Botany (Hons.) syllabus, lesson plan and course outcome

Semester – I
CC – 1 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC101
Course Title - Phycology and Microbiology
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Introduction to microbial world 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). (7 lectures)

Unit 2: Viruses Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T4-phage), lytic and lysogenic cycle; RNA virus (TMV). (7 lectures)

Unit 3: Bacteria Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; vegetative and Reproductive structure - asexual and recombination (conjugation, transformation and transduction). (7 lectures)

Unit 4: Algae 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); 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. (11 lectures)

Unit 5: Cyanophyta and Xanthophyta Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc* and Vaucheria. (8 lectures)

Unit 6: Chlorophyta and Charophyta General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Chlamydomonas, Volvox*, *Oedogonium*, *Chara*. Evolutionary significance of Prochloron. (8 lectures)

Unit 7: Phaeophyta and Rhodophyta Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Ectocarpus, Fucus and Polysiphonia. (12 lectures)

Practical

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Study od bacteria from curd and root nodule.

Phycology
Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), *Volvox, Oedogonium, Chara, Vaucheria, Ectocarpu*s and *Polysiphonia*, through electron micrographs, temporary preparations and permanent slides.

Course outcome:
After the completion of the course the students will be able to:

1. Develop understanding about the classification and diversity of Bacteria, viruses, Algae and their economic importance.

2. Develop conceptual skill about identifying microbes and algae.

3. Gain knowledge about developing commercial enterprise of microbial products.

4. Understand the structure and lifecycles of certain selected Algae.

Semester – I
CC – 2 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC102
Course Title - Biomolecules and Cell Biology
Course Instructor – Dr. Avishek Dey

Syllabus:
Unit 1: Biomolecules (20 lectures) Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Carbohydrates: Nomenclature and classification; Monosaccharides ; Disaccharides; Oligosaccharides and polysaccharides.
Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides. Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins. Nucleic acids: 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.
Unit 2: Bioenergenetics (4 lectures) Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.
Unit 3: Enzymes (6 lectures) 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 theroy), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.
Unit4: The cell (4 lectures) Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin ofeukaryotic cell (Endosymbiotic theory).
Unit 5: Cell wall and plasma membrane (4 lectures) 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.Exracellular matrix
Unit 6: Cell organelles (16 lectures) Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and

structure of microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes: Structural organization; Function;
Semiautonomous nature of mitochondria and chloroplast. Endomembrane system: 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
Unit 7: Cell division (6 lectures) Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases
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Practical
1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of *Onion/Rhoeo/Crinum.*
3. Measurement of cell size by the technique of micrometry.
4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
5. Study of cell and its organelles with the help of electron micrographs.
6. Cytochemical staining of : DNA - Aceto orcein and cell wall in the epidermal peel of onion.
7. Study the phenomenon of plasmolysis and deplasmolysis.
8. Study different stages of mitosis and meiosis.

Course outcome:
After the completion of the course the students will be able to:

1. Develop comprehensive understanding about the cellular architecture, communication systems and divisional types.

2. Understand details about bio-molecules, enzymes and bioenergetics.

3. Gain knowledge about developing practical skills in cell biology and biochemistry.

Semester – II
CC – 3 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC201
Course Title - Mycology and Phytopathology
Course Instructor – Keya Sarkar

Syllabus:
Unit 1: Introduction to true fungi (6 lectures) General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.
Unit 2: Chytridiomycota and Zygomycota (5 lecture) Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to Synchytrium, Rhizopus .
Unit 3: Ascomycota (10 lectures) General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to *Saccharomyces*, *Penicillium*, *Neurospora* and *Peziza*.
Unit 4: Basidiomycota (8 lectures) General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological

Spec5alization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation (Oyster).
Unit 5 Oomycota (4 lectures) General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*.
Unit 6 Symbiotic associations (4 lectures) 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.
Unit 7: Applied Mycology (9 Lectures) Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Agriculture (Biofertilizers); Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.
Unit 8: Phytopathology (14 lectures)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.

Practical
1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. *Aspergillus and Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. *Peziza*: sectioning through ascocarp.
5. *Puccinia*: 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.
6. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
7. 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)
8. 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.

Course outcome:

After the completion of the course the students will be able to:

1. Develop understanding about the classification and diversity of Fungi, Lichens and their economic importance.

2. Develop conceptual skill about identifying fungi, fungal pathogens, and lichens.

3. Understand the structure and lifecycles of certain selected Fungi.

Semester – II
CC – 4 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC202
Course Title - Archegoniate and Palaeobotany
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Introduction (4 lectures) Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Unit 2: Bryophytes (6 lectures) General characteristics; Adaptations to land habit; Classification; Range of thallus organization.

Unit 3: Type Studies- Bryophytes (12 lectures) Classification (up to order), morphology, anatomy and reproduction of *Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria*; Reproduction and evolutionary trends in *Riccia, Marchantia, Anthoceros and Polytrichum* (developmental stages not included). Ecological and economic importance of bryophytes with special reference to *Sphagnum.*

Unit 4: Pteridophytes (6 lectures) General characteristics; Classification; Early land plants *(Cooksonia and Rhynia*).

