

Paper - II Theoretical 50 Marks
(Code - 121102)

1. Bryophyta 10 Marks [10 Periods]
2. Pteridophyta 15 Marks [15 Periods]
3. Gymnosperms..... 15 Marks [15 Periods]
4. Palaeobotany..... 10 Marks [10 Periods]

Bryophyta

1. General account: - 1.1 Characteristic features; 1.2 Amphibian nature; 1.3 An outline idea of classification system following Proskauer (1957) upto class.
2. Hepaticopsida: - 2.1 Class characters; 2.2 Characteristic features of gametophytes and sporophytes of *Marchantia*;
3. Anthocerotopsida: - 3.1 Class characters; 3.2 Gametophytic and Sporophytic features of *Anthoceros*. 3.3 Development of sporophyte.
4. Bryopsida: - 4.1 Class characters; 4.2 Characteristic features of gametophytes and sporophytes of *Sphagnum* and *Funaria*.
5. Specialized topics: - 5.1 Origin of Bryophytes; 5.2 Alternation of generations in different classes and Evolution of Sporophytes (Progressive and Regressive concepts). 5.3 Roles of Bryophytes in plant succession and pollution monitoring.

Pteridophyta

1. General account: - 1.1 Characteristics; 1.2 Classification (Sporne, 1975) - upto class with characters and examples.
2. Morphology and Anatomy of vegetative body, and reproductive organs of sporophytes, and alternation of generations in - *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum* and *Dryopteris*.
3. Fossil study: - 3.1 Characteristic features of *Rhynia*; 3.2 Structural and anatomical features of *Lepidodendron* and *Calamites*.
4. Progymnosperms: - 4.1 Diagnostic features of the group; 4.2 Vegetative and reproductive features of *Archaeopteris*.
5. Specialized topics: - 5.1 Life cycle patterns in Homosporous and Heterosporous forms; 5.2 Alternation of generations and origin of sporophyte (Antithetic & Homologous theories); Telome concept (Zimmermann's hypothesis) and its

significance in the origin of Psilopsida, Lycopsidea, Sphenopsida and Pteropsida. 5.3
Heterospory and seed habit

Gymnosperms

1. General characters and Classification (Sporne, 1975) upto class with characters and examples.
2. Distribution, vegetative and reproductive morphologies of sporophytes, wood anatomy, structures of ovules, development of gametophytes and embryogeny of - *Cycas*, *Pinus* and *Gnetum*.
3. Fossil Gymnosperms: - 3.1 General characters of Pteridospermales, Cordaitales and Bennettitales; 3.2 Structural features of *Lyginopteris oldhamia* and *Cordaites*; 3.3 Reconstruction of *Williamsonia Sewardiana*.
4. Economic importance of Gymnosperms with reference to wood, resin, essential oil, fatty acid & drugs

Palaeobotany

1. Fossils: - 1.1 Definition, Types and Mode of Preservation (Schoff 1975); 1.2 Conditions for fossilization; 1.3 Palaeopalynology - a brief idea about its application.
2. Geological time scale and major events of plant life through geological ages.
3. Indian Gondwana system with major mega-fossil assemblages.

Bibliography

Bryophytes

1. Parihar, N.S.-Introduction to Embryophyta: Vol. I Bryophyta [Central Book Depot]
2. Rashid, A.An Introduction to Bryophyta [Vikas Publishing House]
3. Vashishta, B.R.Bryophyta [S. Chand & Co.]
4. Ganguly, H.C. & Kar, A.K.College Botany Vol. II [New Central Book Agency]
5. Chopra, R.N. & Kumar, P.K.Biology of Bryophyte [Wiley Eastern]
6. Puri, P.Bryophyte [Atmaram & Sons]

Pteridophytes

1. Sporne, K.R.The morphology of Pteridophytes [Hutchinson & Co.]
2. Vasishta, P.C.Pteridophyta [S. Chand & Co.]
3. Gifford, E.M. & Foster, A.S.Morphology and Evolution of Vascular Plants [Freeman & Co.]
4. Mukherjee, R.N. & Chakraborty, K.An Introduction to Vascular Cryptogams (Pteridophytes) [Kalyani Publishers]
5. Ganguly, H.C. & Kar, A.K.College Botany Vol. II [New Central Book Agency]

Paper - III Practical 50 Marks [5 hr.]
(Code - 121103)

1. Algae (work out)	10 Marks
2. Fungi (work out)	10 Marks
3. Microbiology (work out)	6 Marks
4. Plant Pathology (work out)	6 Marks
5. Identification..... [3 specimens x 3 marks each.].....	9 Marks
[Not more than one from Algae/Fungi/Lichen/Plant Pathology]	
6. Laboratory Note Books [No Slide].....	4 Marks
7. Viva Voce	5 Marks
[Laboratory Note Book (no slide submission) of each section, signed by the respective teachers with date, must be submitted at the time of examination]	

Algae

1. [Work out] Staining (no permanent slide preparation). Free Hand Drawing and drawing under Drawing - Prism with Magnification of the following genera with reproductive structures - *Nostoc*, *Oedogonium* & *Vaucheria*.
2. Study from permanent slides of the following genera - *Gloeotrichia*, *Chara*, *Coleochaete*, Pennate diatom, *Laminaria* & *Polysiphonia*.

Fungi & Lichen

1. [Work out] Staining (no permanent slide preparation), Drawing and Microscopic Measurement of the following genera with reproductive structures - *Rhizopus* (asexual) & *Ascobolus*.
2. Study from permanent slides of the following - Zygosporangium of *Rhizopus*, Conidiophores & Conidia of *Penicillium*, conidia of *Fusarium* and trama, hymenium, subhymenium, basidia & basidiospores of *Agaricus* in the V. L. S. of gills.
3. Morphological study of foliose & fruticose Lichens, *Polyporus* and *Cyathus*.

Microbiology

1. [Work out] Preparation of NA, sterilization and sub-culturing
2. [Work out] Simple staining (Ziel's Carbol Fuchsin stain) from curd sample and Gram Staining from culture.

