



Department of Botany
EWING CHRISTIAN COLLEGE
ALLAHABAD

(An Autonomous Constituent College of Allahabad University)

Curriculum for Semester System of Three Year Degree Course

in

Botany

Under

Choice Based Credit System

Aims and Objectives

Plants are the only producers and providers of food, energy, life saving oxygen and other biological services on the earth. The study of Plant Sciences dealing with the structure, function, systematics, origin and evolution of plants, has attracted and inspired many great personalities. Modern Plant Sciences include fusion of knowledge from traditional botany along with frontier aspects of Biochemistry, Molecular Biology, Biotechnology, Bioinformatics and other allied branches of Science and technology. Keeping recent advancements in view and to actively involve student and faculty facilitators in knowledge based activity without diluting the academic standards, Botany Department of Ewing Christian College is proposing new Curriculum of semester system under choice based credit system for three year Undergraduate program (B.Sc.) from session 2015-16 taking care of different aspects of Plant sciences (Diversity of Plants, Systematic, Anatomy, Physiology, Biochemistry, Cytogenetics, Molecular biology, Bioinformatics, Biostatistics, Palaeobotany, Ecology, Biodiversity and Analytical techniques) and giving due weightage, the entire curriculum has been divided into 14 theory papers (each of 70 marks) , 06 Practicals (one in each semester with weightage of 50 marks in semesters I- IV and 75 marks in semesters V-VI) over 6 semesters of total weightage of 42 credits.

In addition the students are given the option of elective paper and skill enhancement paper in VIth semester to ensure following aims and objectives.

- To ensure a comprehensive curriculum in Botany at undergraduate level to meet national interest.
- To provide the curriculum such that it can inspire, attract, enthuse, sustain and promote the interest among students for opting Botany and allied disciplines as their career.
- To provide the opportunity to Undergraduate students of Botany of Ewing Christian College to opt one or more courses in Botany and allied disciplines (Biotechnology, Microbiology, Life Sciences, Environmental Sciences, Genetics and Plant breeding, Food Technology, Bioinformatics) at master level.
- To update course contents in Botany by introducing recent development to ensure academic advantage to young botanists.
- To increase the awareness of students about the abuses to which plants have been subjected by human greed and train them in exploration, identification, evaluation and conservation of plant diversity.

**Curriculum structure of Botany
(w.e.f session 2014-15)**

Three year Undergraduate Degree course (06 Semesters)

Academic Year	Semester No.	Page No.	Course Code	Title of The Paper	DISTRIBUTION OF MARKS			CREDITS
					IA	TE	TOTAL	
B.Sc. 1	I	Core 1	1BOTT1	Diversity of Cell organization in Plants and General Botany	10	60	70	02
		Core 2	1BOTT2	Diversity of Algae and Bryophytes	10	60	70	02
		Core 3	1BOTP	PRACTICALS BASED ON PAPER 1AND 2		50	50	02
	II	Core 1	2BOTT1	Diversity of Pteridophytes and Gymnosperms	10	60	70	02
		Core 2	2BOTT2	Mycology and Phytopathology	10	60	70	02
		Core 3	2BOTP	PRACTICALS BASED ON PAPER 1AND 2		50	50	02
B.Sc. 2	III	Core 1	3BOTT1	Morphology, anatomy and Economic utilization of Angiosperms	10	60	70	02
		Core 2	3BOTT2	Cytogenetics, Genetics and Plant Breeding	10	60	70	02
		Core 3	3BOTP	PRACTICALS BASED ON PAPER 1AND 2		50	50	02
	IV	Core 1	4BOTT1	Angiosperms Taxonomy and Embryology and Biodiversity	10	60	70	02
		Core 2	4BOTT2	Plant Physiology Growth and Development	10	60	70	02
		Core 3	4BOTP	PRACTICALS BASED ON PAPER 1AND 2			50	02
B.Sc. 3	V	Core 1	5BOTT1	Biochemistry and Molecular Biology of Plants	10	60	70	02
		Core 2	5BOTT2	Ecology and environment	10	60	70	02
		Core 3	5BOTT3	Palaeobotany, Palynology, Plant diversification and Applied Anatomy	10	60	70	02
		Core 4	5BOTP	PRACTICALS BASED ON PAPER 1, 2 AND	3	75	75	03