Unit 5: Type Studies- Pteridophytes (10 lectures) Classification (up to family), morphology, anatomy and reproduction of *Psilotum, Selaginella, Equisetum* and *Pteris* (Developmental details not to be included).Apogamy, and apospory, heterospory andseed habit, telome theory, stelar evolution; Ecological and economic importance.

Unit 6: Gymnosperms (16 lectures) General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas, Pinus* and *Gnetum* (Developmental details not to be included); Ecological and economic importance.

Unit 7: Palaeobotany (6 Lectures) Plant life through ages, Geological time table, Fossils - definition, types, process of fossilization, factors for fossilization, Importances.

Practical

1. *Riccia* – Morphology of thallus.
2. *Marchantia*- Morphology of thallus, whole mount of rhizoids & Scales, vertical sectionof thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
3. *Anthocero*s- Morphology of thallus, dissection of sporophyte (to show stomata, spores,pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. *Pellia*, Porella- Permanent slides.
5. *Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only).
6. *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.

7. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).
8. *Selaginella*- 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).
9. *Equisetum*- 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).
10. *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
11. *Cycas*- 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).
12. *Pinus*- 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 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. Study of fossil genera - *Rhynia, Cooksonia and Lepidodendron* through photographs.
14. Botanical excursion.

Course outcome:

After the completion of the course the students will be able to:

1. Develop critical understanding on morphology, anatomy, reproduction, affinities and evolutionary significance of Bryophytes, Pteridophytes and Gymnosperms.

2. Understand the process of plant evolution and their transition to land habitat.

Semester – III
CC – 5 [Credit – 4 (L)+2(P)]
Course Code – 301
Course Title - Anatomy of Angiosperms
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Introduction and scope of Plant Anatomy (4 Lectures) Applications in systematics and pharmacognosy.

Unit 2: Structure and Development of Plant Body (6 Lectures) Internal organization of plant body: The three tissue systems, types of cells and tissues.Root stem transition.
Unit 2: Tissues (12 Lectures) 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.
Unit 3: Apical meristems (15 Lectures) 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, exodermis and origin oflateral root.
Unit 4: Vascular Cambium and Wood (15 Lectures) Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth in *Bignonia, Boerhaavia, Aristolochia 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.
Unit 5: Adaptive and Protective Systems (8 Lectures) Epidermal tissue system, cuticle, epicuticular waxes, trichomes(uni-and multicellular, glandular
and nonglandular, two examples of each), stomata (classification). Mechanical tissue.

Practical
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, xylem fibres.
5. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
6. Root: monocot, dicot, secondary growth.
7. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
8. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
9. Secretory tissues: cavities, lithocysts and laticifers.

Course outcome:

After the completion of the course the students will be able to develop a concept and knowledge on anatomical details of angiosperm.

Semester – III
CC – 6 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC302
Course Title - Economic Botany
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Origin of Cultivated Plants (6 lectures) 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.
Unit 2: Cereals (6 lectures) Wheat and Rice (origin, morphology, cultivation, management, processing & uses).
Unit 3: Legumes (6 lectures) Origin, morphology cultivation, management and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.
Unit 4: Sources of sugars and starches (4 lectures) Morphology and processing of sugarcane, cultivation, management, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.
Unit 5: Spices (6 lectures) Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper
Unit 6: Beverages (4 lectures) Tea, Coffee (morphology, processing & uses)
Unit 7: Sources of oils and fats (10 lectures) General description, classification, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, comparison with fatty oils & their uses.
Unit 8: Natural Rubber (3 lectures) Para-rubber: tapping, processing and uses.
Unit 9: Drug-yielding plants (8 lectures) Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis; Tobacco (Morphology, processing, uses and health hazards).
Unit 10: Timber plants (3 Lectures) General account with special reference to teak and pine.
Unit 11: Fibers (4 lectures) Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).

Practical
1. Cereals: 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).
2. Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. Sources of sugars and starches: 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).
4. Spices: Black pepper, Fennel and Clove (habit and sections).
5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Sources of oils and fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
7. Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs).
8. Rubber: specimen, photograph/model of tapping, samples of rubber products.
9. Drug-yielding plants: Specimens of Digitalis, Papaver and Cannabis.

10. Tobacco: specimen and products of Tobacco.
11. Woods: Tectona, Pinus: Specimen, Section of young stem.
12. Fiber-yielding plants: 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).

Course outcome:

After the completion of the course the students will be able to:
1. Identify the major economically important plants and their role in civilization.
2. Use evidenced-based comparative knowledge and the propagation of plants with respect to environmental conditions.