Plant Pathology

1. [Work out] Preparation of PDA and Czapek-Dox Agar (CDA), sterilization and sub-culturing.
2. [Work out] Isolation of pathogen from diseased leaf.
3. [Work out] Inoculation of fruit
4. Identification: - Pathological specimens (diseased plant) of Bacterial blight of rice and late blight of potato; Slides showing uredial, telial, pycnidial & aecial stages of *Puccinia graminis* (any variety).

PART - II : 200 Marks

Paper - IV Theoretical 100 Marks (Code - 121104)

1. Morphology & Palynology	20 Marks [15 Periods]
2. Taxonomy of Angiosperms	50 Marks [45 Periods]
3. Ecology & Plant geography	30 Marks [25 Periods]

Morphology & Palynology

1. Inflorescence: - 1.1 Types with examples; 1.2 Concept of advance and primitive types.
2. Flower: - 2.1 Types with examples; 2.2 Aestivation; 2.3 Floral parts – various types of Cohesion and Adhesion with examples; 2.4 Carpel – Types, advance and primitive types and Placentations.
3. Fruit: - Types with examples.
4. Palynology: - 4.1 Spore & Pollen; 4.2 Pollen wall – chemical nature, stratification & ornamentation; 4.3 NPC classification; 4.4 Basic concepts of Aeropalynology & Melissopalynology.

Taxonomy of Angiosperms

1. Introduction: - 1.1 Components and Objectives of Plant Systematics; 1.2 Alpha and Omega Taxonomy; 1.3 Data source in plant taxonomy – anatomy, cytology, Phytochemistry, Palynology etc. 1.4 Phases and Functions of taxonomy; 1.5 Phenetics – Definition, Character-state, Phenogram and OTU; 1.6 Cladistics – Definition, Cladogram, concept of monophyletic, polyphyletic & paraphyletic groups; 1.7 Plesiomorphy & Apomorphy; 1.8 Principles of Parsimony.
2. Nomenclature: - 2.1 Elementary knowledge of ICBN [Vienna code 2005 (updated 2006-07)] – Principles, Valid names [Binomial, Authors' Citation, Legitimate & Correct names, Homonym, Basionym, Autonym, Synonyms], Typification, Principle of Priority, Effective and Valid Publication, Retention and Rejection of names.
3. Herbaria & Botanical Gardens: - 3.1 Their Roles/Functions; 3.2 Important Indian Botanical Gardens & CNH-India;
4. Identification: - 4.1 Use of Floras, Monographs, Manuals and Dichotomous Keys.
5. Systems of Classification: - 5.1 Broad outline of the system [upto series/cohorts] of Bentham & Hooker (1863) with merits and demerits; 5.2 Cronquist's system (1988) [upto sub-class with characters & showing affinities] - with merits and demerits.
6. Diagnostic features, systematic positions (as in B&H, and Cronquist's system) and economically important plants (parts used & uses) of the following families:-

- 6.1 Dicotyledonous families – Magnoliaceae, Malvaceae, Leguminosae (subfamilies), Euphorbiaceae, Solanaceae, Verbenaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Apiaceae, Rosaceae, Cucurbitaceae, Rubiaceae & Asteraceae.
- 6.2 Monocotyledonous families – Alismataceae, Araceae, Poaceae, Liliaceae, Zingiberaceae & Orchidaceae.

Ecology & Plant Geography

1. Plant and Environment: - 1.1 Niche (multidimensional, fundamental & realized niche); 1.2 Ecotype (Ecotone, Ecads & Ecoelins); 1.3 Microclimate.
2. Population Ecology: - 2.1 Unitary and Modular organisms, Ramets & Genets (clone); 2.2 Age pyramid; 2.3 Population growth (density dependent & independent); 2.4 Carrying capacity; 2.5 Simple population growth models (difference & logistic equations).
3. Community Ecology: - 3.1 Plant succession (primary & secondary) and Seral stages (with reference to Hydrosere); 3.2 Autogenic and Allogenic succession; 3.3 α , β , γ - diversity & diversity index (Simpson index)
4. Conservation: - 4.1 Biodiversity hot spots in India; 4.2 *in situ* & *ex situ* - conservation, seed bank and Cryopreservation.
5. Plant Geography: - 5.1 Phytogeographical regions in India (Chatterjee 1960); 5.2 Dominant flora of Eastern Himalayas, and Sunderban; 5.3 Endemism - types & factors; 5.4 Geographical Information System (GIS) - a brief idea.

Bibliography

Morphology of Angiosperms

1. Mitra, D., Guha, J. & Chowdhury, S.K....Studies in Botany, Vol.I [Moulik Library]
2. Eames, A.J.Morphology of Angiosperms [McGraw Hill]
3. Lawrence, G.H.M..... (Glossary in) Taxonomy of Vascular Plants [Oxford & IBH]

Palynology

1. Mehra, P.N.Evolution of spore through the ages [Palynological Society of India, National Botanic Garden, Lucknow]
2. Nair, P.K.K.Pollen Morphology of Angiosperms [Scholar Publication]
3. Erdtman, G.Pollen Morphology and Plant Taxonomy [Ielden: E.G. Brill]
4. Faegri, K. & Iverson, J.Text Book of Pollen Analysis [Oxford: Blackwell Scientific Publication]

Paper - V Theoretical 50 Marks
(Code - 121105)

