VIDYASAGAR UNIVERSITY

BOTANY

(Honours)

Under Graduate Syllabus

(3 Tier Examination Pattern)

w.e.f. 2014-2015

REVISED

Vidyasagar University

Midnapore 721 102

West Bengal

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Vidyasagar University

Botany

B.Sc. (Honours)

Part-I

Paper – I (Theoretical)	F.M..: 100 (90 + 10)*
Paper – II (Theoretical)	F.M..: 100 (90 + 10)*

Part – II

Paper – III (Theoretical)	F.M. : 100 (90 + 10)*
Paper – IV (Theoretical)	F.M. : 100 (90 + 10)*
Paper – V (Practical)	F.M. : 100

Part – III

Paper – VI (Theoretical)	F.M. : 100 (90 + 10)*
Paper – VII (Practical)	F.M. : 100
Paper – VIII (Practical)	F.M. : 100

* External Assessment (University level) – 90 marks
Internal Assessment (College level) – 10 marks.

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Paper wise Distribution of Subject Contents

PART – I

PAPER – I (Theory)

Section – I

Microbiology

Section – II

Phycology

Section – III

Mycology and Plant Pathology

Section – IV

Morphology

PAPER – II (Theory)

Section – I

Bryology and Pteridology

Section – II

Gymnosperm, Paleobotany

Section III

Palynology, Embryology

PART – II

Paper- III (Theory)

Section – I

Taxonomy of Angiosperms

Section – II

Ecology, Economic Botany, Ethnobotany, Floriculture

Section – III

Pharmacognosy, Phytogeography

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Paper IV (Theory)

Section I

Plant Physiology, Biochemistry

Section II

Applied Botany

Section III

Anatomy

PAPER – V (Practical)

Microbiology (10)

Algae (10)

Fungi (10)

Pathology (5)

Bryophyte (10)

Pteridophyte (10)

Morphology (12)

Submission of specimen (5)

Identification of slides (6)

Practical Note Book (7)

Tour report (3)

Slide submission (2)

Viva 10

PART III

Paper VI (Theory)

Section I

Cell Biology and Molecular Biology

Section II

Genetics

Section III

Biotechnology and Bioinformatics

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Section IV
Plant Breeding and Biometry

Paper- VII (Practical)
Taxonomy (18)
Pharmacognosy (7)
Anatomy (20)
Ecology (10)
Identification (15)
Submission (6)
Lab Note Book (10)
Field report (4)
Viva voce (10)

Paper VIII (Practical)
Plant Physiology (20)
Biochemistry (10)
Biometry (8)
Cytology (15)
Plant Breeding (6)
Dissertation (15)
Identification of cytological slides (6)
Laboratory Note Book (10)
Viva voce (10)

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Detailed Syllabus

Part I

Paper I (Theory)

Section – I

Microbiology

Section – II

Phycology

Section – III

Mycology and Plant Pathology

Section – IV

Morphology

Section – I

MICROBIOLOGY:

Origin of life, History, Definition and Distribution of microorganisms, Scope and importance of their study, Classification of microorganisms - Idea about prokaryotic and eukaryotic microorganisms including five and three kingdom concepts.

i) Virus: Nature of viruses, Types (Plant, Animal and Bacteriophage), Structure of T4 and TMV, Lytic and Lysogenic cycle with reference to T4 and Lambda phage. Interferon, Structure of AIDS causing virus-HIV.

ii) Bacteria: Systematic position, Characters need for identification, Types (on the basis of cell shape), Ultrastructure (Flagella, Pilli, Endospore, Capsule and Slime Layer, Cell Wall of Gram Positive and Gram Negative Bacteria), Cell membrane (structure and function in brief), Concept of genome and plasmid, Special organelles (Mesosome, Magenetosome) and reserve materials, Bacterial growth-definition, growth curve, Generation time, Cultural condition - physical (temperature, pH), Nutritional requirements, Recombination-transformation *(Streptococcus pneumonae),* transduction (generalised), conjugation (F and Hfr mediated), Idea of soil

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microorganisms, Role of microbes in biogeochemical cycle (Nitrogen cycle). Actinomycetes, Archaebacteria, Myxomycetes (Diagnostic features only).

Section – II

ALGAE:

A general account: Habit and habitat, thallus organization, mode of reproduction, origin and evolution of sex in algae. Criteria of classification, Classification of algae Lee (1989) with class characters. Life cycle patterns in algae.