Semester – III
CC – 7 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC303
Course Title - Genetics
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Mendelian genetics and its extension (16 lectures)
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.
Unit 2: Extrachromosomal Inheritance (6 lectures) Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast;Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.
Unit 3: Linkage, crossing over and chromosome mapping (12 lectures) 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.
Unit 4: Variation in chromosome number and structure (8 lectures) Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy
Unit 5: Gene mutations (6 lectures) Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method.Role of Transposons in mutation.DNA repair mechanisms.
Unit 6: Fine structure of gene (6 lectures) Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.
Unit 7. Population and Evolutionary Genetics (6 lectures) Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.
Practical
1. Meiosis through temporary squash preparation with special reference to *Allium sp*.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
3. Chromosome mapping using point test cross data.
4. Idea about pretreatment, fixation, staining and smear preparation.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1,

9:3:4).
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.

Course outcome:

After the completion of the course the students will be able to:

1. Interpret the Mendelian principles of Genetics, Non-Mendelian inheritance, Linkage and Crossing over, cytoplasmic inheritance and sex-linked inheritance.

2. Acquire knowledge on Population and Evolutionary Genetics.

Semester – III
SEC – 1 [Credit – 2 (L)]
Course Code – BBOTSEHT305
Course Title - Biofertilizers
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1:General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.
(4 lectures)

Unit 2:Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. (8 lectures)

Unit 3:Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.(4 lectures)

Unit 4: 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.
(8 lectures)

Unit 5: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. (6 lectures)

Course outcome:

After the completion of the course the students will be able to understand the different types and importance of biofertilizers in nursery and gardening as well as in agriculture for a sustainable future.

Semester – IV
CC – 8[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC401
Course Title – Molecular Biology
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Nucleic acids : Carriers of genetic information (4 lectures) Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.

Unit 2. The Structures of DNA and RNA / Genetic Material (10 lectures) 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.

Unit 2:The replication of DNA (10 lectures) 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, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.

Unit 3: Central dogma and genetic code (2 lectures) Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

Unit 4: Transcription (18 lectures) Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.

Unit 5: Processing and modification of RNA (8 lectures) 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.

Unit 6: Translation (8 lectures)

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.

Practical

1. Preparation of LB medium and raising E.Coli.
2. Isolation of genomic DNA from E.Coli.
3. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication

and semi-discontinuous replication).
4. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
5. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
6. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Course outcome:

After the completion of the course the students will be able to:

1. Understand the mechanism and concepts of life process at molecular level through central dogma concept.

2. Gain knowledge on nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.

3. Know about Processing and modification of RNA and translation process, function and regulation of expression.

Semester – IV
CC – 9[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC402
Course Title – Plant Ecology and Phytogeography
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Introduction (4 lectures) Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.
Unit 2: Soil (8 lectures) Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.
Unit 3: Water (4 lectures) Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.
Unit 4: Light, temperature, wind and fire (6 lectures) Variations; adaptations of plants to their variation.
Unit 5: Ecosystems (4 lectures) Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.
Unit 6: Population ecology (4 lectures) Characteristics and Dynamics .Ecological Speciation
Unit 7: Plant communities (8 lectures) Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes,

types; climax concepts.
Unit 5: Biotic interactions (2 lectures) Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.
Unit 9: Functional aspects of ecosystem (8 lectures) Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.
Unit 10: Phytogeography (12 lectures) Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation.
Practical
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 of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
5. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
6. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each). (b). Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants).
8. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
9. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
10. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
11. Field visit to familiarise students with ecology of different sites.

Course outcome:

After the completion of the course the students will be able to:

1. Develop knowledge on the cognitive development and get the latest exposure in the domain of plant sciences.

2. Develop a knowhow for the development of the proper description of the different environmental issues.

3. Internalization of the concept of conservation and evolution through the channel of the spirit

of enquiry.

Semester – IV
CC – 10[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC403
Course Title – Plant Systematics
Course Instructors – Dr. Avishek Dey and Keya Sarkar

Syllabus:

Unit 1: Significance of Plant systematics (12 lectures) 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.

Unit 2: Taxonomic hierarchy (6 lectures) Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

Unit 3: Botanical nomenclature (10 lectures) Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit 4: Systems of classification (12 lectures) 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.

Unit 5: Biometrics, numerical taxonomy and cladistics (10 lectures) Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit 6: Phylogeny of Angiosperms (12 lectures) Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram only).

Practical

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 & Hooker's system of classification):

Malvaceae - *Sida / Abutilon.*
Acanthaceae - *Ruellia/Barleria*
Fabaceae - *Tephrosia/Crotalaria*
Verbenaceae - *Lantana/Vitex*
Asteraceae - *Vernonia/Ageratum, Eclipta/Tridax*
Solanaceae - *Solanum /Nicotiana*
Lamiaceae - *Leucas/Ocimum*
Euphorbiaceae - *Euphorbia / Jatropha*
Liliaceae - *Lilium/Allium*
Poaceae - *Triticum/Andropogon*

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).

Course outcome:

After the completion of the course the students will be able to learn about systematic beauty of the angiosperms especially diversity of angiosperms along with its identification.

Semester – IV
SEC – 2 [Credit – 2 (L)]
Course Code – BBOTSEHT405
Course Title - Herbal Technology
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1:Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants. (6 Lectures)
Unit 2:Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.(6 Lectures)
Unit 3:Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster). (6 Lectures)
Unit 4:Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds) (8 Lectures)
Unit 5:Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy) (4 Lectures)

Course outcome:

After the completion of the course the students will be able to:

1. Gain knowledge about different herbal and medicinal plants of India
2. Know about the phytochemistry and active principles of these plants and utilize them to make commercially available drugs.
3. Develop conceptual skill about traditional Indian medicinal system, herbal medicines, their processing, storage and marketing.