Academic Year	Semester No.	Page No.	Course Code	Title of The Paper	DISTRIBUTION OF MARKS			CREDITS
					IA	TE	TOTAL	
B.Sc. 3	VI	Core Paper 1	6BOTT1	Plant Biotechnology	10	60	70	02
		Core Paper 2	6BOTT2	Applied microbiology	10	60	70	02
		Elective Paper 3	6BOT3A	Analytical techniques in plant Sciences	10	60	70	02
		(Select any one)	6BOT3B	Research Methodology in Plant Sciences	10	60	70	02
			6BOT3C	DISSERTATION		70	70	02
		Core Paper 4	6BOTP	PRACTICALS BASED ON PAPER 1, 2 AND 3		75	75	03
SSEC	6BOTS	SKILL ENHANCEMENT COURSE (Herbal technology and Ethnobotany)		30	30	02		

SEMESTER I

Core course : Botany Paper 1

Max. Marks : 60

TITLE :- GENERAL BOTANY AND DIVERSITY OF CELL ORGANIZATION IN PLANTS

Unit 1: General Botany (15 Lectures) 20 marks

Scope of Botany: Characteristics of plants, Branches of Plant sciences, Botanical institutions, Important herbaria and botanical gardens of the world and India; Plant kingdom diversity and classification, Curious plants, Scope and future prospects of plant sciences

History of Botany: Brief history of Plant Sciences and contributions of the following Indian Scientists in their specific fields- Winfield. Dudgeon, E.J. Butler, M.O.P. Iyengar, K.C. Mehta, and S.R. Kashyap, Birbal Sahni, Divya Darshan Pant, P. Maheshwari, R. Mishra, R.N. Singh, J. S. Singh, Govindjee, H.G. Khorana, M.S. Swaminathan

Evolution : Origin of life : (Biochemical origin with evidences) Concept of Evolution (Lamarckism, Darwinism Neo Darwinism and Modern Synthetic theory of evolution), Mechanism of evolution (Mutation, isolation, natural selection, speciation, genetic drift, Gene frequency and Hardy Weinberg law

Unit 2 : Viruses and Bacteria (15 Lectures) 20 marks

Viruses: Discovery, General description, classification Structure and chemical composition of Viruses, Structure and multiplication of Tobacco mosaic virus (TMV), Structure of Bacteriophage, Lytic and Lysogenic cycles of Bacteriophages, Cynophages, Viroids and Prions Transmission of viruses, Economic importance

Bacteria: Discovery, General characteristics, classification, types- archaeobacteria, eubacteria, cell structure and cell wall composition of Eubacteria , shape, flagellation, pili, plasmid and episome, wall-

less forms (Mycoplasma), Nutritional types, Differential Gram staining, Reproduction vegetative asexual (endospore and binary fission), Genetic recombination (Transformation, conjugation and Transduction), Economic importance.

Unit 3: Prokaryotic and Eukaryotic Plant Cell Organization
(15 Lectures) **20 marks**

Plant Cell Organization, Cell theory and concept of organism, Prokaryotic Plant cell (Cynobacterial cell) Prokaryotic cell versus Eukaryotic cell, Structure and function of Plant cell and its components, cell membrane, Endoplasmic reticulum, Golgi apparatus, Lysosomes, Peroxisomes, Hydrogenosome, Ribosomes, Mitochondria, Chloroplast, and Nucleus. : Concept of R.N.A world and origin of eukaryotic cells

SEMESTER - I

Core course : Botany Paper 2 **Max. Marks : 60**

TITLE :- DIVERSITY OF ALGAE AND BRYOPHYTES

Unit 1: Diversity of Algae (22 Lectures) **30 marks**

General Account and Classification : General characters, economic importance (Food, Phycocolloid agar, carragenin, Diatomite, biofertilizer), Principles of Classification, Fritch's Classification and recent trends in classification, types of life cycles in algae

Cyanophyceae: General characteristic, heterocyst and mechanism of nitrogen fixation, chromatic adaptation, Morphology and life cycle of *Oscillatoria* and *Nostoc*,

Chlorophyceae: Important general features of Chlorophyceae, occurrence, structure reproduction and life cycles of *Volvox*, *Oedogonium* and *Chara*.

