Azotobacter</i>: classification, characteristics – crop response to <i>Azotobacter</i> inoculum, maintenance and mass multiplication.</p> <p><b>Unit- 3:</b> Cyanobacteria (blue green algae), <i>Azolla</i> and <i>Anabaena azollae</i> association, nitrogen fixation, factors affecting growth, blue green algae and <i>Azolla</i> in rice cultivation.</p> <p><b>Unit- 4:</b> Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.</p> <p><b>Unit-5:</b> Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.</p>

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>GE3T</b>	PROF.SASWATI ROY(S.ROY)	<b>GE3T: Economic Botany and Plant Biotechnology Credits 04</b> <b>Course Contents:</b> <b>Unit 1: Origin of Cultivated Plants</b> Concept of centres of origin, their importance with reference to Vavilov's work. <b>Unit 2: Cereals</b> Wheat - Origin, morphology, uses <b>Unit 3: Legumes</b> General account with special reference to Gram and soybean <b>Unit 4: Spices</b> General account with special reference to clove and black pepper (Botanical name, family, part used morphology and uses) <b>Unit 5: Beverages</b> Tea (morphology, processing, uses) <b>Unit 6: Oils and Fats</b> General description with special reference to groundnut <b>Unit 7: Fibre Yielding Plants</b> General description with special reference to Cotton (Botanical name, family, part used, morphology and uses) <b>Unit 8: Introduction to biotechnology</b> <b>Unit 9: Plant tissue culture</b> Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications <b>Unit 10: Recombinant DNA Techniques</b> Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immuno detection. Molecular diagnosis of human disease, Human gene Therapy.
<b>GE3P</b>	PROF.SASWATI ROY(S.ROY)	<b>GE3P: Economic Botany and Plant Biotechnology Credits 04</b> <b>Practical:</b> 1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and micro chemical tests  2. Familiarization with basic equipments in tissue culture.  3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation. 4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

**SEM-IV**

PAPER	TEACHER	DETAILED SYLLABUS
C8T	PROF.MANIKLAL PATI (M.P)	<p><b>C8T: Molecular Biology Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit- 1: Nucleic acids: Carriers of genetic information</b>                      Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey &amp; Chase, Avery, McLeod &amp; McCarty, Fraenkel-Conrat's experiment.</p> <p><b>Unit -2. 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, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNA-Prokaryotes, Viruses, Eukaryotes.RNA Structure-Organelle DNA -- mitochondria and chloroplast DNA.The Nucleosome-Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.</p> <p><b>Unit- 2:The replication of DNA</b>                      Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semiconservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, <math>\theta</math> (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.</p> <p><b>Unit- 3: Central dogma and genetic code</b>                      Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering &amp; salient features)</p> <p><b>Unit 4: 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 and peptide hormones; Gene silencing.</p> <p><b>Unit 5: 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' polyA tail); Ribozymes; RNA editing and mRNA transport.</p>

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<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>C8T</b>	PROF.MANIKLAL PATI (M.P)	<b>Unit 5: 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' polyA tail); Ribozymes; RNA editing and mRNA transport. <b>Unit 6: 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. Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immuno detection. Molecular diagnosis of human disease, Human gene Therapy.
<b>CC8-P</b>	PROF.MANIKLAL PATI (M.P)	<b>C8P: Molecular Biology Credits 02</b> <b>Practical</b> 1. Preparation of LB medium and raising <i>E.Coli</i> . 2. Isolation of genomic DNA from <i>E.Coli</i> . 3. DNA isolation from cauliflower head. 4. DNA estimation by diphenylamine reagent/UV Spectrophotometry. 5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. 7. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al,Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments) 8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

**SEM-IV**

PAPER	TEACHER	DETAILED SYLLABUS
CC9-T	<p>PROF.BISWAJIT PRADHAN(B.P)</p>	<p><b>C9T: Plant Ecology and Phytogeography Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Introduction</b>                      Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.  <b>Unit 2: Soil</b>                      Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.  <b>Unit 3: Bacteria</b>                      Discovery, general characteristics; Types-archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).  <b>Unit 3: Water</b>                      Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.  <b>Unit 4: Light, temperature, wind and fire</b>                      Variations; adaptations of plants to their variation.  <b>Unit 5: Ecosystems</b>                      Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.</p>
	<p>PROF.SASWATI ROY (S.ROY)</p>	<p><b>Unit 6: Population ecology</b>                      Characteristics and Dynamics .Ecological Speciation  <b>Unit 7: Plant communities</b>                      Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.  <b>Unit 8: Biotic interactions</b>                      Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.  <b>Unit 9: Functional aspects of ecosystem</b>                      Principles and models of energy flow; Production and productivity;Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.  <b>Unit 10: Phytogeography</b>                      Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate &amp; tundra); Phytogeographical division of India; Local Vegetation.</p>