Semester – V
CC –11[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC501
Course Title – Reproductive Biology of Angiosperms
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Introduction (4 lectures) 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.
Unit 2: Reproductive development (6 lectures) Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.
Unit 3: Anther and pollen biology (10 lectures) 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.
Unit 4: Ovule (10 lectures) Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac.
Unit 4: Pollination and fertilization (6 lectures) Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.
Unit 5: Self incompatibility (10 lectures) Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization;
Cybrids, in vitro fertilization.
Unit 6: Embryo, Endosperm and Seed (10 lectures) 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 Paeonia. Seed structure, importance and dispersal mechanisms
Units 7: Polyembryony and apomixis (6 lectures) Introduction; Classification; Causes and applications.
Practical
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.
3. 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 differentmedia using hanging drop method.
4. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).
5. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
6. Intra-ovarian pollination; Test tube pollination through photographs.
7. Endosperm: Study of different types..
8. Embryogenesis: Study of development of dicot embryo through permanent slides.

Course outcome:

1. Students will have the pleasure of the cognitive development and get the latest exposure in the domain of the reproductive biology plant sciences.

2. Skill development of for the proper description of the different plant reproduction issues
3. Internalization of the concept of plants reproductive behavioural pattern through the channel of the spirit of enquiry.

Semester – V
CC –12[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC502
Course Title – Plant Physiology
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Plant-water relations (10 lectures) 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.
Unit 2: Mineral nutrition (8 lectures) 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.
Unit 3: Nutrient Uptake (8 lectures) 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.
Unit 4: Translocation in the phloem (8 lectures) Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.
Unit 5: Plant growth regulators (14 lectures) Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.
Unit 6: Physiology of flowering (6 lectures) Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.
Unit 7: Phytochrome , crytochromes and phototropins (6 lectures) Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

Practical

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 study the phenomenon of seed germination (effect of light).
6. To study the induction of amylase activity in germinating barley grains.

Demonstration experiments

1. To demonstrate suction due to transpiration.
2. Fruit ripening/Rooting from cuttings (Demonstration).
3. Bolting experiment/Avena coleptile bioassay (demonstration).

Course Outcome:

After the completion of the course the students will be able to:

1. Gain knowledge on the role of physiological processes for plant growth and development.

2. Learn symptoms of mineral deficiency in crops and their management.

3. Assimilate knowledge about Biochemical constitution of plant diversity.

Semester – V
DSE – 1 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSHC1
Course Title – Industrial and Environmental Microbiology
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Scope of microbes in industry and environment (6 lectures)
Unit 2: Bioreactors/Fermenters and fermentation processes (12 lectures) 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.
Unit 3: Microbial production of industrial products (12 lectures) 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)
Unit 4: Microbial enzymes of industrial interest and enzyme immobilization (8 lectures) Microorganisms for industrial applicationsand 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).
Unit 5: Microbes and quality of environment.(6 lectures) Distribution of microbes in air; Isolation of microorganisms from soil, air and water.
Unit 6: Microbial flora of water. (8 lectures) 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.
Unit 7: Microbes in agriculture and remediation of contaminated soils. (8 lectures) Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.
Practical
1.Principles and functioning of instruments in microbiology laboratory
2.Hands on sterilization techniques and preparation of culture media.

Course Outcome:

1. Studying industrial microbiology to exploit microorganisms for a specific product or use as commercial level.
2. Students will learn about bioreactors/fermenters and fermentation processes.

Semester – V
DSE – 3 [Credit – 5 (L)+1(Tu)]
Course Code – BBOTDSHT3
Course Title – Plant Breeding
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Plant Breeding (2 lectures) Introduction and objectives. Modes of reproduction in crop plants.
Unit 2: Methods of crop improvement (20 lectures) 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.
Unit 3: Quantitative inheritance (4 lectures) Concept, mechanism with examples of inheritance.Monogenic vs polygenic Inheritance.
Unit 4:Heterosis (4 lectures) Theories and Applications.
Unit 5: Crop improvement and breeding (10 lectures) Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

Project / Dissertation / Seminar / Review work and Viva-voce (20 lectures)

Course Outcome:

To develop conceptual skill about the plant breeding and method of crop improvement.

Semester – VI
CC –13[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC601
Course Title – Plant Metabolism
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Concept of metabolism (6 lectures) Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes).
Unit 2: Carbon assimilation (14 lectures) 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_2 reduction, photorespiration, C4 pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction.
Unit 3: Carbohydrate metabolism (2 lectures) Synthesis and catabolism of sucrose and starch.
Unit 4: Carbon Oxidation (10 lectures) 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.
Unit 5: ATP-Synthesis (8 lectures) 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.
Unit 6: Lipid metabolism (8 lectures) Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.
Unit 7: Nitrogen metabolism (8 lectures) Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes);Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.
Unit 8: Mechanisms of signal transduction (4 lectures) Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade.
Practical
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 during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.