Xantophyceae: Important general features of Xanthophyceae, occurrence, Morphology, reproduction and life history of *Vaucheria*.

Bacillariophyceae: General account, cell structure, cell division sexual reproduction auxospore formation and life cycle in reference to the diatoms.

Phaeophyceae: Important general features of Phaeophyceae, occurrence structure, reproduction and life cycles of *Ectocarpus*

Rhodophyceae: Important general features of Rhodophyceae, occurrence, structure, reproduction cystocarp development and life cycles of (i) *Batrachospermum* (ii) *Polysiphonia*

Unit 2. Diversity of Bryophytes (23 lectures) **30 marks**

General account : General characters of Bryophytes, Amphibious nature, affinities of bryophytes, classification of bryophytes up to class with diagnostic features, Economic importance of bryophytes, evolution of sporophyte in bryophytes

Hepaticopsida: Comparative account of gametophyte (morphology and anatomy) structure, reproduction , sporophyte development spore dispersal and alternation of generation in *Riccia* with *Marchantia* and *Pellia* with *Porella*

Anthocerotopsida: Occurrence, gametophyte structure (morphology and anatomy) reproduction , sporophyte development, spore dispersal and alternation of generation in *Anthoceros*, synthetic nature and affinities of hornworts

Bryopsida: Occurrence, gametophyte structure (morphology and anatomy) reproduction, sporophyte structure, spore dispersal and alternation of generation in *Sphagnum* and *Funaria*,

SEMESTER II

Core course : Botany Paper 1 Max. Marks: 60

TITLE : DIVERSITY OF PTERIDOPHYTES AND GYMNOSPERMS

Unit-1 Pteridophytes (25 Lectures) 30 marks

General Account: General characters of Pteridophytes, Pteridophytes as early land plant, Classification with diagnostic characters and examples, economic importance

Fossil Pteridophyte: Structural features, Geographical distribution and reconstruction of *Rhynia*

Life History: Distribution, Habit, Habitat, Range of morphological and anatomical variation, reproduction and structure of gametophyte in (i) *Lycopodium* and *Selaginella* (comperative account) (ii) *Equisetum* (iii) *Marsilea* (iv) *Pteris / Dryopteris*

Special topics: Telome Theory, Stelar Theory, Heterospory and origin of seed-habit.

Unit 2 : Gymnosperms (20 Lectures) 30 marks

General Account: Affinities, general characters, classification (D.D.Pant, 1957) with diagnostic features and economic importance.

Comperative account of distribution, morphology and anatomy of root, stem, leaves, male and female reproductive parts, structure and development of male and female gametophyte and gametes, pollination, fertilization, Embryogeny and phylogeny of *Cycas* and *Pinus*

SEMESTER II

Core course: Botany Paper 2 Max. Marks: 60

TITLE: MYCOLOGY AND PHYTOPATHOLOGY

Unit 1 Fungi (25 Lectures) 30 marks

General Account: General Characters of fungi, Cell structure, hyphal forms, fungal spore forms, Sexual reproduction, classification (Ainsworth system), Economic importance.

Mastigomycotina: Diagnostic feature, classification and life cycle with reference to *Albugo*

Zygomycotina: Diagnostic features, life cycle and Zygosporangium formation in *Rhizopus*

Ascomycotina: Diagnostic features, classification, Ascus development and types of ascocarps, Life cycle with reference to *Eurotium* (*Aspergillus*), *Neurospora* and *Peziza*

Basidiomycotina: Diagnostic features, classification types and development of basidium, Life cycle with reference to *Puccinia*, and *Agaricus*.

Deuteromycotina : Diagnostic features and life cycle of *Collectotrichum*.

Myxomycotina : Diagnostic features of slime molds

Special topics : Heterokaryosis and Parasexuality in fungi.

Unit 2 Fungal Association (08 Lectures) 12 marks

Lichens: General characters, Thallus organization, nature of association of algal and fungal partners, Reproduction and economic importance.