**SEM-IV**

PAPER	TEACHER	DETAILED SYLLABUS
CC9-P	PROF.BISWAJIT PRADHAN(B.P)	<p><b>C9P: Plant Ecology and Phytogeography Credits 02</b></p> <p><b>Practical</b></p> <ol style="list-style-type: none"> <li>1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.</li> <li>2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)</li> <li>3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from</li> <li>4. two soil samples by rapid field tests.</li> <li>5. Determination of organic matter of different soil samples by Walkley &amp; Black rapid titration</li> <li>6. method.</li> </ol> <p>Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.</p> <ol style="list-style-type: none"> <li>7. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.</li> <li>8. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.</li> <li>9. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).</li> <li>(b). Study of biotic interactions of the following: Stem parasite (<i>Cuscuta</i>), Root parasite (<i>Orobanche</i>) Epiphytes, Predation (Insectivorous plants).</li> <li>10. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).</li> <li>11. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.</li> <li>12. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.</li> <li>13. Field visit to familiarise students with ecology of different sites.</li> </ol>

## SEM-IV

PAPER	TEACHER	DETAILED SYLLABUS
CC10-T	PROF.MAMTAJ KHATUN(M.K)	<p><b>C10T: Plant Systematics Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit 1: Significance of Plant systematics</b> Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys:Single access and Multi-access.</p> <p><b>Unit 2: Taxonomic hierarchy</b> Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).</p> <p><b>Unit 3: Botanical nomenclature</b> Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.</p> <p><b>Unit 5: Gene mutations</b> 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.</p> <p>Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.</p> <p><b>Unit 5: Biometrics, numerical taxonomy and cladistics</b> Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).</p> <p><b>Unit 6: 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 evolutionary relationship (phylogenetic tree, cladogram).</p>
	PROF.MAMTAJ KHATUN(M.K)	<p><b>C10P: Plant Systematics Credits 02</b></p> <p><b>Practical</b></p> <p>1. Study of vegetative and floral characters of 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):</p> <ol style="list-style-type: none"> <li>1. Ranunculaceae - <i>Ranunculus</i>, <i>Delphinium</i>.</li> <li>2. Brassicaceae - <i>Brassica</i>, <i>Alyssum</i> / <i>Iberis</i>.</li> <li>3. Malvaceae – <i>Sida Sp.</i> <i>Urena lobota</i>.</li> <li>4. Myrtaceae - <i>Eucalyptus</i>, <i>Callistemon</i></li> <li>5. Umbelliferae - <i>Coriandrum</i> /<i>Anethum</i> / <i>Foeniculum</i>.</li> <li>6. Asteraceae - <i>Sonchus/Launaea</i>, <i>Vernonia/Ageratum</i>, <i>Eclipta/Tridax</i>.</li> <li>7. Solanaceae - <i>Solanum nigrum/Withania</i>, <i>Nicotina</i>, <i>Plumbaginefolia</i>.</li> </ol>

**SEM-IV**

<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC10-P</b>	<b>PROF.MAMTAJ KHATUN(M.K)</b>	<p>8. Lamiaceae - <i>Salvia/Ocimum</i>. 9. Euphorbiaceae - <i>Euphorbia hirta/E.milii, Jatropha</i>. 10. Fabaceae – <i>Tephrosia Sp., Crotalaria Sp.</i>, 11. Caesalpinieaceae – <i>Cassia Sp.</i>, 12. Asclepiadaeaceae- <i>Pesularia Gygnema</i>, 13. Apocynaceae – <i>Hollorhen, Catharanthus</i>. 14. Rubiaceae – <i>Oldenladeae, Spermoeoaceae</i>, 15. Liliaceae - <i>Asphodelus/Lilium/Allium</i>. 16. Poaceae - <i>Triticum/Hordeum/Avena</i>.</p> <p>2. Field visit (local) – Subject to grant of funds from the university. 3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book). Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.</p>

**SEM-IV**

<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>SEC-2T</b>	PROF.RACHANA BERA(R.B)	<p><b>SEC-2T: Mushroom Culture Technology</b></p> <p><b>Course Contents:</b></p> <p><b>Unit 1:</b> Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - <i>Volvariella volvacea</i>, <i>Pleurotus citrinopileatus</i>, <i>Agaricus bisporus</i>.</p> <p><b>Unit 2:</b> Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.</p> <p><b>Unit 3:</b> Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.</p> <p><b>Unit 4:</b> Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.</p>