Course Outcome:

After the completion of the course the students will be able to:

1. Understand basic functions and intermediary metabolism in a plant body.

2. Gain knowledge on the role of physiological and metabolic processes for plant growth and development.

Semester – VI
CC –14[Credit – 4 (L)+2(P)]
Course Code – BBOTCCHC602
Course Title – Plant Biotechnology
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Plant Tissue Culture (16 lectures) 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).

Unit 2: Recombinant DNA technology (12 lectures) 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).
Unit 3:Gene Cloning (10 lectures) 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
Unit 4: Methods of gene transfer (8 lectures) Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).
Unit 5: Applications of Biotechnology (14 lectures) Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines;
Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.
Practical
1. (a) Preparation of MS medium. (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & 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: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.

Course Outcome:

After the completion of the course the students will be able to:

1. Have knowledge and skill in plant tissue culture, plant molecular biology and transgenic.
2. Understand the basic tools and techniques used in Plant tissue culture.

Semester – VI
DSE – 5 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSHC5
Course Title – Analytical Techniques in Plant Sciences
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Imaging and related techniques (15 lectures) 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.
Unit 2: Cell fractionation (8 lectures) Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes.
Unit 3: Radioisotopes (4 lectures) Use in biological research, auto-radiography, pulse chase experiment.
Unit 4: Spectrophotometry (4 lectures) Principle and its application in biological research.
Unit 5: Chromatography (8 lectures) Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.
Unit 6: Characterization of proteins and nucleic acids (6 lectures) Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and
nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE
Unit 7:Biostatistics (15 lectures) 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.
Practical
1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
7. Preparation of permanent slides (double staining).

Course Outcome:

After the completion of the course the students will be able to:

1. Understand instruments, techniques, lab etiquettes and good lab practices necessary for working in a laboratory.

2. Develop skill in different microscopic techniques.

3. Gain knowledge on applications of radiolabelling techniques, spectroscopy and chromatographic techniques in analysis biomolecules.

4. Have comprehensive concept on analytical techniques used for DNA, RNA and proteins.

Semester – VI
DSE – 6 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSHC6
Course Title – Stress Biology
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Defining plant stress (2 lectures) Acclimation and adaptation.

Unit 2: Environmental factors (20 lectures) Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction; Pathogenesis– related (PR) proteins; Systemic acquired resistance; Mediation of insect and disease resistance by jasmonates.

Unit 3: Stress sensing mechanisms in plants (20 lectures) Calcium modulation, Phospholipid signaling

Unit 4: Developmental and physiological mechanisms that protect plants against environmental stress (12 lectures) Adaptation in plants; Changes in root: shoot ratio; Aerenchyna development; Osmotic adjustment; Compatible solute production.

Unit 5: Reactive oxygen species–Production and scavenging mechanisms. (6 lectures)

Practical

1. Quantitative estimation of peroxidase activity in the seedlings in the absence and presence of salt stress.

2. Superoxide activity in seedlings in the absence and presence of salt stress.

3. Viability testing of seeds affects heat stress through TTC method.

4. Estimation of superoxide anions.

5. Demonstration of photograph of zymographic analysis of catalase.

Course Outcome:

1. Skill development of for the proper description of the plant health & disease consequences.
2. Internalization of the concept of plant defence mechanisms.

Botany (Program) syllabus, lesson plan and course outcome

Semester – I
CC – 1 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCRC101
Course Title - Biodiversity (Microbes, Algae, Fungi and Archegoniate)
Course Instructors – Dr. Avishek Dey and Keya Sarkar

Syllabus:

Unit 1: Microbes (10 Lectures) 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.

Unit 2: Algae (12 Lectures) General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae.

Unit 3: Fungi (12 Lectures) 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 Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota), Puccinia,
Agaricus (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 4: Introduction to Archegoniate (2 Lectures) Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Unit 5: Bryophytes (10 Lectures) General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of Sphagnum.

Unit 6: Pteridophytes (8 Lectures) General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical
importance of Pteridophytes.

Unit 7: Gymnosperms (6 Lectures) General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus. (Developmental details not to be included). Ecological and economical importance.

Practical

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Oedogonium, Vaucheria, Fucus* and Polysiphonia through temporary

preparations and permanent slides. (* Fucus - Specimen and permanent slides)
5. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. Alternaria: Specimens/photographs and tease mounts.
7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. Selaginella- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. Equisetum- 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).
15. 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).
16. Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. Pinus- 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. & r.l.s. stem (permanent slide).

Course Outcome:

After the completion of the course the students will be able to:

1. Develop understanding about the classification and diversity of Bacteria, viruses, Algae, Fungi & Lichens & their economic importance.

2. Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens.

3. Gain knowledge about developing commercial enterprise of microbial products.

4. Understand the structure and lifecycles of certain selected Algae and Fungi.

5. Develop critical understanding on morphology, anatomy, reproduction, affinities and evolutionary significance of Bryophytes, Pteridophytes and Gymnosperms.