Mycorrhiza: General characters, types and importance

Unit 3 Plant Pathology (12 Lectures) 18 marks

General Plant Pathology: Koch's postulate, Symptoms of plant diseases (Bacterial, viral and fungal); Defense mechanisms in plants, Prevention and control measures of plant diseases (Chemical, biological and integrated)

Symptoms, causal organisms etiology and control measures of following diseases: Leaf curl of Papaya, Citrus canker, Late and early blights of potato, Powdery mildew of cucurbits, Smut of cereals, Leaf spot diseases of ground nut

SEMESTER III

Core course: Botany Paper 1

Max. Marks: 60

TITLE : MORPHOLOGY, ANATOMY AND ECONOMIC UTILIZATION OF ANGIOSPERMS

Unit 1 Morphology (10 Lectures) 14 marks

Morphology of root, stem, leaf and their modification. Inflorescence type and their modification, flower as modified shoot, fruit types, morphology of seeds, Insectivorous plants, Morphological adaptation in xerophytes and hydrophytes

Unit 2. Anatomy (20 Lectures) 26 marks

Tissues ;Classification of tissues; Simple and complex tissues.

Stem ; Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory) Types of vascular bundles; Structure of dicot and monocot stem.

Root: Organization of root apex (Apical cell theory, Histogen theory); Quiescent centre; Root cap; Structure of dicot and monocot root;

Secondary growth:An account of normal secondary growth in herbaceous and woody plants.

Anomalous anatomy;Primary anomaly and anomalous secondary growth as exemplified by structure of *Boerhaavia*, *Pyrostegia* (*Bignonia*) *Leptadenia* and *Dracaena* stem.

Root- stem transition.

Unit 3 Economic Botany (15 Lectures) 20 marks

Use of Plants and Plant products with special reference morphological part, family, processing (if desired) important phytochemicals (if known) and economic importance of the following:

Food Plants: Cereals (Wheat, Rice, and Maize), pseudocereals , millets , Legumes (Pigeon pea, Ground nut, Gram), (g) Edible oils: *Arachis*, *Coconut*, *Brassica*, *Ricinus*. Sugar-cane and fruits.

Food adjuncts: Beverages (Tea and Coffee), Spices and condiments (*Piper nigrum*, *Capsicum*, *Curcuma*, *Zinziber*, *Crocus sativus*, *Coriandrum sativum*, *syzygium aromaticum*)

Masticatories & Fumicatories (*Piper betel*. *Areca catechu*. *Acacia catechu*. *Nicotiana tabacum*).

Timber : Teak, Sal, Shisham.; **Fibre:** Cotton, Jute, Sun hemp and Coir; **Rubber:** *Hevea* and *Ficus*.

Tannins: *Acacia*; **Gums:** *Acacia*, *Sterculia*; **Resins and oleo gum resin;** **Dye yielding plants**

Pharmacognosy : pharmacognosy and its importance in medicine, Drug yielding plants: drugs, narcotics: (*Cinchona*, *Aconitum*, *Atropa*, *Artemisia*, *Rauwolfia*, *Cannabis sativa*, *Papaver somniferum*).

Elementary knowledge of Ethnobotany

SEMESTER III

Core course: Botany Paper 2

Max. Marks: 60

TITLE: CYTOGENETICS, GENETICS AND PLANT BREEDING

Unit 1 Cytogenetics (15 Lectures) 20 marks

Chromatin organization : Types of Chromatin, Chromatin structure and DNA packaging in eukaryotic chromosome, B chromosome, Polytene and Lampbrush chromosome, Centromere, and Kinetochores, telomere structural organization and function

Cell mechanics : Cell cycle and its molecular regulation, mitosis, meiosis and concept of apoptosis and cancer (brief idea)

Variation in chromosome number and structure : Chromosomal aberrations, aneuploidy and polyploidy

Unit 2. Genetics (15 Lectures) 20 marks

Principles of genetics : Elements of heredity and variation, Mendel and his experiments principles of segregation and independent assortment, test and back cross, polygenic inheritance in plants

Genetic interactions : Genetic interactions with special reference to modified monohybrid & modified dihybrid ratio, various types of intra and intergenetic interactions; Multiple alleles, Pleiotropy, Penetrance and expressivity, Numericals; Polygenic inheritance

Linkage and crossing over: - 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.

Gene mutation: Spontaneous and induced mutations, Frame shift mutation; Molecular basis of Mutations; Mutagens – physical and chemical (tautomerization, Base analogs, deamination, alkylation and intercalating agents)

Extra nuclear inheritance. Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in *Paramecium*

Sex determination in Plants.

