ANNEXURE I

Department of Biological Sciences, Aliah University, Newtown, Kolkata

Syllabus for the 3 Years B.Sc. Honours Degree in Botany

(2016-17 & 2017-18 batches)

Overall Curriculum

Semester	Theory			Practical		
	Course Code	Course Title	Marks/ Credits	Course Code	Course Title	Marks/Credits
I	BB101	Algae & Fungi	50/4	BB191	Practical I	50/4
	BB103	Bryophytes, Litchens & Plant Pathology	50/4			
	BZ131	Subsidiary Theory	50/4			
	CH131	Subsidiary Theory	50/4			
	EN131	Subsidiary Theory	50/4			
II	BB102	Biology and diversity of Pteridophytes, Gymnosperms	50/4			
	BB104	Paleobotany and Paleonology, Morphology & Embryology of Angiosperms	50/4			
	BB106	Systematics of Angiosperms	50/4			
	BZ132	Subsidiary Theory	50/4			
	CH132	Subsidiary Theory	50/4			
	AI132	Subsidiary Theory	50/4			
III	BB201	Plant Physiology	50/4	BB291	Practical II	50/4
	BZ231	Subsidiary Theory	50/4	BZ261	Subsidiary Practical	50/4
	CH231	Subsidiary Theory	50/4	CH261	Subsidiary Practical	50/4
IV	BB202	Biotechniques and Biostatistics	50/4	BB 292	Practical III	50/4
	BZ232	Subsidiary Theory	50/4	BZ262	SubsidiaryPractical	50/4
	CH232	Subsidiary Theory	50/4	CH262	SubsidiaryPractical	50/4
V	BB301	Immunology	50/4	BB391	Practical IV	50/4
	BB303	Plant Anatomy	50/4			
	BB305	Cell & Molecular Biology	50/4			
	BB307	Biochemistry	50/4			
	EN331	ENVS	50/4			
VI	BB302	Plant Biotechnology	50/4	BB392	Practical V	50/4
	BB304	Economic Botany	50/4	BB382	Project work/Review writing	50/4
	BB306	Genetics & Genomics	50/4			
	BB308	Ecology	50/4			
Total			1300/104			500/40
Grand Total	**1800 Marks / 144 Credits**					

ANNEXURE I

Syllabus for the 3 Years B.Sc. Honours Degree

Subsidiary Botany

Overall Curriculum

Sl. No.	Course Structure	Sem	Course Code	Course Title	Full Marks	Credit
1	Botany (Sub)	I	BB 131	Plant Diversity	50	4
2	Botany (Sub)	II	BB 132	Plant Anatomy and Embryology	50	4
3	Botany (Sub)	III	BB 231	Plant Ecology and Taxonomy	50	4
4	Botany (Sub)	III	BB 261	Practical Plant Ecology and Taxonomy	50	4
5	Botany (Sub)	IV	BB 232	Economic Botany and Plant Tissue Culture	50	4
6	Botany (Sub)	IV	BB 262	Practical Economic Botany and Plant Tissue Culture	50	4

Semester I

BB101

Algae & Fungi

Total Marks 50, Credits 4

Unit 1: Algae **Hour: 6h**

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; and 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).

Unit 2: Cyanophyta **Hour: 3h**

Ecology and occurrence, range of thallus organization, cell structure, heterocyst, reproduction.economic importance; role in biotechnology. Morphology and life-cycle of Nostoc.

Unit 3: Chlorophyta **Hour: 8h**

General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium, Coleochaete. Evolutionary significance of Prochloron.

Unit 4: Charophyta **Hour: 3h**

General characteristics; occurrence, morphology, cell structure and life-cycle of Chara; evolutionary significance.

Unit 5: Xanthophyta **Hour: 3h**

General characteristics; range of thallus organization;Occurrence, morphology and life-cycle of Vaucheria.

Unit 6: Phaeophyta **Hour: 4h**

Characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of Ectocarpus and Fucus.

Unit 7: Rhodophyta **Hour: 3h**

General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycle of Polysiphonia.

Unit 8: Applied Phycology and mycology **Hour: 3h**

Role of algae and fungi in the environment, medicine, agriculture, biotechnology and industry.