1. Anatomy & Embryology 25 Marks [25 Periods]
2. Biochemistry 25 Marks [25 Periods]

Anatomy & Embryology

1. Cell Wall & Stele: - 1.1 Ultrastructure, chemical composition and functions of Cell wall and middle lamella; 1.2 Ontogeny of Trachea and Sieve tube; 1.3 Types & Evolution of Stellar forms; 1.4 Concept of Floral Anatomy.
2. Stomata: - 2.1 Types of Stomata (Metcalfe and Chalk, Stebbins and Khush).
3. Cambium: - 3.1 Distribution & structure; 3.2 Secondary growth.
4. Specialized Growth & Tissue organization: - 4.1 Mechanical Tissues and their distribution; 4.2 Anomalous secondary growth - in the stems of *Bignonia*, *Boerhaavia*, *Tecoma* and *Dracaena*, -and in the root of *Tinospora*; 4.3 Parastichy, Plastochrone & Leaf - trace.
5. Development: - 5.1 Organization of Shoot Apex and Root Apex (Tunica-Corpus & Körper-Kappe); 5.2 Floral Meristem and Ontogeny of Floral Parts (Primary concept).
6. Embryology: - 6.1 Sporogenesis & Gametogenesis - 6.1.1 Microsporogenesis & Microgametogenesis; 6.1.2 Megasporogenesis & Megagametogenesis (monosporic - 8 nucleate type); 6.2 Fertilization; 6.3 Development of Embryo in *Capsella bursa-pastoris* (Brassicaceae); 6.4 Development of Endosperms.

Biochemistry

1. Fundamentals: - 1.1 Covalent, non - covalent & hydrogen bonds, van der Waals interactions; 1.2 Structure & properties of water; 1.3 pH and buffer, Henderson - Hasselbalch equation; 1.4 Isoelectric point.
2. Biomolecules: - 2.1 Nucleic acids - nucleosides, nucleotides, oligo- & poly - nucleotides, different forms of DNA and RNA, nucleic acids derivatives; 2.2 Proteins - structure and classification of amino acids; Primary, Secondary, Tertiary & Quaternary structures of proteins; 2.3 Carbohydrates - structures of mono-, di-, oligo- & poly- saccharides; stereoisomers, enantiomers, epimers and anomers; sugar derivatives; 2.4 Lipids - structures of triglycerides, phospholipids and glycolipids; saturated and unsaturated fatty acids.
3. Bioenergetics and oxidation-reduction reaction: - 3.1. Laws of thermodynamics, 3.2 Open and closed system; 3.3 Exergonic and endergonic reactions; 3.4 Standard free energy (G°) change and actual free energy (ΔG) change; 3.5 Relation between ΔG° and K_{eq} ; 3.6 Coupling of biochemical reaction (with example) and its significance;

3.7 Energy rich bond with reference to ATP; 3.8 Electromotive force, half-reaction and conjugate redox pair; 3.9 Standard reduction potential ($\Delta E'^0$)

4. Enzymology: - 4.1 Definition, mechanism of action (lock and key, and induced fit hypothesis) and classification (only major groups - according to IUBMB); 4.2 Basics - Co-factor, coenzyme, prosthetic group, apoenzyme, holoenzyme, active site, activation energy, rate equation, rate constant and first order reaction; 4.3 Allosteric regulation with example; 4.4 Enzyme kinetics - steady state, velocity, and equilibrium, Michaelis-Menten equation and Lineweaver-Burk plot, and enzyme inhibition.

Bibliography

Anatomy

1. Esau, K.Plant Anatomy [Wiley Eastern]
2. Fahn, A.Plant Anatomy [Pergamon press]
3. Mauseth, J.D.Plant Anatomy [Benjamin Cummings Publications]
4. Foster, A.S.Practical Plant Anatomy [D. Van Nestnand Co.]
5. Ganguly, H.C. & Kar, A.K.College Botany Vol. I [New Central Book Agency]

Embryology

1. Maheswari, P.An Introduction to the Embryology of Angiosperms [Tata McGraw Hill]
2. Bhojwani, S.S. & Bhatnagar, S.D.The Embryology of Angiosperms [Vikas Publishing House]

Biochemistry

1. Voet, D. & Voet, J.G.Biochemistry [John Wiley]
 2. Conn, E.E., Stumpf, P.K., Bruening, G. & Doi, R.H.Outlines of Biochemistry [John Wiley & Sons]
 3. Lehninger, A.L., Nelson, D.L. & Cox, M.M.Principles of Biochemistry [CBS]
 4. Elliot, W.H. & Elliot, D.C.Biochemistry and Molecular Biology [Oxford University Press]
 5. Goodwin, T.W. & Mercer, E.I.Introduction to Plant Biochemistry [Oxford: Pergamon]
 6. Lea, P.J. & Leegwood, R.C.Plant Biochemistry and Molecular Biology [John Wiley]
 7. Berg, J.M., Tymoczko, J.L. & Stryer, L.Biochemistry [Freeman Publ.]
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Paper - VI Practical 50 Marks [External/ 5 hr.]
(Code - 121106)

<u>Topics</u>	<u>Marks</u>
1. Angiosperms (work out)	10
2. Anatomy (work out- double staining).....	10
3. Plant recognition (Angiosperm) [genus 1+species 1+family 1].....	3
4. Identification..... [4 specimens x 3 marks each].....	12
[From Bryophyta/ Pteridophyta/ Gymnosperms/ Palaeobotany/ Anatomy: - Not more than two from any group]	
5. Laboratory Note Books & Slides.....	4
6. Field records.....	4
7. Herbarium.....	3
8. Viva Voce..... [4 Qs. x 1 mark each].....	4
{2 Local Excursions, a visit to the BSI/CAL and One Excursion to a Different Phyto-Geographical Region - are all compulsory}	
[Field records, Laboratory Note Book of each section, Herbarium sheets [<u>only angiospermic weeds- at least 20 sheets</u>], signed by the respective teachers with date, and Slides, must be submitted at the time of examination]	

Angiosperms

1. [Work out] Identification of the Genus, with drawings, description, floral diagram, floral formula and identifying characters, of the wild plant specimens from the following families - **Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Verbenaceae, Scrophulariaceae, Acanthaceae, Lamiaceae and Rubiaceae.**
2. **Plant recognition** - Names & Families of the specimens from the angiospermic families included in the theoretical syllabus.