Unit 3.Plant breeding (15 Lectures) 20 marks

Introduction : Definition, scope, achievement and future prospects challenges of plant breeding, Vavilovs concept of center of origin of crop plants

Methods of Plant Breeding: Domestication, Introduction, Selection (Mass and Pure line selection),

Hybrid production for crop improvement: Methods of hybridization and selection of hybrids (Pedigree, Bulk selection and back cross method)

Natural emasculation devices in plant breeding: Genetic basis and role of Male sterility and self incompatibility plant breeding

Heterosis: Heterosis and Inbreeding depression , genetic basis and significance, Biotechnological approach in plant breeding (elementary idea).

SEMESTER IV

Core course: Botany Paper 1

Max. Marks: 60

TITLE: ANGIOSPERMS (TAXONOMY AND EMBRYOLOGY) AND BIODIVERSITY

Unit-1 Taxonomy of Angiosperms (20 Lectures) 25 marks

Botanical nomenclature: Principles and rules (ICBN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations;

Systems of classification: Classification systems of Bentham and Hooker (up to series) and Comparative study of the classification system proposed by Linnaeus, Engler and Prantl, Hutchinson and Takhtajan. Introduction to APG System.

Taxonomic studies of the following families.: Ranunculaceae, Malvaceae, Papaveraceae, Capparidaceae, Cucurbitaceae, Fabaceae, Myrtaceae, Apiaceae, Rubiaceae, Acanthaceae, Asclepiaceae, Solanaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae, Poaceae.

Unit 2. Biodiversity (10 Lectures) 15 marks

Biodiversity: Concept and definition, types of biodiversity, endemism, endangered and threatened species, Hot spots of Biodiversity, Red data book, Biodiversity of India and Uttar Pradesh, Conservation of biodiversity.

Phytogeography : Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Forest types of India, Vegetation of Allahabad

Unit -3.Embryology of Angiosperms (15 Lectures) 20 marks

Structure of Angiosperm flowers: Structure of androecium and gynoecium and placentation

Anther and male gametophyte: Development of anther, structure of anther wall, microsporogenesis and pollen development anther dehiscence and viability.

Ovule and female gametophyte : Structure and types of ovule, special ovular structures(endothelium aril, caruncle, hypostase megasporogenesis and mono, bi-and tetrasporic type of embryo sac, megagametogenesis

Pollination and fertilization: Agencies of pollination, contrivances of self and cross pollination, pollen-pistil interaction growth of pollen tube up to entry in embryo sac. Syngamy and triple fusion. Apomixis

Endosperm : Developemt, structure and function of endosperms. Type of haustoria, endosperm and embryo relationship.

Embryogeny: Types of embryogeny, development of mono-and dicot embryo, Polyembryony,

SEMESTER - IV

Core course: Botany Paper 2

Max. Marks: 60

TITLE: PLANT PHYSIOLOGY GROWTH AND DEVELOPMENT

Unit 1. Physiology of Plants (15 Lectures) 20 marks

Plant water relationship: Water Potential and its components, water absorption by roots, pathway of water movement, symplast, apoplast, root pressure, guttation. Ascent of sap—cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement(potassium ion influx).

Organic translocation: General Principles and mechanism of translocation of organic substances.

Mineral nutrition : Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, , mineral deficiency symptoms, roles of essential elements,

Physiology of flowering : Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy

Plant movement: Movement with special reference to paratonic movements.

Unit 2 Plant Metabolism (15 Lecture) 20 marks

Respiration: Glycolysis, fate of pyruvate, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, TCA cycle, amphibolic role, mitochondrial electron transport, oxidative phosphorylation, respiratory substrates factors affecting respiration

Photosynthesis: 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, C₄ pathways; Crassulacean acid metabolism;

Unit 3. Plant Morphogenesis (15 Lectures) 20 marks

Plant morphogenesis: Concept of morphogenesis, growth differentiation and development, Regulation of morphogenesis.

Photomorphogenesis and role of phytochrome.

Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene. Brassinosteroids and Jasmonic acid. Plant hormone as morphogenetic regulator and cell signaling

An elementary knowledge of polarity symmetry and their role in plant morphogenesis

SEMESTER V

Core course : Botany Paper 1

Max. Marks: 60

TITLE: BIOCHEMISTRY AND MOLECULAR BIOLOGY

Unit 1. Chemistry of Biomolecules (15 Lectures) 20 marks

Introduction to cell chemistry Types and significance of chemical bonds; Structure and properties of water; pH and buffers.

Carbohydrates Nomenclature and classification; structure and role of monosaccharides (glucose, fructose,); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides

Lipids: Structure of fat, fatty acids and their Oxidation, phospholipids type, glycolipids and sterols

Enzymes Nomenclature and classification; Concept of holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity

Nitrogen metabolism: Biochemistry of nitrogen fixation and amino acid synthesis in plants.

Amino acids and proteins: Structure of amino acids and Proteins

Unit 2 Molecular organization of Genetic material

(15 Lectures)

20marks

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.

Nucleic acids as carriers of genetic information: Evidence of DNA as carrier of genetic information (Griffith's , Avery, McLeod and McCarthy , Hershey Chase and Fraenkel Conrats experiment) Organization of DNA in Bacteria and Eukaryotes (Nucleosome model of chromatin and molecular organization of chromosome)

The replication of DNA Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi- conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.

Unit 3. Gene expression and regulation(15 Lectures) 20marks

Central dogma and genetic code : The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

Transcription Processing and modification of RNA : Transcription machinery and mechanism of transcription in prokaryotes and eukaryotes, Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways and intron splicing, eukaryotic mRNA processing (5' cap, 3' polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport.

Translation : Mechanism of translation and Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quarternary; Isoelectric point;

Regulation of gene expression: Operon model in prokaryotes, Gene battery model in eukaryotes, Regulated expression of Homeotic gene (ABC model of flowering in *Arabidopsis*)

SEMESTER V

Core course: Botany Paper 2

Max. Marks: 60

TITLE: ECOLOGY AND ENVIRONMENT

Unit 1 Ecosystem ecology (20 Lectures) 25 marks

Ecological factors- An elementary knowledge of ecology, ecological factors: climatic, edaphic, physiographic and biotic factors,

Ecosystem: Concept and type of ecosystem, structure of abiotic and biotic component, food chain, food web , ecological pyramids, energy flow, biogeochemical cycles of carbon nitrogen and phosphorous. Productivity of ecosystem

Population Ecology: Concept of species habitat, ecological niche, ecad , ecotype and ecotone, Life forms, density and frequency

Ecological Succession: Concept, type and cause of succession , Hydrosere and xerosere, Climax concept in succession

Ecological adaptation in Plants: Hydrophytes, xerophytes and halophytes, epiphytes, hygrophytes

Unit 2 Habitat ecology (10 Lectures) 15 marks

Habitat Ecology (Limnology) : Fresh water habitat and its division according to horizontal and vertical stratification, Effect of temperature variations in fresh water habitat of temperate zone.

Habitat Ecology (Marine biology) : Structure of sea, horizontal & vertical stratification. Physico-chemical properties of sea water, Division of marine biota and their adaptations. Factors influencing growth of marine flora.

Soil ecology: Importance of soil, composition of soil, soil formation soil profile, soil erosion and soil conservation.

Unit 3 Environmental Challenges and related social issues (15 Lectures) 20 marks

Environmental pollution: Kinds of pollution (air, water radioactive pollution, noise pollution, pollution control law, Acid rain, green house effect, global warming, Ozone depletion

Environment and Development: Environmental challenge in India, Environmental education and organization Concept of sustainable development, ecology and environment of Allahabad

Bioremediation: Concept, need, scope and application of bioremediation in environmental clean up

SEMESTER V

Core course: Botany Paper 3 Max. Marks: 60

TITLE: PALAEOBOTANY, PALYNOLOGY, PLANT DIVERSIFICATION AND APPLIED ANATOMY

Unit 1. Palaeobotany (14 Lectures) 18 marks

Introduction: Concept of Paleobotany, Scope and objectives of Paleobotanical studies

Structure of rocks: Introduction to structure of earth, types of rocks and dating the past

Geological time scale.

Fossil and Fossilization: Types of fossils, Process of fossilization

Techniques of Fossil study: Unilateral light illumination, Bulk Maceration, Schulze's method, Walton's transfer technique, Ground thin section method, Peel method, CLSM and Raman Imagery

Reconstruction of plant fossils.