Unit 9: Introduction to true fungi **Hour: 4h**

Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cellwall composition; Nutrition; Classification.

Unit 10: Chytridiomycota **Hour: 3h**

General account

Unit 11: Zygomycota **Hour: 3h**

General characteristics; Ecology; Thallus organisation; Life cycle with reference to Rhizopus.

Unit 12: Ascomycota **Hour: 7h**

General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to Saccharomyces, Aspergillus,Penicillium, Alternaria and Neurospora, Peziza.

Unit 13: Basidiomycota **Hour: 4h**

General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symptoms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation.

Unit 14: Allied Fungi **Hour: 3h**

General characterises; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

Unit 15: Oomycota **Hour: 3h**

General characteristic; Ecology; Life cycle and classification with reference to Phytophthora, Albugo

BB103
Bryophytes, Lichens, Plant Pathology

Total Marks 50, Credits 4

Unit 1: Bryophytes **hour: 24h**

General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family).Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends in Riccia, Marchantia , Anthoceros and Funaria (developmental stages not included).Ecological and economic importance of bryophytes with special reference toSphagnum.

Unit 2: Lichens **hour: 16h**

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 3: Plant Pathology **hour: 20h**

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 disease of Cotton.Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, white rust of crucifers.

BB 191
PRACTICAL – I

Unit I

1. Good laboratory practices
2. Preparation of solutions based on molarity, normality, percentage, dilutions
3. Preparation of buffers
4. Study the working of a light microscope

Unit II

1. Morphological studies of lichen-Crustose, fruitcose & foliose,*Ascobolus*,*Agaricus,Cyathus, Lycoperdon, Polyporus*
2. Study of pathological specimens of- late blight of potato, loose smut of heat, brown spot of rice, red rotof sugarcane, citrus canker
3. Study of vegetative and reproductive structures of the following(At least five)
    a. Nostoc
    b. Chlamydomonas
    c. Volvox
    d. Oedogonium
    e. Coleochaete
    f. Chara
    g. Vaucheria
    h. Ectocarpus
    i. Fucus
    j. Polysiphonia
    k. Procholoron

    -through electron micrographs, temporary preparations and permanent slides.

Semester II

BB 102
Biology and Diversity of Pteridophytes, Gymnosperms

Total Marks 50, Credits 4

Unit 1: Pteridophytes **Hour: 6h**

General characteristics and classification of pteridophytes: general features of sporophyte and gametophyte, habitat diversity; Stewart & Rothwell 1994 classification with examples. Structures and life history: basic concepts of life cycle patterns of homosporous heterosporous pteridophytes.

Unit 2: Reproduction in pteridophytes **Hour: 14h**

Vegetative and reproductive morphology of sporophyte, structure and development of gametophyte and embryology of the following: *Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum, Marsilea.*

Unit 3:Fossil gymnosperms **Hour: 6h**

General account of fossil taxa: Rhyniopsida-general characters, distribution (geological & geographical) and life cycle of Rhynia. Zosterophyllopsida- general characters, structural and anatomical features of Lepidodendron and Calamites, and cause of their extinction.

Unit 4:Origin & evolution of algae- **Hour: 4h**

Algal origin of pteridophytes, significance of telome concepts in the psilopsida, lycopsida, sphenopsida, and pteropsida. Economic importances of pteridophytes as food, medicine, and agriculture.

Unit 5: Progymnosperms- **Hour: 6h**

diagnostic features of the group, vegetative and reproductive features of Archaeopteris. Phylogenetic importance of the group in the origin of gymnospermous stele. Brief character diversity in gymnosperm, habitat, classification of gymnosperm (Stewart & Rothwell 1993) with characters and examples.

Unit 6:Gymnosperms- **Hour: 12h**

Study of life history: vegetative and reproductive morphology of sporophytes, wood anatomy, development of gametophyte, embryogeny and life history of- Cycas, Pinus, Gnetum, Ginkgo. Indian distribution of each taxa.

Unit 7:Fossil gymnosperms- **Hour: 10h**

Pteridospermales, general characters of the order and structural features. Geological distribution of Lyginopteris oldhamia. Cordaitales: general characters of the order and its role in the origin of seed-cone complex. Bennettitales: general characters of the order, structural features, geological and geographical distribution of Williamsoniasewadiana.