## SEM-IV

PAPER	TEACHER	DETAILED SYLLABUS
GE-4	PROF.SHAMBHU RANA(S.R)	<p><b>GE-4: Plant Physiology and Metabolism Credits 06</b>  <b>GE4T: Plant Physiology and Metabolism Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Plant-water relations</b>                      Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.  <b>U nit 2: Mineral nutrition</b>                      Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.  <b>Unit 3: Translocation in phloem.</b>                      C omposition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading  <b>Unit 4: Photosynthesis</b>                      Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.  <b>U nit 5: Respiration</b>                      Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.  <b>U nit 6: Enzymes</b>                      Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.  <b>U nit 7: Nitrogen metabolism</b></p>
	PROF.SASWATI ROY(S.ROY)	<p>Biological nitrogen fixation; Nitrate and ammonia assimilation.  <b>Unit 8: Plant growth regulators</b>                      Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.  <b>Unit 9: Plant response to light and temperature</b>                      Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.</p>
GE4P	PROF.SHAMBHU RANA(S.R)	<p><b>GE4P: Plant Physiology and Metabolism Credits 02</b>  <b>Practical</b>                      1. Determination of osmotic potential of plant cell sap by plasmolytic method.                      2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.                      3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.                      4. Demonstration of Hill reaction.                      5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.                      To study the effect of light intensity and bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.                      Comparison of the rate of respiration in any two parts of a plant.                      Separation of amino acids by paper chromatography.  <b>monstration experiments (any four)</b>                      1. Bolting. 2. Effect of auxins on rooting.                      3. Suction due to transpiration.</p>

## SEM-V

PAPER	TEACHER	DETAILED SYLLABUS
CC11-T	PROF.MANIKLAL PATI (M.P)	<p><b>C11T: Reproductive Biology of Angiosperms Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit 1: Introduction</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.</p> <p><b>Unit 2: Reproductive development</b> Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.</p> <p><b>Unit 3: 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, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.</p> <p><b>Unit 4: 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.</p> <p><b>Unit 4: Pollination and fertilization</b> Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.</p>
	PROF.SHAMBHU RANA(S.R)	<p><b>Unit 5: Self incompatibility</b> Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self-incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and <i>in vitro</i> pollination; Modification of stigma surface, parasexual hybridization; Cybrids, <i>in vitro</i> fertilization.</p> <p><b>Unit 6: 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</p> <p><b>Units 7: Polyembryony and apomixis</b> Introduction; Classification; Causes and applications.</p>

**SEM-V**

<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC11-P</b>	PROF.MANIKLAL PATI (M.P)	<b>C11P: Reproductive Biology of Angiosperms Credits 02</b> <b>Practical</b> 1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.  2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test.germination: Calculation of percentage germination in different media using hanging drop method.  3.Ovule:Types-anatropous,orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).  4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.  5. Intra-ovarian pollination; Test tube pollination through photographs.  6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.  7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

**SEM-V**

PAPER	TEACHER	DETAILED SYLLABUS
CC12T	PROF.MAMTAJ KHATUN(M.K)	<p><b>C12T: Plant Physiology Credits 04</b>  <b>Course Contents:</b>  <b>Unit 1: Plant-water relations</b>                      Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap – cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.  <b>Unit 2: Mineral nutrition</b>                      Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.  <b>Unit 3: Nutrient Uptake</b>                      Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.  <b>Unit 4: Translocation in the phloem</b>                      Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.  <b>Unit 5: Plant growth regulators</b>                      Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.  <b>Unit 6: Physiology of flowering</b>                      Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.  <b>Unit 7: Phytochrome , crytochromes and phototropins</b>                      Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.</p>
C12P	PROF.MAMTAJ KHATUN(M.K)	<p><b>C12P: Plant Physiology Credits 02</b>  <b>Practical</b>                      1. Determination of osmotic potential of plant cell sap by plasmolytic method.                      2. Determination of water potential of given tissue (potato tuber) by weight method.                      3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.                      4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.                      5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).                      6. To study the phenomenon of seed germination (effect of light).</p>