Unit 2. Palynology (10 Lectures) 12 marks

Introduction: Concept of Palynology with special reference to pollen and spore morphology, Role of Palynology in taxonomy and allergies Basic concepts of aeropalynology, Melissopalynology.

Pollen characters: Pollen aperture types, NPC classification, Pollen wall stratification

Pollen studies of following families : Malvaceae, Chenopodiaceae, Cucurbitaceae, Acanthaceae, Mimosaceae, Asclepiadaceae, Poaceae

Unit 3. Plant Diversification: (14 Lectures) 18 marks

Elementary knowledge of Precambrian Biota- Origin of different plant groups- Bacteria, Algae, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms, ANITA Grade angiosperms, Primitive and advanced features in relation to vegetative and reproductive parts. Elementary Molecular Phylogeny.

Unit 4 Applied anatomy: (07 Lectures) 12 marks

Wood anatomy: Sapwood and heartwood; Non porous (*Thuja*), Ring (*Tectona*) and diffuse porous (*Dalbergia*) wood; Early and late wood, tyloses; Dendrochronology, reaction and compression wood, Development and composition of periderm,

Epidermal anatomy; Cell wall, Stomata types, Trichomes and epidermal appendages

Application of anatomy: Application of anatomy in taxonomy, horticulture. Food adulteration, archaeology and forensic sciences

SEMESTER VI

Core course : Botany Paper 1

Max. Marks: 60

TITLE: PLANT BIOTECHNOLOGY

Unit 1 Genetic Engineering (15 Lectures) 20 marks

Introduction: historical perspectives, development, scope and terminology.

Gene Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC)

Gene cloning enzymes: Restriction Endonucleases (History, Types, biological role and application); Ligases

Gene cloning Strategies: Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning); Blotting techniques, DNA fingerprinting, DNA Sequencing Molecular probe, Human Genome project

Unit 2. Plant tissue culture (15 Lectures) 20 marks

Concept and general technique: Concept of cellular totipotency and plant tissue culture, composition of tissue culture media, aseptic manipulation

Callus culture : Concept of dedifferentiation, Callus initiation, growth pattern, characteristics maintenance and application

Micropropagation: (I) Concept of redifferentiation and organogenesis (ii) Somatic embryogenesis and artificial seeds (iii) Meristem culture

Haploid culture: Haploid production through anther and pollen culture and their significance

Secondary metabolite production: Production of valuable secondary through molecular farming (Cell suspension culture) and biotransformation and their significance

Unit 3. Application of Biotechnology (15 Lectures) 20 marks

Genetic manipulation: Genetic manipulation through Somaclonal variations, protoplast culture, somatic hybridization and cybridization,

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)

Transgenic crops: Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations);

Application of biotechnology : Application of genetic engineering and plant tissue culture in medicine, agriculture, industry , environment and biodiversity conservation

SEMESTER VI

Core course: Botany Paper 2

Max. Marks: 60

TITLE: MICROBIOLOGY

Unit 1 General Microbiology (13 Lectures) 18 marks

Introduction: .History, Definition, Classification of bacteria on the basis of mode of nutrition and Scope of Microbiology.

Microbes : elementary knowledge of Mycoplasma, Rickettsia, Actinomycets, Archaeobacteria & N₂ –fixing bacteria.

General techniques in microbiology: Sterilization techniques, Culture techniques & types of culture used for micro-organisms, Counting of the colonies in a culture through colony counter, Measurement of size of spores & micro-organisms through ocular & stage micro-meter.

Unit 2 Industrial Microbiology (12 Lectures) 18 marks

Industrial Micro-biology : Use of micro-organism in industries, with reference to production of organic acids (Lactic acid/ Acetic acid). Alcohol and Alcoholic beverages, yeast, Enzymes, Vitamins (B12 & B3) and Antibiotics.

Unit 3 Applied Microbiology (20 Lectures) 24 marks

Water Microbiology-Water born diseases, Purification of water, water potability test.

Sewage- microbiology- Composition & characteristics of sewage, Sewage treatment processes (Soak- pit, Septic tank, Imhoff tank, Municipal sewage treatment.