Unit 8: Economic importances of of gymnosperms **Hour: 2h**

BB 104
Paleobotany and Paleonology, Morphology & Embryology of Angiosperms
Total Marks 50, Credits 4

Unit 1:Plant fossil **Hour: 12h**

Types of fossils, modes of preservation (after J. M. Schopf, 1975), conditions favouring fossilization. Importance of fossils; geological time scale withdominant plant groups through geological ages; method of radiometric dating with special reference to C14 dating.

Unit 2: Indian Gondwana System- **Hour: 4h**

A brief account of three-fold classification and major megafossil assemblages.

Unit 3:Palynology **Hour: 8h**

Definition, characteristics, polarity, symmetry, shape of spore & pollen. NPC classification and sporedom stratification. Application of palynology with reference to aeropalynology, forensic palynology, melissopalynology, hydrocarbon exploration.

Unit 4: Angiosperm inflorescence **Hour: 12h**

Types of angiosperm inflorescence with examples, Flower, types, parts-calyx (modification). Corolla (forms, aestivation), Stamens (Cohesion and Adhesion), Carpel (Apocarpous and Syncarpous), Placentation types, Ovule structure & types. Pollination: definition & types. Merits & demerits of self & cross-pollination.

Unit 5:Fruits & seeds **Hour: 6h**

Types of fruits & seeds. Dispersal of seeds and fruits. Apomixis: a brief idea of apospory and apogamy.

Unit 6: Fertilization and embryogeny of angiosperms **Hour: 18h**

Pre-fertilization events, microsporogenesis & microgametogenesis; megasporogenesis & megagametogenesis (monosporic, bisporic & tetrasporic); fertilization process; post-fertilization events-embryogenesis in capsella; development & types of endospore, and their functions

BB 106
Systematics of Angiosperms
Total Marks 50, Credits 4

Unit 1: Systematics of Angiosperms **Hour: 8h**

Introduction, Components of Systematic: Nomenclature, Identification, Classification, Taxonomy and its phases - Pioneer, Consolidation, Biosystematic and Encyclopaedic; alpha- and omega- taxonomy.

Unit 2: Nomenclature **Hour: 6h**

Type method, Publication, Rank of taxa, Rules of priority, Retention and rejection of names, Author Citation, Effective and valid publication, Elementary knowledge of ICN- Principles.

Unit 3: Systems of classification **Hour: 10h**

Broad outline of Bentham & Hooker (1862-1883), Cronquist (1988), Takhatajan (1991) - system of classification with merits and demerits, Systematics in Practice: Herbaria and Botanical Gardens – their role in teaching and

research; important Herbaria and Botanical Gardens of India and world (3 each); Dichotomous keys – indented and bracketed.

Unit 4: Phenetics and Cladistics **Hour: 8h**

Brief idea on Phenetics, Numerical taxonomy- methods and significance; Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy.

Unit 5: Data sources in Taxonomy **Hour: 8h**

Supportive evidences from, Phytochemistry, Cytology, Palynology and Molecular biology data (Protein and Nucleic acid homology).

Unit 6: Theories of origin of Angiosperms **Hour: 20h**

Diagnostic features, Systematic position (Bentham & Hooker and Cronquist), Economically important plants (parts used and uses) of the following families: Monocotyledons: Alismataceae, Gramineae (Poaceae), Palmae, Orchidaceae. Dicotyledons :Magnoliaceae, Leguminosae (subfamilies), Malvaceae, Euphorbiaceae, Malvaceae, Umbelliferae (Apiaceae), Labiatae (Lamiaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Rubiaceae, Cucurbitaceae, Compositae (Asteraceae)

Semester III

BB 201
Plant Physiology
Total Marks 50, Credits 4

Unit 1: Plant Physiology **Hour: 6h**

Plant-water relations: Concept of water potential, components of water potential in plant system, Soil-plant-Atmosphere continuum concept, Cavitation in xylem and embolism, Stomatal physiology-mechanism of opening and closing, Role of carbon di-oxide, potassium ion, abscisic acid and blue light in stomatal movement, Antitranspirants.