6. Understand the process of plant evolution and their transition to land habitat.

Semester – II
CC – 2 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCRC201
Course Title - Plant Ecology and Taxonomy
Course Instructors – Dr. Avishek Dey and Keya Sarkar

Syllabus:

Unit 1: Introduction (2 Lectures)
Unit 2: Ecological factors (10 Lectures) 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.
Unit 3: Plant communities (6 Lectures) Characters; Ecotone and edge effect; Succession; Processes and types.
Unit 4: Ecosystem (8 Lectures) Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous
Unit 5: Phytogeography (4 Lectures) Principle biogeographical zones; Endemism
Unit 6 Introduction to plant taxonomy (2 Lectures) Identification, Classification, Nomenclature.
Unit 7 Identification (4 Lectures) Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access.
Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. (6 Lectures)
Unit 9 Taxonomic hierarchy (2 Lectures) Ranks, categories and taxonomic groups
Unit 10 Botanical nomenclature (6 Lectures) Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.
Unit 11 Classification (6 Lectures) Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).
Unit 12 Biometrics, numerical taxonomy and cladistics (4 Lectures) Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences)
.
Practical

1. Determination of pH, and analysis of two soil / water samples for carbonates, chlorides, nitrates, sulphates, organic matter by rapid kit 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 (Cuscuta), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
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)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
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 & Hooker's system of classification):Malvaceae - *Sida / Abutilon*;

Asteraceae - *Vernonia / Ageratum, Eclipta / Tridax*;
Solanaceae -*Solanum nigrum, Withania*; Lamiaceae - *Leucas, Ocimum*; Liliaceae - *Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted with record book).

Course outcome:

After the completion of the course the students will be able to:

1. Develop knowledge on the cognitive development and get the latest exposure in the domain of plant sciences.

2. Develop a knowhow for the development of the proper description of the different environmental issues.

3. Internalization of the concept of conservation and evolution through the channel of the spirit of enquiry.
4. To learn about systematic beauty of the angiosperms especially diversity of angiosperms along with its identification.

Semester – III
CC – 3 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCRC301
Course Title - Plant Anatomy and Embryology
Course Instructor – Keya Sarkar

Syllabus:
Unit 1: Meristematic and permanent tissues (8 Lectures) Root and shoot apical meristems; Simple and complex tissues.
Unit 2: Organs (4 Lectures) Structure of dicot and monocot root stem and leaf.
Unit 3: Secondary Growth (8 Lectures) Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).
U nit 4: Adaptive and protective systems (8 Lectures) Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.
Unit 5: Structural organization of flower (8 Lectures) Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.
Unit 6: Pollination and fertilization (8 Lectures) Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.
Unit 7: Embryo and endosperm (8 Lectures)
Endosperm types, structure and functions; Dicot and monocot embryo; Embryoendosperm relationship.
Unit 8: Apomixis and polyembryony (8 Lectures) Definition, types and practical applications.

Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous / campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Course outcome:

After the completion of the course the students will be able to develop concept and knowledge on anatomical details and embryology of angiosperm.

Semester – III
SEC – 1 [Credit – 2 (L)]
Course Code – BBOTSERT304
Course Title - Biofertilizers
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1:General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.
(4 lectures)

Unit 2:Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. (8 lectures)

Unit 3:Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.(4 lectures)

Unit 4: 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.
(8 lectures)

Unit 5: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. (6 lectures)

Course outcome:

After the completion of the course the students will be able to understand the different types and importance of biofertilizers in nursery and gardening as well as in agriculture for a sustainable future.

Semester – IV
CC – 4 [Credit – 4 (L)+2(P)]
Course Code – BBOTCCRC401
Course Title - Plant Physiology and Metabolism
Course Instructor – Dr. Avishek Dey

Syllabus:

U nit 1: Plant-water relations (8 Lectures) Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.
U nit 2: Mineral nutrition (8 Lectures) 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.
Unit 3: Translocation in phloem (6 Lectures) Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.
Unit 4: Photosynthesis (12 Lectures) 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.
Unit 5: Respiration (6 Lectures) Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.
Unit 6: Enzymes (4 Lectures) Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.
Unit 7: Nitrogen metabolism (4 Lectures) Biological nitrogen fixation; Nitrate and ammonia assimilation.
Unit 8: Plant growth regulators (6 Lectures) Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.
Unit 9: Plant response to light and temperature (6 Lectures) Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Practical
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.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in

photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)
1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Course Outcome:
After the completion of the course the students will be able to:

1. Understand basic functions and intermediary metabolism in a plant body.

2. Gain knowledge on the role of physiological and metabolic processes for plant growth and development.

3. Learn symptoms of mineral deficiency in crops and their management.

Semester – IV
SEC – 2 [Credit – 2 (L)]
Course Code – BBOTSERT404
Course Title - Herbal Technology
Course Instructor – Dr. Avishek Dey

Syllabus:
Unit 1:Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants. (6 Lectures)
Unit 2:Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.(6 Lectures)
Unit 3:Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster). (6 Lectures)
Unit 4:Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds) (8 Lectures)
Unit 5:Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy) (4 Lectures)

Course outcome:

After the completion of the course the students will be able to:

1. Gain knowledge about different herbal and medicinal plants of India
2. Know about the phytochemistry and active principles of these plants and utilize them to make commercially available drugs.
3. Develop conceptual skill about traditional Indian medicinal system, herbal medicines, their processing, storage and marketing.