Anatomy

1. [Work out] Microscopic studies on - Types of Stomata, Sclereids, Raphides, Cystolith, Aleurone grains, Laticiferous ducts and oil glands.
2. [Work out] Staining, Preparation of permanent slides and study of Anomalous secondary structures - in the stems of **Bignonia, Boerhaavia & Dracaena**, and in the root of **Tinospora**.

Bryophytes

1. External Morphology (macroscopic - from preserved specimens) of the gametophyte plant body and Internal Morphological (microscopic - from permanent slides) study of the features given in parentheses, in the genera as - **Riccia** (V.T.S. of Thallus showing Antheridia/ Archegonia/ Sporophyte), **Marchantia** (L.S. of gemma cup/ Antheridiophore/ Archegoniophore), **Anthoceros** (L.S. of sporophyte) and **Funaria** (L.S. of capsule)

Pteridophytes

1. External Morphology (macroscopic - from preserved specimens) of the sporophyte plant body and Internal Morphological (microscopic - from permanent slides) study of the features found in the conditions / preparations given in parentheses, in the genera as - *Psilotum* (L.S. of synangium), *Lycopodium* (L.S. of strobilus), *Selaginella* (L.S. of strobilus), *Equisetum* (L.S. / T.S. of strobilus), *Ophioglossum* (L.S. of spike), *Dryopteris* (V.T.S. of fertile pinnule through sori) and *Marsilea* (H.L.S. / V.L.S. of sporocarp).

Gymnosperms

1. Morphological and Anatomical study (from preserved specimens and permanent slides) of different parts of certain genera as stated in the following - *Cycas* (Megasporophyll, Microsporophyll & L.S. of Ovule), *Pinus* (Male Cone, Female Cone and their L.S. views) and *Gnetum* (Male and Female Cones, and L.S. of male cone and Ovule).

Palaeobotany

1. Morphological study of *Ptilophyllum* and *Glossopteris* leaf fossils.
2. Study from slides - T.S. views of the stems of *Rhynia*, *Lepidodendron*, *Calamites*, *Lyginopteris* and *Cordaites*.

PART - III : 400 Marks

Paper - VII Theoretical 100 Marks (Code - 121107)

1. Plant Physiology60 Marks [50 Periods]
2. Pharmacognosy.....20 Marks [15 Periods]
3. Plant Biotechnology.....20 Marks [15 Periods]

Plant physiology

1. Plant water relations: - 1.1 Water transport - short distance transport by diffusion (Fick's law) & long distance transport by mass flow; 1.2 Components of water potential - osmotic potential (Van't Hoff equation), pressure potential, relation between cell water potential with its components and relative cell volume (Hoffler diagram), cell water potential and its components; 1.3 Absorption by roots - apoplastic, symplastic & transmembrane pathways; 1.4 Ascent of sap - tensile strength of water & cohesion - tension theory, role of air-water interface in the development of transpiration pull, Cavitation.
2. Transpiration: - 2.1 Stomata - micellation of guard cell; 2.2 Role of CO₂, K⁺ - ion, sucrose, blue light & abscisic acid in stomatal movement; 2.3 Antitranspirant.
3. Membrane Transport: - 3.1 Transport proteins - channels and carriers; 3.2 Primary active transport (electrogenic pump) and secondary active transport (symport & antiport).
4. Phloem Transport: - 4.1 Source & Sink; 4.2 Phloem loading & unloading, and composition of phloem sap; 4.3 Mass flow hypothesis.
5. Photosynthesis: - 5.1 Pigments - Structure of chlorophyll a & b, importance of carotenoids, and nature of phycobilins and anthocyanins; 5.2 Photobiology - Absorption and Action spectra, Red drop & Emerson effect, Photosystems & Photochemical reaction centers, Water splitting, and Cyclic and non-cyclic Photophosphorylation; 5.3 Calvin cycle and Photorespiration (mechanism & significance); 5.4 C₄ cycle (an out line), and efficiency of C₃ & C₄ plants; 5.5 CAM and its ecological significance.
6. Respiration: - 6.1 Glycolysis & its significance, and synthesis of acetyl Co-A; 6.2 Krebs cycle and its significance; 6.3 Oxidative pentose phosphate pathway and its significance; 6.4 Electron Transport System and Mechanism of Oxidative Phosphorylation; 6.5 P/e ratio; 6.6 Stoichiometry of glucose oxidation.
7. Nitrogen metabolism: - 7.1 Nitrogen fixing organisms and process of nodule formation; 7.2 Biochemistry of N₂ - fixation; 7.3 Amino acid biosynthesis (by GS-GOGAT, Transamination and direct amination); 7.4 Nitrification, nitrate assimilation and denitrification; 7.5 A general idea about *nif* and *nod* genes.

8. Growth regulators: - 8.1 Source, chemical nature, structure and role of - auxins, gibberellins, cytokinins, ethylene and abscisic acid; 8.2 Biosynthesis of IAA; 8.3 Signal Transduction pathway; 8.4 G-proteins, Ca^{2+} -ion & Calmodulin; 8.5 Mode of action of GA_3 .

9. Photomorphogenesis: - 9.1 Definition with example; 9.2 Photoreceptors, chemical composition of phytochrome, photostationary state and active form of phytochrome and photoreversibility.

10. Photoperiodism: - 10.1 Classification of plants, on the basis of 'Critical day length', with examples; 10.2 Importance of dark period in flowering and phytochrome control of flowering; 10.3 Photoperiodic stimulus and translocation of floral hormone; 10.4 Florigen concept; 10.5 Vernalization.

11. Dormancy: - 11.1 Concept of bud & seed dormancy; 11.2 Factors causing seed dormancy and method of breaking seed dormancy.

Pharmacognosy

1. General account: 1.1 Pharmacognosy and its importance in modern medicine; 1.2 Crude drugs; 1.3 Pharmacological and chemical classification of drugs; 1.4 Drug evaluations - (Definitions with examples of the following) - organoleptic, microscopic, chemical & physical; 1.5 Bioassay of drug - Definition and examples.