Unit 2: Organic Translocation **Hour: 2h**

Phloem sap, P-protein, Phloem loading and unloading, Mass-flow (pressure flow) hypothesis and its critical evaluation.

Unit 3: Photosynthesis **Hour: 8h**

Chemical structure of chlorophyll a and b, absorption and action spectra, biological significance of carotenoid pigments, Red drop and Emerson effect, Components of photosystems (light harvesting complex), Photochemical reaction centres, Cyclic and noncyclic electron transport, Water splitting mechanism, Calvin cycle – Biochemical reactions & stoichiometry, HSK Pathway– three variants of the pathway, Photosynthetic efficiency of C3 and C4 plants and crop productivity, Photorespiration – mechanism and significance, Crassulacean Acid metabolism– mechanism and ecological significance.

Unit 4: Respiration **Hour: 10h**

EMP pathway, regulation and its anabolic role, Conversion of Pyruvic acid to Acetyl CoA, TCA-cycle and its amphibolicrole, Oxidative pentose phosphate pathway and its significance, ß-oxidation of fatty acids and significance, Mitochondrial electron transport system, uncouplers, Oxidation of cytosolic NADH+H+ Stoichiometry of glucose oxidation (aerobic).

Unit 5: Nitrogen Metabolism **Hour: 8h**

Assimilation of nitrate by plants, Biochemistry of dinitrogen fixation in nitrogen fixing bacteria, General principle of amino acid biosynthesis (including GS and GOGAT enzyme system).

Unit 6: Plant Growth Regulators **Hour: 6h**

Physiological roles of Auxin, Gibberellin, Cytokinin, Abscisic acid, Ethylene, Chemical nature –IAA, GA3, Kinetin, Biosynthesis and bioassay of IAA, Mode of action of IAA, Brassinosteroids and Polyamines as PGRs

Unit 7: Photomorphogenesis **Hour: 8h**

Concept of photomorphogenesis, Photoperiodism and plant types, Perception of photoperiodic stimulus, Critical day length, concept of light monitoring, Phytochrome – chemical nature, interconversion, function in flowering, Role of GA in flowering, Vernalisation – role of low temperature in flowering, Concept of biological clock and biorhythm .

Unit 8: Seed dormancy **Hour: 6h**

Types, Causes and Methods of breaking seed dormancy, Biochemistry of seed germination.

Unit 9: Physiology of Senescence and Ageing **Hour: 6h**

Physiology and molecular biology of stress: Plant responses to: Water stress, Temperature stress, Salt stres

BB 291
PRACTICAL- II
Total Marks 50, Credits 4

1. Morphological study of the sporophytic plant body: Lycopodium, Ophioglossum, Marsilea and Pteris
2. Workout of reproductive structures: Selaginella, Equisetum, Pteris
3. Study of permanent slides: Psilotum (T.S. of synangium), Lycopodium (L.S. of strobilus), Ophioglossum (L.S. of spike), Marsilea (L.S. of sporocarp)
4. Study of types of inflorescence, flower and fruit with labeled sketches
5. Work out, description, preparation of floral formula and floral diagram: Malvaceae, Fabaceae, Solanaceae, Acanthaceae, Labiatae, Rubiaceae
6. Spot identification (binomial, family) of plants from families included in the theoretical syllabus
7. Morphological study of gymnosperms: Cycas (microsporophyll and megasporophyll), Pinus (male & female cone), Gnetum (L.S. of male cone and ovule)
8. At least four excursions including one long excursion to a specialized phytogeographical zone of India.
9. Study of community structure by quadrat method and determination of (i) minimal size of quadrat (ii) frequency, density, and abundance of components (to be done during excursion)
10. Herbarium specimen: preparation of 25 angiospermic specimens (identified with author citation, voucher number and arranged following Bentham & Hooker's system of classification) to be submitted in the University examination

Semester IV

BB 202
Biotechniques and Biostatistics
Total Marks 50, Credits 4

Unit 1. Bioenergetics **Hours: 4**
First and Second Laws of Thermodynamics; Definition of Gibb's Free Energy, Enthalpy, and Entropy; Mathematical Relationships Among Them; Standard Free Energy Change and Equilibrium Constant; Coupled Reactions And Additive Nature of Standard Free Energy Change; Energy Rich Compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP.