Semester – V
DSE-1 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSRC1
Course Title - Economic Botany and Biotechnology
Course Instructors – Dr. Avishek Dey and Keya Srkar

Syllabus:

Unit 1: Origin of Cultivated Plants (4 Lectures) Concept of centres of origin, their importance with reference to Vavilov's work
Unit 2: Cereals (4 Lectures) Wheat -Origin, morphology, uses
Unit 3: Legumes (6 Lectures) General account with special reference to Gram and soybean
Unit 4: Spices (6 Lectures) General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)
Unit 5: Beverages (4 Lectures) Tea (morphology, processing, uses)
Unit 6: Oils and Fats (4 Lectures) General description with special reference to groundnut
Unit 7: Fibre Yielding Plants (4 Lectures) General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)
Unit 8: Introduction to biotechnology (2 lecture)
Unit 9: Plant tissue culture (8 Lectures) Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications
Unit 10: Recombinant DNA Techniques (18 Lectures) 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 Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

Practical

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical 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.

Course Outcome:

After the completion of the course the students will be able to:

1. Have knowledge & skill in plant tissue culture, plant molecular biology and transgenic.
2. Understand the basic tools and techniques used in Plant tissue culture.
3. Identify the major economically important plants and their role in civilization.
4. Use evidenced-based comparative knowledge and the propagation of plants with respect to environmental conditions.

Semester – V
DSE-2 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSRC2
Course Title - Cell and Molecular Biology
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Techniques in Biology (8 Lectures) Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.
Unit 2: Cell as a unit of Life (2 Lectures) The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.
Unit 3: Cell Organelles (20 Lectures) Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA.Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplastDNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes:Structures, composition, functions in animals and plants and biogenesis. Nucleus:Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).
Unit 4: Cell Membrane and Cell Wall (6 Lectures) The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.
Unit 5: Cell Cycle (6 Lectures) Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.
Unit 6: Genetic material (6 Lectures) DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ø (theta) mode of replication, replication of linear, ds- DNA, replicating the 5′end of linear chromosome including replication enzymes.
Unit 7: Transcription (Prokaryotes and Eukaryotes) (6 Lectures) Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.
Unit 8: Regulation of gene expression (6 Lectures) Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.

Practical
1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and

electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Demonstration of dialysis of starch and simple sugar.
7. Study of plasmolysis and deplasmolysis on Rhoeo leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph (from Gerald Karp)Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
10. Study DNA packaging by micrographs.
11. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Course Outcome:

After the completion of the course the students will be able to:

1. Understanding the mechanism and concepts of life process at molecular level through central dogma concept.

2. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.

3. Know about Processing and modification of RNA and translation process, function and regulation of expression.

Semester – V
SEC-3 [Credit – 2 (L)]
Course Code – BBOTSERT504
Course Title - Etnobotany
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Ethnobotany Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. (6 Lectures)
Unit 2: Methodology of Ethnobotanical studies a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places. (6 Lectures)
Unit 3: Role of ethnobotany in modern Medicine Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo.* d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina*, *Trichopus zeylanicus,*
Artemisia,Withania. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). (10 Lectures)

Unit 4: Ethnobotany and legal aspects Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge. (8 Lectures)

Course Outcome:

After the completion of the course the students will be able to learn about various medicinal plants, active principles and their therapeutic uses.

Semester – VI
DSE-3 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSRC3
Course Title - Genetics and Plant Breeding
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Mendelian genetics and its extension (8 lectures)
Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy.

Unit 2: Extrachromosomal Inheritance (6 lectures) Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail.
Unit 3: Linkage, crossing over (6 lectures) Linkage and crossing over-Cytological and molecular basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence.

Unit 4: Variation in chromosome number and structure (8 lectures) Deletion, Duplication, Inversion, Translocation, Euploidy and Aneuploidy.
Unit 5: Gene mutations (4 lectures) Types of mutations; Molecular basis of mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents).
Unit 6. Population Genetics (4 lectures) Basic idea, Hardy-Weinberg Law.

Unit 7. Plant Breeding (8 lectures) Introduction and objectives; Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods; Hybridization: Procedure, advantages and limitations.

Unit 8: Crop improvement and breeding (6 lectures) Role of mutations; Polyploidy; role of biotechnology in crop improvement.
Practical
1. Idea about pretreatment, fixation, staining and smear preparation.

2. Mitosis through temporary squash preparation with special reference to root of *Allium sp*.
3. Mendalian and Non-Mendalian inheritance through seed ratios.