2. Secondary metabolites of plants: - 2.1 Definitions of, and difference in between, Primary and Secondary Metabolites; 2.2 Secondary metabolites and plant protection; 2.3 Utilization of major types of metabolites as drug - phenolics & quinones, terpenoids, flavonoids and alkaloids.

3. Active constituents: - Source plants, parts used, chemical nature & uses of the following - 3.1 Glycosidic anthraquinone (Barbaloin); 3.2 Tannic acid derivative (Catechin); 3.3 Resins (Gingerol, Curcuminoids); 3.4 Steroids (Diosgenin, Digitoxin); 3.5 Alkaloids (Emetine, Caffeine, Quinine, Strychnine, Reserpine, Vinblastine).

Plant Biotechnology

1. Plant Tissue Culture: - 1.1 Cellular Totipotency; 1.2 Tissue culture media; 1.3 Methods of sterilization; 1.4 Methods and applications of Callus and Cell Suspension culture; 1.5 A brief idea about Organogenesis and Somatic Embryogenesis; 1.6 Factors affecting organ induction; 1.7 Artificial seeds.

2. Other Culture Techniques: - 2.1 Methods and applications of Embryo culture; 2.2 Techniques of Pollen and Haploid culture and their applications; 2.3 Protoplast isolation and culture; 2.4 Protoplast fusion (somatic hybridization) and its importance.

3. Micropropagation: - 3.1 Definition and applications.

4. Recombinant DNA Technology:- 4.1 Restriction Endonucleases (Definition and examples), 4.2 Cloning Vector (pBR322), 4.3 Genomic and cDNA library.

5. Genetic Engineering: - 5.1 Brief idea about gene transfer methods with special reference to Ti Plasmid; 5.2 Transgenic plants and their importance.

Bibliography

Plant Physiology

1. Taiz, L & Zeiger, E.Plant Physiology [Sinauser Associates Inc. Publishers]
2. Wilkins, M.B.Advanced Plant Physiology [ELBS, Longman]
3. Hopkins, W.G. & Hüner, M.P.Introduction to Plant Physiology [John Wiley & Sons.]
3. Jain, V.K.Fundamentals of Plant Physiology [S. Chand & Co.]
4. Salisbury, F.B. & Ross, C.W.Plant Physiology [Wordsworth Publ. Co.]
5. Mukherji, S. & Ghosh, A.Plant physiology [New central Book Agency]
6. Pandey, S.N & Sinha, B.K.Plant Physiology [Vikas Publ. House]
7. Verma, S.K.A Text book of Plant Physiology & Biochemistry [S. Chand & Co.]
8. Sinha, R.K.Modern Plant Physiology [Narosa Publishing House]
9. Hall, D.O & Rao, K.K.Photosynthesis [Cambridge Publishing House]
10. Singhal, G.S.Concepts Photobiology, Photosynthesis & photomorphogenesis [Narosa Publishing House]

Pharmacognosy

1. Wallis, T.E.Text Book of Pharmacognosy [CBS Publishers....]
2. Evans, W.C..... (G.E. Trease & W.C. Evans') Pharmacognosy [Saunders]
3. Melentyeva, G. & Antonova, L.Pharmaceutical Chemistry [MIR Publishers]
4. Beckett, A.H.Practical Pharmaceutical Chemistry [CBS Publishers.....]

Plant Biotechnology

1. Razdan, M.K.An Introduction to Plant Tissue Culture [Oxford & IBH]
 2. Bhojwani, S.S. & Razdan, M.K.Plant Tissue Culture: Theory and Practice [Elsevier]
 3. Dixon, R.A. & Gonzales. M.K.Plant Cell Culture: A Practical Approach [Oxford Univ. Press]
 4. Dubey, R.C.Biotechnology [S. Chand & Co.]
 5. Balasubramanian, D. et alConcepts in Biotechnology [Universities Press]
 6. ChannarayappaMolecular Biotechnology: Principles and Practices [Universities Press]
 7. Gamborg, O.L. & Philips, G.C.Plant Cell, Tissue and Organ Culture - Fundamental Method [Narosa Publications]
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Paper - VII

(Co.)

1. Cell Biologyof the Gene [Benjamin/Cummings] 100s]
2. Genetics & Molecular Biology Principles of Gen 145] Periods]
3. Plant Breeding & Biometry20 Marks [15 Periods]

Cell Biology

1. Microscopy: - 1.1 Brief knowledge about microscopy (light, Phase contrast, TEM, SEM, Immunofluorescence and confocal) 1.2 Resolving power.
2. Origin and Evolution of cells: - 2.1 Ribozyme and RNA world; 2.2 The first cell; 2.3 Origin of Eukaryotic cell; 2.4 Organellar DNA (cp- & mt- DNA).
3. Cell Membrane: - 3.1 Ultrastructure and function; 3.2 Endomembrane system and Cytoskeleton; 3.3 Cellular Organelles - Mitochondria, Plastid and Golgi apparatus.
4. Nucleus and Chromosome: - 4.1 Ultrastructure of Nuclear pore complex; 4.2 Nucleolus ultrastructure and ribosome biogenesis; 4.3 Eukaryotic chromosome - chromatin organization and DNA packaging, euchromatin and heterochromatin; 4.4 Karyotype concept and its parameters; 4.5 Brief knowledge of chromosome banding (C, G, & Q) and its application.
5. Cell Cycle & its Regulation: - 5.1 Meiotic cell division and its significance; 5.2 structure & Functions of Centromere, Kinetochores & Spindle apparatus; 5.3 Structural organization & function of Telomere; 5.4 Dynamics of chromosome movement in anaphase; 5.5 Mechanism of cell cycle control in yeast (role of MPF); 5.6 Apoptosis (Preliminary idea).