Unit 2. Microscopy: Principles and applications. **Hours: 8**
Principles and applications of - Light microscopy: brightfield and darkfield, Phase contrast microscopy, Fluorescence Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy); Micrometry.

Unit 3. Electromagnetic radiation and Spectrophotometry. **Hours: 8**
Basic principles of electromagnetic radiation: Energy, wavelength, wave numbers and frequency, review of electronic structure of molecules.
UV-visible spectrophotometry: Beer Lambert law, light absorption and its transmittance, factors affecting absorption properties of a chromophore, Principle and use of study of absorption spectra of biomolecules; structural analyses of DNA/ protein using absorption of UV light. Colorimetry and turbidometry
Fluorescence spectroscopy: Theory of fluorescence, static and dynamic quenching, resonance energy transfer, fluorescent probes in the study of protein and nucleic acids.
Mass spectrometry (MALDI-TOF): Physical basis and uses of MS in the analysis of proteins/ nucleic acids.

Unit 4. Radiation Biology. **Hours: 6**
Concept of radioisotopes, types of radioactive decay (gamma and beta emitter), half-life, detection and measurement of radioactivity: methods based upon ionization (GM counter), methods based upon excitation (scintillation counter). Autoradiography, radioisotopes in diagnosis and radiotherapy. Effect of radiations (ionizing and non-ionizing) on living systems, precautions and safety measures in handling radioisotopes.

Unit 5. Chromatography. **Hours: 10**
Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography, Column chromatography: packing and fraction collection. Gel filtration chromatography, ionexchange chromatography and affinity chromatography; GLC, HPLC.

Unit 6. Electrophoresis. **Hours: 6**
Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, Isoelectric focusing, 2D gel electrophoresis; Zymogram preparation; Principle and applications of Agarose gel electrophoresis.

Unit 6. Hydrodynamic methods & Centrifugation **Hours: 10**
Viscosity: Methods of measurement of viscosity, specific and intrinsic viscosity, relationship between viscosity and molecular weight, measurement of viscoelasticity of DNA.
Sedimentation: Principle of centrifugation; Svedberg equation, RCF and sedimentation coefficient; relationship between RPM and RCF; Fixed angle and swinging bucket rotors; differential and density gradient centrifugation, preparative and analytical ultracentrifugation techniques, fractionation of cellular components using centrifugation with examples.
Flow Cytometry: Basic principle of flow cytometry and cell sorting, detection strategies in flow cytometry.

Unit 8. Biostatistics. **Hours: 8**
Data in Biology: samples and populations, techniques of sampling (random and stratified), sampling and non-sampling errors, variables in biology, accuracy, precision, univariate and bivariate frequency distributions and their graphical representations.

Measures of Central Tendency: Arithmetic, geometric and harmonic means, mode, median and partition values. Measures of Dispersion: Range, standard deviation, coefficient of variance and covariance. Skewness and Kurtosis.

Probability: Basic concepts, addition and multiplication rules of probability, conditional probability, Binomial distribution, Poisson distribution, normal distribution and exponential distribution along with their properties and relationships. Test of Hypothesis: Chi square, t Test

BB 292
Practical III

Total Marks 50, Credits 4

Unit I

1. Paper and thin layer chromatography: separation of plant pigments
2. Demonstration of Agarose and SDS Page electrophoresis
3. Effect of different solvents on UV absorption spectra of proteins.
4. Study of structural changes of proteins at different temperature using UV spectrophotometry.
5. Determination of melting temperature of DNA.
6. Study the effect of temperature on the viscosity of a macromolecule (Protein/DNA).
7. Use of viscometry in the study of ligand binding to DNA/protein.

Unit II

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 xerophytes
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces)
6. To study the phenomenon of seed germination (effect of light)
7. To study the effect of different concentrations of IAA on Avena coleoptile elongation (IAA Bioassay)
8. To study the induction of amylase activity in germinating barley grains.

Semester V

BB 301
Immunology
Total Marks 50, Credits 4

Unit 1 Introduction **Hours: 2h**

Concept of Innate and Adaptive immunity; Contributions of eminent scientists in immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa.

Unit 2 Immune Cells and Organs **Hours: 6h**

Immune Cells –T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

Unit 3 Antigens **Hours:6h**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants.