Course Outcome:

After the completion of the course the students will be able to:

1. Interpret the Mendel's principles; acquire knowledge on cytoplasmic inheritance and sex-linked inheritance.

2. Develop conceptual skill about the plant breeding and method of crop improvement.

Semester – VI
DSE-4 [Credit – 4 (L)+2(P)]
Course Code – BBOTDSRC4
Course Title - Analytical Techniques in Plant Sciences
Course Instructor – Dr. Avishek Dey

Syllabus:

Unit 1: Principles of microscopy (8 lectures); Light microscopy; Fluorescence microscopy; Confocal microscopy; Transmission and Scanning electron microscopy Unit 2: Centrifugation (6 lectures): Principle and application of differential and density gradient centrifugation.
Unit 3: Spectroscopy (4 lectures) Principle and its application in biological research (UV-Vis and IR).
Unit 4: Chromatography (6 lectures) Principle and types.
Unit 5: Characterization of proteins and nucleic acids (4 lectures) using Gel electrophoresis
Unit 6:Biostatistics (5 lectures) Arithmetic mean, mode, median; standard deviation.

Practical
1. Photographs of different analytical instruments used in Plant sciences.

2. Observation of double stained permanent slides of plant samples using light microscopy.

3. Photographs of different Blotting techniques.
4. Separation of amino acid through TLC.

Course Outcome:

After the completion of the course the students will be able to:

1. Understand instruments, techniques, lab etiquettes and good lab practices necessary for working in a laboratory.

2. Develop skill in different microscopic techniques.

3. Gain knowledge on applications of radiolabelling techniques, spectroscopy and chromatographic techniques in analysis biomolecules.

4. Have comprehensive concept on analytical techniques used for DNA, RNA and proteins.

Semester – VI
SEC-3 [Credit – 2 (L)]
Course Code – BBOTSERT604
Course Title - Nursery and Gardening
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. (4 Lectures)

Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification. (6 Lectures)

Unit 3:Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glass house. (6Lectures)

Unit 4: Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.
(8 Lectures)

Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic,tomatoes, and carrots - Storage and marketing procedures. (6 Lectures)

Course Outcome:

To develop in depth knowledge about nursery and gardening. Gain knowledge about developing commercial enterprise of nursery.

Botany (Generic Elective) syllabus, lesson plan and course outcome

Semester – I
GE [Credit – 4 (L)+2(P)]
Course Code – BBOTGEHC6
Course Title - Plant Ecology and Taxonomy
Course Instructor – Keya Sarkar

Syllabus:

Unit 1: Introduction (2 Lectures)

Unit 2: Ecological factors (10 Lectures) 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.

Unit 3: Plant communities (6 Lectures) Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 4: Ecosystem (8 Lectures) Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous
Unit 5: Phytogeography (4 Lectures) Principle biogeographical zones; Endemism
Unit 6 Introduction to plant taxonomy (2 Lectures) Identification, Classification, Nomenclature.
Unit 7 Identification (4 Lectures) Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access.
Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. (6 Lectures)
Unit 9 Taxonomic hierarchy (2 Lectures) Ranks, categories and taxonomic groups
Unit 10 Botanical nomenclature (6 Lectures) Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.
Unit 11 Classification (6 Lectures) Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).
Unit 12 Biometrics, numerical taxonomy and cladistics (4 Lectures) Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences)
.
Practical

1. Determination of pH, and analysis of two soil / water samples for carbonates, chlorides, nitrates, sulphates, organic matter by rapid kit 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 (Cuscuta), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
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)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
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 & Hooker's system of classification):Malvaceae - *Sida / Abutilon*; Asteraceae - *Vernonia / Ageratum, Eclipta / Tridax*; Solanaceae -*Solanum nigrum, Withania*; Lamiaceae - *Leucas, Ocimum*; Liliaceae - *Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted with record book).

Course outcome:

After the completion of the course the students will be able to:

1. Develop knowledge on the cognitive development and get the latest exposure in the domain of plant sciences.

2. Develop a knowhow for the development of the proper description of the different environmental issues.

3. Internalization of the concept of conservation and evolution through the channel of the spirit of enquiry.

4. To learn about systematic beauty of the angiosperms especially diversity of angiosperms along with its identification.

Semester – II
GE [Credit – 4 (L)+2(P)]
Course Code – BBOTGEHC6A
Course Title - Plant Physiology and Metabolism
Course Instructor – Dr. Avishek Dey

Syllabus:

U nit 1: Plant-water relations (8 Lectures) Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

U nit 2: Mineral nutrition (8 Lectures) 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.

Unit 3: Translocation in phloem (6 Lectures) Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 4: Photosynthesis (12 Lectures) 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.

Unit 5: Respiration (6 Lectures) Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit 6: Enzymes (4 Lectures) Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Nitrogen metabolism (4 Lectures) Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit 8: Plant growth regulators (6 Lectures) Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Unit 9: Plant response to light and temperature (6 Lectures) Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Practical

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.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.

7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)
1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Course Outcome:
After the completion of the course the students will be able to:

1. Understand basic functions and intermediary metabolism in a plant body.

2. Gain knowledge on the role of physiological and metabolic processes for plant growth and development.

3. Learn symptoms of mineral deficiency in crops and their management.