Genetics & Molecular Biology

1. Inheritance: - 1.1 Mendelian basis of inheritance and Gene Interaction; 1.2 Epistasis; 1.3 Cytoplasmic inheritance; 1.4 Sex determination; 1.5 Sex linked inheritance.
2. Linkage, Crossing over and Gene mapping: - 2.1 Complete and incomplete linkage & linkage group; 2.2 Molecular mechanism of crossing over (Holliday Model) and Detection of crossing over (McClintock's experiment); 2.3 Gene mapping (Three point test cross); 2.4 Molecular mapping- FISH and GISH (brief idea),
3. Ploidy: - 3.1 concept and examples; 3.2 Aneuploidy and Polyploidy - types, examples, meiotic behavior and importance.
4. Chromosomal aberration: - 4.1 Definition and Factors responsible; 4.2 Types, meiotic behavior and significance of Deletion, Duplication, Translocation and Inversion.

Paper - IX Practical 100 Marks [6 hr.]
(Code - 121109)

1. Plant Physiology (Major & Minor)	30 Marks
2. Biochemistry (Qualitative & Quantitative).....	35 Marks
3. Pharmacognosy (Two Experiments)	15 Marks
4. Laboratory Note Books	10 Marks
5. Viva Voce	10 Marks

[Laboratory Note Book of each section, signed by the respective Teachers with date, must be submitted at the time of examination]

Plant Physiology

Major [20 marks]

1. Determination of stomatal frequency and rate of transpiration per stomata per hour.
2. Rate of photosynthesis under varying HCO_3^- concentration (using bicarbonate) in an aquatic plant to find out the optimum and toxic concentration.
3. Measurement of oxygen uptake by respiring tissue (per gram / hr.)- By germinating seeds.
4. Determination of R.Q. of germinating seeds.
5. Measurement of osmotic pressure of storage tissue by weighing method.
6. Measurement of osmotic pressure in the leaf cells of *Rhoeo discolor* by plasmolytic method.

Minor [10 Marks]

1. Determination of stomatal frequency.
2. Relationship between evaporation and transpiration.
3. Extraction and detection of anthocyanins pigments from plants.
4. Separation of plastidial pigments by usual solvent system method.
5. Comparison of imbibitions of water by starchy, proteinaceous and fatty seeds.

Plant biochemistry

A. Qualitative [15 Marks]

1. Detection of organic acids - citric, oxalic, malic & tartaric from laboratory samples.
2. Detection of protein from plant samples.
3. Detection of nature of carbohydrate- glucose, fructose and starch from laboratory samples.
4. Detection of Ca, Mg, Fe and S from plant ash samples.

B. Quantitative [20 Marks]

1. Estimation of amino-nitrogen in an amino acid by formol titration method.
2. Estimation of glucose by Benedict's quantitative reagent.
3. Estimation of titrable acidity from lemon.
4. Estimation of catalase activity in plant samples.
5. Estimation of urease activity in plant samples.
6. Colorimetric estimation of protein using Folin-Ciocalteu phenol reagent.

Pharmacognosy
Major [10 marks]

1. Chemical tests for - (a) Tannin (from *Camellia sinensis* & *Terminalia chibula* - any two confirmatory tests), and (b) Alkaloids (Caffeine and Quinine from any drug - single test - by I_2 Soln. in KI added to the sample in acidic medium).

Minor [5 Marks]

1. Microscopic study of powder (of parts used in drug) - *Zingiber officinale* and *Holarrhena antidysenterica*.

2. Histo-chemical tests of - (a) Curcumin (*Curcuma longa*), (b) Starch in non-lignified vessel (*Zingiber officinale*) and Alkaloids (in the stem of *Catharanthus roseus* and bark of *Holarrhena antidysenterica*)

Paper - X Practical 100 Marks [6 hr.]
(Code - 121110)

1. Study of Mitotic Chromosomes	25 Marks
2. Study of Meiotic Chromosomes	15 Marks
3. Study of Mitotic Index	10 Marks
4. Biometry	15 Marks
5. Identification.....[5 specimens x 3 marks each].....	15 Marks
(Specimens / Slides: - as prescribed in the syllabus)	
6. Laboratory Note Books & Slides	10 Marks
7. Viva Voce	10 Marks

[Laboratory Note Book of each section, signed by the respective Teachers with date, and Slides, must be submitted at the time of examination]

Study of Chromosomes & Mitotic Index

1. Chromosome Preparation: - 1.1 Pretreatment, Fixation, Staining, Squash and Smear preparation; 1.2 Preparation of permanent slides.

2. Study of Mitotic Index: - 2.1 Determination of index and frequency of different mitotic stages (to be calculated from dividing cells) in normal pre-fixed growing root tips of *Allium cepa*.

3. Study of Mitotic Chromosomes: - 3.1 Metaphase chromosome preparation, free hand drawing and drawing under drawing prism (under oil-immersion lens); 3.2 Determination of $2n$ number and comment on chromosome morphology of *Allium cepa*, *Nigella sativa*, and *Lens culinaris*.

4. Study of Meiotic Chromosomes: - 4.1 Smear preparation of meiotic plates, identification and free hand drawing of different meiotic stages of *Allium cepa* flower bud.

5. Identification from permanent slides: - 5.1 Meiotic cells - normal stages, abnormal stages - laggards, anaphase bridge and ring chromosome (*Rhoeo discolor*); 5.2 Mitotic cells - Abnormal stages: early separation, late separation, multipolarity, sticky bridge, fragmentation and pollen mitosis.

6. Isolation of plant genomic DNA (from Rice or Mustard seedling).

BIOMETRY

1. Determination of goodness of fit in normal and modified mono and dihybrid ratios (3:1, 9:7, 13:3, 1:1:1:1, 15:1, 9:3:3:1) by Chi-square analysis and comment on the nature of inheritance.

2. Univariate analysis of statistical data: Statistical tables, mean mode, median, standard deviation, and standard error (using seedling population/leaflet size).