Unit 4 Antibodies **Hours:6h**

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and hybridoma technology

Unit 5 Major Histocompatibility Complex **Hours: 6h**

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)

Unit 6 Complement System **Hours: 6h**

Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation.

Unit 7 Generation of Immune Response **Hours: 10h**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.Principle of vaccination.

Unit 8 Immunological Disorders and Tumor Immunity **Hours: 10h**

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Tumor Immunology

Unit 9 Immunological Techniques **Hours: 8h**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Immunoblotting, Immunofluorescence.

BB 303
Plant Anatomy
Total Marks 50, Credits 4

Unit 1: Introduction and scope of Plant Anatomy **Hours: 4h**
Applications in systematics, forensics and pharmacognosy

Unit 2: Tissues **Hours: 10h**
Classification of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of tracheary elements and sieve elements;Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances.

Unit 3: Stem, leaf and root **Hours: 20h**
Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meri`stematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. 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 of lateral root.

Unit 4: Vascular Cambium **Hours: 6h**
Structure, function and seasonal activity of cambium; Secondary growth in root and stem.

Unit 5: Wood **Hours: 8h**
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.

Unit 6: Adaptive and Protective Systems **Hours: 12h**
Epidermal tissue system, cuticle, epicuticular waxes, trichomes(uni-and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.

BB 305
Cell & Molecular Biology
Total Marks 50, Credits 4

Unit 1 Structure of Cell **Hours: 6h**
Plasma membrane: Structure and transport of small molecules; Cell Wall: Eukaryotic cell wall, Extracellular matrix; Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.

Unit 2 Cell Organelles **Hours: 6h**
Mitochondria, plastids, lysosomes and peroxisomes; Nucleus: Nuclear envelope, nuclear pore complex, nucleolus and nuclear lamina; Chromatin; Endoplasmic Reticulum and Golgi Apparatus.

Unit 3 Cell Cycle, Cell Death and Cell Renewal **Hours: 8h**

Cell cycle, Mitosis and Meiosis; Programmed cell death, Stem cells: Embryonic stem cell, induced pluripotent stem cells.

Unit 4 Structures of DNA and RNA / Genetic Material **Hours: 4h**

DNA structure: Salientfeatures of double helix, Types of DNA, denaturation and renaturation, cot curves. DNA topology: linking number, RNA Structure,

Unit 5 Replication of DNA (Prokaryotes and Eukaryotes) **Hours: 12h**

Bidirectional and unidirectional replication, semi- conservative replicatiojn. DNA polymerases, DNA ligase, primase, telomerase.

Unit 6 Transcription in Prokaryotes and Eukaryotes **Hours: 12h**

Mechanism of Transcription; promoter; RNA Polymerase, transcription unit; Transcription in Eukaryotes: RNA polymerases, general Transcription factors.

Unit 7 Translation (Prokaryotes and Eukaryotes) **Hours: 12h**

Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote. Concept of operon (*lac and trp*).

BB 307
Plant Metabolism
Total Marks 50, Credits 4

Unit 1: Concept of metabolism **Hours: 6h**

Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric,covalent modulation and Isozymes).

Unit 2: Carbon assimilation **Hours: 12h**

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, CO2 reduction, photorespiration, C4pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction.

Unit 3: Carbohydrate metabolism **Hours: 8h**

Synthesis and catabolism of sucrose and starch.

Unit 4: Carbon Oxidation **Hours: 12h**

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 **Hours: 6h**

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 **Hours: 6h**

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 **Hours: 8h**

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 **Hours: 2h**

Concept of signal transduction; Calcium, phospholipids, cGMP and NO mediated signaling.

BB 391
Practical IV
Total Marks 50, Credits 4

Unit I

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample (demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform DOT ELISA.
7. Perform immunoelectrophoresis.

Unit II

1. Study of anatomical details through permanent slides/temporary stain mounts/macerations/ museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).

Unit III

1. Chromatographic 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 germinationg 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 absorption spectrum of photosynthetic pigments

Semester VI

BB 302
Plant Biotechnology
Total Marks 50, Credits 4

Unit 1: Plant Tissue Culture **Hours: 15h**

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 **Hours: 30h**

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 and briefly PAC, MAC, HAC).Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning); Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, PCR; Methods of gene transfer- *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit 3: Applications of Biotechnology **Hours: 15h**

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.