Air- microbiology : Common air micro-organisms, Air borne-diseases, Sampling of air- micro-organisms and its qualitative and quantitative estimation, Control of air- micro-organisms

Milk Microbiology- Composition of milk, Types of micro-organisms that contaminate milk & cause spoilage., Milk Pasterurization, Microbial production of cheese, butter

Food Microbiology – Microbial contamination & spoilage of food, Food preservation, Food poisoning.

Soil- microbiology –Microbial degradation of soil organic matter by micro-organisms. Bio-geochemical cycle.

SEMESTER VI

Discipline Specific Elective Botany: Paper 3A Max. Marks: 60

TITLE: ANALYTICAL TECHNIQUES IN PLANT SCIENCES

Unit 1 Analytical technique (25 Lectures) 30 marks

Imaging and related techniques 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(MCFISH); Transmission and Scanning electron microscopy

Analytical technique: Basic informations on Cell fractionation, Chromatography, Electrophoresis, X ray crystallography, Spectrophotometry, Micrometry, autoradiography, Blotting techniques (Northern, Southern, Western), Molecular probes

Microtechniques and instrumentation: Microtomy (Fixation, dehydration, Embedding, Staining and Section cutting) Maceration technique, Cytological technique for chromosome study, Autoclaving and sterilization techniques

Bioethics in biological experiments

Unit 2. Biostatistics (10 Lectures) 18 marks

Representation of statistical Data: tabular and graphical

Measurement of central tendency: Mean, median and mode

Measurement of dispersion: Standard deviation, mean deviation, variance

Tests of significance: t test and chi square test.

Unit 3. Bioinformatics (10 Lectures) 18 marks

Computer application: application of Microsoft excel and PowerPoint in presentation of biological and statistical data

Introduction to bioinformatics: Concept and elementary knowledge

SEMESTER VI

Discipline Specific Elective Botany: Paper 3B Max. Marks: 60

TITLE : RESEARCH METHODOLOGY IN PLANT SCIENCES

Unit 1. (25 Lectures) 30 marks

Basic concept of research, Research methodology, Literature review and its consolidation, Library research, Field research and Laboratory research.

General laboratory practices: Common calculations in Botanical Laboratory, preparation of solutions, Dilution, Percentage solution, Molar, molal and normal solutions, handling of Micropipettes, Toxic chemical and safety.

Plant micro techniques: Whole mount, peel mount squash preparation, smear preparation, maceration and sectioning, tissue fixation and dehydration, paraffin infiltration, microtome sectioning, Staining techniques, cytogenetic techniques, Paleobotanical techniques

Unit 2 (25 Lectures) 30 marks

Data collection and documentation of observation: maintaining of laboratory records, Tabulation and generation of graphs, the art of microscopic and field photography

The art of Scientific writing and its presentation: Units, abbreviations and nomenclature used in scientific writing, writing references, Power point presentation, Poster presentation, Scientific writing and ethics , copyright and plagiarism

Intellectual Property rights: concept of patent, copyright, trademarks, geographical indicators, IPR in Biotechnology and information technology. Ethics in Biological research

SEMESTER VI

Discipline Specific Elective Botany: Paper 3C Max. Marks: 60

Dissertations

Thesis / Project work/ Field survey and Presentation

SEMESTER VI

Skill Enhancement Course in Botany : Paper 1 (Optional)

Max. Marks: 30

TITLE : HERBAL TECHNOLOGY AND ETHNOBOTANY

Unit A

(10 Lectures)

Herbal medicines its history, scope, utilization and marketing.

Pharmacognosy: Systematic position and medicinal uses of some familiar medicinal plants

Phytochemistry : Active principles and their extraction, phytochemical screening tests for secondary metabolites (Alkaloids, Flavonoids, Steroids, Triterpenoids and Phenolic compounds.

Unit B

(10 Lectures)

Ethno botany : Concept, scope, objectives and medicoethnobotanical significance of some important plants.

Ethno botany and folk medicine : Application of natural products to certain diseases (Jaundice, Cardiac ailments, Infertility, Diabetes, Blood pressure and skin diseases)

Cocept of indigenous medicinal sciences (Ayurveda, Siddha, Unani) and conservation and propagation of medicinal and other plants having phytonutritive value .