West Bengal State University

Barasat

Syllabi for 3 year - B. Sc. Degree Course
[3 years 1+1+1 Examination System]

BOTANY

(GENERAL)

[WBSU Code - 1212]

2009

[Syllabus to be effective from 2010 – 2011 Session]

[Mode of internal assessment is to be made as per the directive given in the respective pages vide page No. 34 & 37]

Distribution of Marks

Total Allotment – 400 Marks				
Terminal Examinations	Theoretical Assessment	Practical Assessment		Total Marks
		Internal	External	
Part - I (Paper I) First Year	Paper I [100] 121201	Shall start and continue till the 2 nd Yr. Part II examination *	Nil	100
Part – II (Paper II & III) Second Year	Paper II [100] 121202	Paper III Practical** 121203		200
		80	20	
Part – III (Paper IV & V) Third Year	Paper IV [70] 121204	Paper V Practical 121205		100
		20	10	
Total Marks →	270	100	30	400

*/** It is very important to note that the Practical Classes for the topics included in the Paper III (Scheduled for Part II Exam / 2nd year Terminal Exam), should be started from First Year so as to complete the curriculum in time (see detailed syllabus).

BOTG

PART - I [First Year Terminal] : 100 Marks

Paper - I Theoretical 100 Marks [3hr.] (Code - 121201)

- Group A: - Algae, Fungi & Lichen, Plant Pathology & Microbiology.....40 Marks
Group B: - Bryophyta, Pteridophyta, Gymnosperms & Palaeobotany.....30 Marks
Group C: - Morphology & Taxonomy of Angiosperms, and Palynology.....30 Marks

Group A: - [40 Marks / 25 Periods]

Algae - [10 Marks / 6 Periods] General account.// Morphology, Reproduction & Examples of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Phaeophyceae & Rhodophyceae.// Alternation of Generations in Chlorophyceae and Phaeophyceae.// Sources and uses of edible algae, agar, algin & diatomite.

Fungi & Lichen - [10 Marks / 6 Periods] General characters & types of spores.// Primary features and examples of Oomycota, Chytridiomycota, Zygomycota, Ascomycota and Basidiomycota.// Concept of Anamorph & Teleomorph.// Fungal symbiosis - Mycorrhiza, Lichens and their importance.// Sources and uses of ethanol, alpha amylase, penicillin & Griseofulvin.

Plant Pathology - [10 Marks / 6 Periods] Terms & Definitions - Pathogen, Propagule, Vector, Inoculum, Infection, Symptoms (necrosis, wilt, spot, blight, hypoplastic & hyperplastic).// Disease & Disease Cycle. Disease Triangle, Disease Management // Koch's postulates // Phytoalexins.// Symptoms, Causal organisms, Disease cycle & Control measures of - (a) Tungro virus disease of rice & (b) Late blight of potato.

Microbiology - [10 Marks / 7 Periods] Three Domains of Life.// Prokaryote & Eukaryote.// Binary fission & Exponential Growth.// Bacterial Cell Wall.// Salient features of Plant Virus & Phage.// Lytic (by T₄ phage) cycle & Lysogeny (with λ Phage).// Horizontal gene transfer and gene recombination through - Transformation, conjugation & Transduction.// Sources & Uses of Amylase & Streptomycin.

Group B: - [30 Marks / 15 Periods]

Bryophyta - [8 Marks / 4 Periods] General character (the amphibian nature).// Characters and examples of Hepaticopsida, Anthocerotopsida & Bryopsida.// Reproductive Structures and Sporophytes of *Riccia*, *Anthoceros* and *Funaria*.

Pteridophyta - [8 Marks / 4 Periods] Characters and examples of Psilophyta, Lycophyta, Sphenophyta & Filicophyta.// Structure of reproductive organs in the Sporophytes of *Lycopodium*, *Selaginella* and *Dryopteris*.

Gymnosperms - [8 Marks / 4 Periods] Concept of Progymnosperms // Characters and examples of Cycadophyta, Coniferophyta & Gnecophyta // Structures of Microsporangia and Ovules of *Cycas*, *Pinus* & *Gnetum*.

Palaeobotany - [6 Marks / 3 Periods] Importance of fossil study // Definitions and Examples of Impression, Cast and Amber // Organization of Reconstructed *Williamsonia Sewardiana*.

Group C: - [30 Marks / 15 Periods]

Morphology - [5 Marks / 3 Periods] Types of Inflorescences and Flowers with Examples // Aestivation // Cohesion and Adhesion of floral parts.

Palynology - [5 Marks / 2 Periods] Definition // Pollen Types // Various Branches & Applications.

Taxonomy - [20 Marks / 10 Periods] Objectives & Functions // Alpha & Omega taxonomy, Phylogenetic Classification & Data source // ICBN - Principles, Binomial, Authors' citations, Suffixes for major taxa & sub-groups // Definitions of Artificial, Natural and Phylogenetic systems of classification // Classification of Dicotyledonous angiosperms, following Bentham & Hooker, upto series with characters // Diagnostic features of the following families - Malvaceae, Leguminosae (Fabaceae), Solanaceae, Lamiaceae, Cucurbitaceae, Asteraceae, Poaceae & Orchidaceae.

PART - II [Second Year Terminal] : 100 Marks

Paper - II Theoretical 100 Marks [3 hr.] (Code - 121202)

Group A: - Anatomy, Embryology, Economic Botany & Ecology.....40 Marks

Group B: - Cell Biology and Genetics30 Marks

Group C: - Biochemistry and Plant Physiology.....30 Marks

Group A: - [40 Marks / 25 Periods]

Anatomy - [10 Marks / 8 Periods] Cell wall - chemistry, ultrastructure & function // Stomatal types // Evolution of stelar types // Shoot apex (Tunica-Corpus) and root apex (Körper-Kappe) // Secondary growth in the stem of *Tecoma*.

Embryology - [10 Marks / 6 Periods] Sporogenesis and Gametogenesis // Embryo development in *Capsella bursa-pastoris* // Endosperm development.