BB 304
Economic Botany
Total Marks 50, Credits 4

Unit 1: Origin of Cultivated Plants **Hours: 6h**

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 diversty.

Unit 2: Cereals **Hours: 6h**

Wheat and Rice (origin, morphology, processing &uses), brief account of millets, Green revolution.

Unit 3: Legumes **Hours: 4h**

General account, importance to man and ecosystem

Unit 4: Sugars & Starches (4 lectures) **Hours: 4h**

Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit 5: Spices **Hours: 4h**
Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper

Unit 6: Beverages **Hours: 4h**
Tea, Coffee (morphology, processing & uses)

Unit 7: Oils & Fats **Hours: 4h**
General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and *Brassica* andCoconut (Botanical name, family & uses)

Unit 8: Essential Oils **Hours: 4h**
General account, extraction methods, comparison with fatty oils & their uses.

Unit 9: Natural Rubber **Hours: 4h**
Para-rubber: tapping, processing and uses.

Unit 10: Drug-yielding plants **Hours: 6h**
Therapeutic and habit-forming drugs with special reference to C*inchona, Digitalis, Papaver* and *Cannabis*

Unit 11: Tobacco **Hours: 4h**
Tobacco (Morphology, processing, uses and health hazards)

Unit 12: Timber plants **Hours: 4h**
General account with special reference to teak and pine

Unit 13: Fibres **Hours: 6h**
Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses).

BB 306
Genetics & Genomics
Total Marks 50, Credits 4

Unit 1: Mendelian genetics and its extension **Hours: 10h**
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 **Hours: 5h**
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 **Hours: 10h**
Linkage and crossing over-Cytological 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 **Hours: 5h**
Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

Unit 5: Gene mutations **Hours: 10h**
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 **Hours: 10h**
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 **Hours: 10h**
Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection mutation, genetic drift.Genetic variation and Speciation.

BB 308
Ecology
Total Marks 50, Credits 4

Unit 1: Introduction **Hours: 6h**
Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.

Unit 2: Soil **Hours: 6h**
Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.

Unit 3: Water **Hours: 6h**
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 **Hours: 6h**
Variations; adaptations of plants to their variation.

Unit 5: Population ecology **Hours: 8h**
Characteristics and Dynamics .Ecological Speciation

Unit 6: Plant communities **Hours: 6h**
Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit 7: Ecosystems **Hours: 6h**
Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids

Unit 8: Functional aspects of ecosystem **Hours: 8h**

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus

Unit 9: Phytogeography **Hours: 8h**

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.

BB 392
Practical V
Total Marks 50, Credits 4

Unit I

1. Preparation of MS medium.
2. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4. Isolation of protoplasts.
5. Construction of restriction map of circular and linear DNA from the data provided.
6. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
8. Isolation of plasmid DNA.
9. Restriction digestion and gel electrophoresis of plasmid DNA.

Unit II

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: Soya bean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. Sugars & 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. Oils & Fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushedseeds.
7. Essential oil-yielding plants: Habit sketch of*Rosa*, V*etiveria, 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. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibreand test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre).

Unit III

1. Meiosis through temporary squash preparation.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.

3. Chromosome mapping using test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
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. Blood Typing: ABO groups & Rh factor.
7. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
8. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
9. Study of human genetic traits: Sickle cell anemia, XerodermaPigmentosum, Albinism, red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe.

Unit IV

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/Lovi bond 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. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources
7. (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

BB 382
Project Work/ Review writing
Total Marks 50, Credits 4

A student has to do a project work / review work in a topic given by his/her supervisor (to be decided by lottery amongst all the teachers present for that Semester) and submit the report/review within a stipulated time. During examination the work has to be presented before an evaluation team (one external member may be invited) and the student will be credited based on the quality of the report and presentation.