## SEM-V

PAPER	TEACHER	DETAILED SYLLABUS
		<p>7. To study the effect of different concentrations of IAA on <i>Avena</i> coleoptile elongation (IAA Bioassay).</p> <p>8. To study the induction of amylase activity in germinating barley grains.</p> <p><b>Demonstration experiments</b></p> <ol style="list-style-type: none"><li>1. To demonstrate suction due to transpiration.</li><li>2. Fruit ripening/Rooting from cuttings (Demonstration).</li><li>3. Bolting experiment/<i>Avena</i> coleptile bioassay (demonstration).</li></ol>

**SEM-V**

<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>DSE1T</b>	PROF.SASWATI ROY(S.ROY)	<b>DSE1T: Biostatistics Credits 04</b> <b>Course Contents:</b> <b>Unit 1: Biostatistics</b> Definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistics. <b>Unit 2: Collection of data primary and secondary</b> Types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data - sampling methods. <b>Unit 3:Measures of central tendency</b> Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient of variations. <b>Unit 4: Correlation</b> Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression <b>Unit 5: Statistical inference</b> Hypothesis - simple hypothesis - student 't' test - chi square test.
<b>DSE1P</b>	PROF.SHAMBHU RANA(S.R)	<b>DSE1P: Biostatistics Credits 02</b> <b>Practical</b> 1. Calculation of mean, standard deviation and standard error 2. Calculation of correlation coefficient values and finding out the probability 3. Calculation of 'F' value and finding out the probability value for the F value.

**SEM-V**

PAPER	TEACHER	DETAILED SYLLABUS
DSE2T	PROF.BISWAJIT PRADHAN(B.P)	<p><b>DSE2T: Plant Breeding Credits 04</b>  <b>Course Contents:</b>  <b>Unit -1: Plant Breeding</b>                      Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.  <b>Unit -2: Methods of Crop improvement</b>                      Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.</p>
	PROF.RACHANA BERA(R.B)	<p><b>Unit -3: Quantitative inheritance</b>                      Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic Inheritance.  <b>Unit - 4: Inbreeding depression and heterosis</b>                      History, genetic basis of inbreeding depression and heterosis : Applications.  <b>Unit - 5: Crop improvement and breeding</b>                      Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.</p>
DSE2P	PROF.BISWAJIT PRADHAN(B.P)	<p><b>DSE2P: Plant Breeding (Practical) Credits 02</b>  <b>Practical</b>                      1. Identification of offspring's having parental genotypes and recombinant genotypes, based on combination of morphological attributes in a dihybrid cross..                      2. Processes of emasculation –                      a) By applying higher temperature,                      b) By amputing anthers.                      3. Determination of genetic inheritance of characters in monohybrid and dihybrid crosses by Chi-square test (including Mendelian ratios and the ratios of gene interactions e.g. Dominant Epistasis, Supplementary gene action, Polymeric Gene action, Complementary Gene action, Inhibitory Gene action and Duplicating Gene action.                      4. Identification of fertile and sterile pollens with carmine stain and TTC test.</p>

**SEM-VI**

<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>CC13T</b>	PROF.MAMTAJ KHATUN(M.K)	<b>C13T: Plant Metabolism Credits 04</b> <b>Course Contents:</b> <b>Unit 1: Concept of metabolism</b> Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes). <b>Unit 2: Carbon assimilation</b> Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO <sub>2</sub> reduction, photorespiration, C <sub>4</sub> pathways; Crassulacean acid metabolism; Factors affecting CO <sub>2</sub> reduction. <b>Unit 3: Carbohydrate metabolism</b> Synthesis and catabolism of sucrose and starch. <b>Unit 4: Carbon Oxidation</b> Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration. <b>Unit 5: ATP-Synthesis</b> Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker’s experiment, Jagendorf’s experiment; role of uncouplers. <b>Unit 6: Lipid metabolism</b> Synthesis and breakdown of triglycerides, $\beta$ -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, $\alpha$ oxidation. <b>Unit 7: Nitrogen metabolism</b> Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination. <b>Unit 8: Mechanisms of signal transduction</b> Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade.
<b>C13P</b>	PROF.MAMTAJ KHATUN(M.K)	<b>C13P: Plant Metabolism Credits 02</b> <b>Practical</b> 1. Chemical separation of photosynthetic pigments. 2. Experimental demonstration of Hill’s reaction. 3. To study the effect of light intensity on the rate of photosynthesis. 4. Effect of carbon dioxide on the rate of photosynthesis. 5. To compare the rate of respiration in different parts of a plant. 6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources. 7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids 1. during germination. 8. Demonstration of fluorescence by isolated chlorophyll pigments. 9. Demonstration of absorption spectrum of photosynthetic pigments.