Economic Botany - [10 Marks / 5 Periods] Study of the following economically important plants [only binomials, families, parts used and uses] - rice & wheat // sugarcane // mung & gram // ginger & cumin // onion & garlic // tea & coffee // cinchona, neem, ipecac & vasak // mustard, ground nut & coconut // potato, pumpkin & carrot // cotton & jute // sal & teak // mango, litchi & jack fruit.

Ecology - [10 Marks / 6 Periods] Ecotype and microclimate // Plant community // Plant succession - Hydrosere & Xerosere // Adaptive features of Hydrophytes, Halophytes & Xerophytes // Biodiversity - definition & levels of biodiversity (genetic, species & ecosystem) // Methods of *in situ* & *ex situ* conservation.

Group B: - [30 Marks / 25 Periods]

Cell Biology - [10 marks / 8 Periods] Endomembrane system & Cytoskeleton // Ultrastructure of nuclear membrane & nucleolus // Nucleosome, euchromatin & heterochromatin // cell cycle, interphase & cell division with reference to meiosis // Chromosomal aberration - deletions, duplications, inversion and translocation // Aneuploidy and polyploidy - types, importance, and role in evolution.

Genetics - [20 Marks / 17 Periods] Central dogma // DNA replication - Meselson and Stahl's experiment & mechanism of replication // Transcription and translation (Protein synthesis) // Genetic code - Properties // Mendelian basis of inheritance, predicting Mendelian ratios, sex determination, sex linked inheritance, gene concept, gene interactions (allele interactions) & epistasis // Linkage group and genetic map (three point test cross) // Test cross and back cross // Mutation, point mutation (tautomerization, transition, transversion and frame shift) // Mutagen - examples of physical & chemical mutagens // Brief concept of split gene, transposons & repetitive DNA.

Group C: - [30 Marks / 25 Periods]

Biochemistry - [10 marks / 8 Periods] Carbohydrates - chemistry and importance of ribose, glucose, fructose, sucrose, maltose, starch, cellulose & dextran // Protein - primary, secondary, tertiary & quaternary structures // Enzyme- Definition, Types and examples, co-factors, co-enzymes.

Plant Physiology - [20 Marks / 17 Periods] Transpiration - transpiration stream and pathway of water movement // Role sugar and K^+ ion in stomatal movement // Xylem cavitation & embolism // Source-sink relation in phloem transport // Photosynthesis - Absorption and action spectra, enhancement effect, PS-I & PS-II, Z-scheme and photo-phosphorylation // Calvin cycle & RUBISCO // Significance of photorespiration, C4 cycle & CAM // Respiration - Glycolysis, Role of ATP, Krebs cycle, ETS & oxidative phosphorylation // N_2 fixation and amino acid synthesis (GS - GOGAT system) // Specific role of auxine, gibberellins, cytokinin, ethylene and abscisic acid in the biological cycle of a plant // Photomorphogenesis - physiology of flowering, phytochrome, cryptochrome & Florigen concept.

Paper - III Practical 100 Marks

(Code - 121203)

[Internal - 80 Marks] & [External - 20 Marks]
Regular & Daily Internal Assessment [60 Marks]

<u>Topics</u>	<u>Marks [Completion & Performance]</u>
1. Cryptogams - Algae/Fungi.....	8
2. Angiosperms.....	10
3. Anatomy.....	8
4. Plant Physiology.....	10
5. Study of Mitotic Chromosome.....	8
6. Field Work.....	6
7. Attendance.....	10

Field record - stating date, types of vegetation & predominant plant species present in the area visited [Two local excursions (3 x 2 = 6 Marks) are to be attended by the students]

Centralized Internal Assessment [20 Marks]

8. Identification..... [10 specimens x 2 marks each].....20

Centralized External Assessment [20 Marks]

To be scheduled by the W. B. State University

9. Laboratory note books, Slides, Field records, Herbarium sheets..... [5+3+3+3].....14

10. *Viva Voce*.....6

Laboratory note books [must regularly be checked and signed with date]; Slides [permanent slides prepared in the class]; Herbarium [at least 10 (ten) herbarium specimens (sheets) of common angiospermic weeds are to be prepared by the students, stating details of the specimens].

[The materials included under Topic No. 9 are to be submitted, as and when required, at the time of external centralized examination]-----

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Pro-forma of Log Book cum Attendance Register for continuous Internal Assessment of Paper III: Effective & Valid from 2008 -09 Session

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West Bengal State University

Barasat

Syllabi for 3 year - B. Sc. Degree Course
[3 years 1+1+1 Examination System]

BOTANY

(GENERAL)

[WBSU Code - 1212]

2009

[Syllabus to be effective from 2010 – 2011 Session]

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		80	20	
Part – III (Paper IV & V) Third Year	Paper IV [70] 121204	Paper V Practical 121205		100
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BOTG

PART - I [First Year Terminal] : 100 Marks

Paper - I Theoretical 100 Marks [3hr.]
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Group B: - Bryophyta, Pteridophyta, Gymnosperms & Palaeobotany.....30 Marks
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Group C: - [30 Marks / 15 Periods]

Morphology - [5 Marks / 3 Periods] Types of Inflorescences and Flowers with Examples // Aestivation // Cohesion and Adhesion of floral parts.

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PART - II [Second Year Terminal] : 100 Marks

Paper - II Theoretical 100 Marks [3 hr.]

(Code - 121202)

Group A: - Anatomy, Embryology, Economic Botany & Ecology.....40 Marks

Group B: - Cell Biology and Genetics30 Marks

Group C: - Biochemistry and Plant Physiology.....30 Marks

Group A: - [40 Marks / 25 Periods]

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Group B: - [30 Marks / 25 Periods]

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Group C: - [30 Marks / 25 Periods]

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Paper - III Practical 100 Marks

(Code - 121203)

[Internal - 80 Marks] & [External - 20 Marks]

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Field record - stating date, types of vegetation & predominant plant species present in the area visited [Two local excursions (3 x 2 = 6 Marks) are to be attended by the students]

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