ANNEXURE I

Syllabus for the 3 Years B.Sc. Honours Degree
Subsidiary Botany
Overall Curriculum

Sl. No.	Course Structure	Sem	Course Code	Course Title	Full Marks	Credit
1	Botany (Sub)	I	BB 131	Plant Diversity	50	4
2	Botany (Sub)	II	BB 132	Plant Anatomy and Embryology	50	4
3	Botany (Sub)	III	BB 231	Plant Ecology and Taxonomy	50	4
4	Botany (Sub)	III	BB 261	Practical Plant Ecology and Taxonomy	50	4
5	Botany (Sub)	IV	BB 232	Economic Botany and Plant Tissue Culture	50	4
6	Botany (Sub)	IV	BB 262	Practical Economic Botany and Plant Tissue Culture	50	4

Semester I

BB131

Plant Diversity

Total Marks 50, Credits 4

Unit 1: Algae **Hours: 12h**

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 2: Fungi **Hours: 12h**

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 andendomycorrhiza and their significance

Unit 3: Introduction to Archegoniate **Hours: 2h**

Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Unit 4: Bryophytes **Hours: 12h**

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 5: Pteridophytes **Hours: 12h**

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, stellar evolution. Ecological and economical importance of Pteridophytes.

Unit 6: Gymnosperms **Hours: 10h**

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.

Semester II

BB132

Plant Anatomy & Embryology

Total Marks 50, Credits 4

Unit 1: Meristematic and permanent tissues **Hours: 8**

Root and shoot apical meristems; Simple and complex tissues

Unit 2: Organs **Hours: 4**

Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth **Hours: 8**

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)

Unit 4: Adaptive and protective systems **Hours: 8**
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 5: Structural organization of flower **Hours: 8**
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 **Hours: 8**
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm **Hours: 8**
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship

U nit 8: Apomixis and polyembryony **Hours: 8**
Definition, types and Practical applications

Semester III

BB231

Plant Ecology & Taxonomy

Total Marks 50, Credits 4

Unit 1: Introduction **Hours: 2**

Unit 2: Ecological factors **Hours: 10**
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 **Hours: 6**
Characters; Ecotone and edge effect; Succession; Processes and types

Unit 4: Ecosystem **Hours: 8**
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 **Hours: 4**
Principle biogeographical zones; Endemism

Unit 6 Introduction to plant taxonomy **Hours: 2**
Identification, Classification, Nomenclature.

Unit 7 Identification **Hours: 4**
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. **Hours: 6**

Unit 9 Taxonomic hierarchy **Hours: 2**

Ranks, categories and taxonomic groups

U nit 10 Botanical nomenclature **Hours: 6**
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 **Hours: 6**
Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

Unit 12 Biometrics, numerical taxonomy and cladistics **Hours: 4**
Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

Semester III

BB261

Practical I

Total Marks 50, Credits 4

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).
   (b)Study of biotic interactions of the following: Stem parasite (*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):Brassicaceae - *Brassica,Alyssum / Iberis;* Asteraceae -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae -*Solanum nigrum, Withania;* Lamiaceae -*Salvia, Ocimum*; Liliaceae - *Asphodelus / Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Semester IV

BB232

Economic Botany & Plant Tissue Culture

Total Marks 50, Credits 4

Unit 1: Origin of Cultivated Plants **Hours: 6**
Concept of centres of origin, their importance with reference to Vavilov's work.

Unit 2: Cereals **Hours: 6**
Rice & Wheat -Origin, morphology, cultivation, varieties; Green Revolution

Unit 3: Legumes **Hours: 8**
General account with special reference to Gram and soybean

Unit 4: Spices **Hours: 8**
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

U nit 5: Beverages **Hours: 6**
Tea (morphology, processing, uses)

Unit 6: Oils and Fats **Hours: 6**
General description with special reference to groundnut

Unit 7: Fibre Yielding Plants **Hours: 6**
General 4description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to biotechnology **Hours: 2**

U nit 9: Plant tissue culture **Hours: 12**
Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications

Semester IV

BB262

Practical II

Total Marks 50, Credits 4

1. Calculation of leaf area using graphical method
2. Demonstration of plasmolysis and deplasmolysis in epidermal cells of onion
3. Calculation of stomatal index in upper and lower epidermis of plant leaf
4. Demonstration of mitosis from onion root tips
5. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove,, Tea, Cotton, Groundnut through specimens, sections and microchemical tests
6. Familiarization with basic equipments in tissue culture.
7. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.