**SEM-VI**

PAPER	TEACHER	DETAILED SYLLABUS
CC14T	PROF.MANIKLAL PATI(M.P)	<p><b>C14T: Plant Biotechnology Credits 04</b>  <b>Course Contents:</b>  <b>Unit -1: 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; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation)..  <b>Unit- 2: 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).  <b>Unit- 3:Gene Cloning</b>                      Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCRmediated 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  <b>Unit- 4: 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).</p>
	PROF.SHAMBHU RANA(S.R)	<p><b>Unit - 5: Applications of Biotechnology</b>                      Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moon dust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.</p>
C14P	PROF.MANIKLAL PATI(M.P)	<p><b>C14P: Plant Biotechnology Credits 02</b>                      1. (a) Preparation of MS medium.                      (b) Demonstration of <i>in vitro</i> sterilization and inoculation methods using leaf and nodal explants of tobacco, <i>Datura</i>, <i>Brassica</i> etc.                      2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis &amp; artificial seeds through photographs.                      3. Isolation of protoplasts.                      4. Construction of restriction map of circular and linear DNA from the data provided.                      5. Study of methods of gene transfer through photographs: <i>Agrobacterium</i>-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.                      7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.                      8. Isolation of plasmid DNA.                      9. Restriction digestion and gel electrophoresis of plasmid DNA.</p>

**SEM-VI**

<b>PAPER</b>	<b>TEACHER</b>	<b>DETAILED SYLLABUS</b>
<b>DSE-3T</b>	PROF.RACHANA BERA(R.B)	<p><b>DSE-3T: Industrial and Environmental Microbiology Credits 04</b></p> <p><b>Course Contents:</b></p> <p><b>Unit 1: Scope of microbes in industry and environment</b></p> <p><b>Unit 2: Bioreactors / Fermenters and fermentation processes</b> Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors-laboratory, pilotscale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.</p> <p><b>Unit 3: Microbial production of industrial products</b> Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying; Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin)</p> <p><b>Unit 4: Microbial enzymes of industrial interest and enzyme immobilization</b> Microorganisms for industrial applications_ and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).</p> <p><b>Unit 5: Microbes and quality of environment.</b> Distribution of microbes in air; Isolation of microorganisms from soil, air and water.</p> <p><b>Unit 6: Microbial flora of water.</b> Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coliform in water samples.</p> <p><b>Unit 7: Microbes in agriculture and remediation of contaminated soils.</b> Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.</p>
<b>DSE-3P</b>	PROF.SHAMBHU RANA(S.R)	<p><b>DSE-3P: Industrial and Environmental Microbiology Credits 02</b></p> <p><b>Practical</b></p> <ol style="list-style-type: none"><li>1. Principles and functioning of instruments in microbiology laboratory</li><li>2. Hands on sterilization techniques and preparation of culture media.</li></ol> <p>oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.</p>

**SEM-VI**

PAPER	TEACHER	DETAILED SYLLABUS
DSE-4	<p>PROF.BISWAJIT PRADHAN(B.P)</p>	<p><b>DSE-4: Analytical Techniques in Plant Sciences Credits 06</b>  <b>DSE4T: Analytical Techniques in Plant Sciences Credits 04</b>  <b>Course Contents:</b>  <b>Unit- 1: Imaging and related techniques</b>                      Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.                      Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl<sub>2</sub> gradient, analytical centrifugation, ultracentrifugation, marker enzymes.  <b>Unit- 3: Radioisotopes</b>                      Use in biological research, auto-radiography, pulse chase experiment.  <b>Unit- 4: Spectrophotometry</b>                      Principle and its application in biological research.</p>
	<p>PROF.SASWATI ROY(S.ROY)</p>	<p><b>Unit- 5: Chromatography</b>                      Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.  <b>Unit- 6: Characterization of proteins and nucleic acids</b>                      Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE  <b>Unit- 7: Biostatistics</b>                      Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.</p>
DSE4P	<p>PROF.BISWAJIT PRADHAN(B.P)</p>	<p><b>DSE4P: Analytical Techniques in Plant Sciences Credits 02</b>  <b>Practical</b>                      1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.                      2. Demonstration of ELISA.                      3. To separate nitrogenous bases by paper chromatography.                      4.To separate sugars by thin layer chromatography.                      5.Isolation of chloroplasts by differential centrifugation.                      To separate chloroplast pigments by column chromatography.                      7.To estimate protein concentration through Lowry’s methods.                      8.To separate proteins using PAGE.                      9.To separation DNA (marker) using AGE.                      10.Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).                      11. Preparation of permanent slides (double staining).                      .</p>