Cyanophyta - Salient features and chromatic adaptation, Bacterial features of Cyanophyta, Ultrastructure of cell including heterocyst and its role in nitrogen fixation.

Types - *Anabaena.*

Chlorophyta - Salient features.

Types - *Chlamydomonas, Oedogonium, Chara.*

Bacillariophyta - Salient features, vegetative structure, reproduction of centric and pinnate diatoms.

Xanthophyta - Salient features.

Type - *Vaucheria.*

Phaeophyta - Salient features

Types - *Ectocarpus, Laminaria*

Rhodophyta - Salient features

Type - *Polysiphonia*

LICHEN:

Definition & types, Reproduction, Economic and Ecological importance.

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Section – III

FUNGI:

General Characters - Habit and habitat. Hyphal forms, Nutrition, Reproduction, Classification (Ainsworth-1973) upto subdivisions with characters and examples. Evolution of sex in fungi. Life Histories – Phycomycotina, Types - *Synchytrium, Rhizopus;* Ascomycotina, Types - *Penicillium, Ascobolus, Claviceps;* Basidiomycotina
Types - *Agaricus, Polyporus;* Deuteromycotina - A general account Types - *Alternaria.*

PLANT PATHOLOGY:

Classification of plant diseases. Terms and definitions: Causal complex, primary and secondary inocula, disease cycle, pathogenecity, susceptibility, resistance and immunity, sign and symptom, necrosis, hyperplasia and hypoplasia, disease syndrome, Koch's postulates, quarantine.

Host - parasite interaction: mechanism of infection, role of enzymes and toxins in pathogenesis, defence mechanism, with special emphasis on phytoalexins.

Physical, chemical and Biological Control of plant diseases.

Knowledge of the following diseases: symptoms, causal organism, etiology of pathogen, disease cycle & control measure of (i) Late Blight of potato, (ii) Tungro Virus disease of rice, (iii) Black stem rust of wheat, (iv) Tikka disease of ground nut, (v) Blight of betel.

Section - IV

MORPHOLOGY

a. **Inflorescence:** Types and evolution.
b. **Flowers:** Types, corolla aestivation, cohesion and adhesion of stamens, different types of ovule, placentation - types and evolution, floral formula and floral diagram.

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c. **Pollination:** Types and contrivances.
d. **Fruits:** Types and dispersal.

PAPER – II (Theory)

Section – I
Bryology and Pteridology
Section – II
Gymnosperm, Paleobotany,
Section – III
Palynology and Embryology

Section - I

BRYOLOGY

1. Classification of Bryophytes (Proskauer, 1957) upto class characters. Mistchler, 1994- outline only.
2. Origin of Bryophytes with reference to different theories.
3. Life history (including Gametophytic structure, Reproduction, Development and structure of sporophyte, Spore dispersal) of *Riccia, Marehantia, Anthoceros, Sphagnum* and *Funaria.*
4. Phylogenetic relationship and evolutionary tendencies in Bryophytes (among the studied genera).
5. Ecological and economic importance of Bryophytes with reference to soil erosion, pollution monitoring and control, geo-botanical prospecting, animal feed, horticulture and antibiotics.

PTERIODOLOGY

1. Origin and Classification of Pteridophytes (Sporne, 1975) with class characters and example, Telome concept.
2. Life history (including Sporophytic nature, Reproduction and structure of gametophyte) of *Psilotum, Lycopodium, Selaginella, Equisetum, Marsilea.* Characteristic features and geographic

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distribution and evolutionary significance of *Rhynia, Lepidodendron, Lepidoearpon, Calamities.*

3. Progymnosperm- diagonostic features and significance.
4. Heterospory and attainment of seed habit in Pteridophytes.
5. Economic importance (food, medicine and agriculture) of Pteridophytes.

Section - II

GYMNOSPERM

1. Classification of Gymnosperm (Stewart and Rothwel, 1993) with class characters and example.
2. Establishment of heterospory and seed habit.
3. General characters of the order and structural features of *Cycadofilicales (Lygenopteris), Glossopteridales (Glossopteris)* and *Benettitales (Williamsonia sewardiana)*.
4. Life history of *Cycas, Pinus, Ginkgo* and *Gnetum.*
5. Economic importance of Gymnosperms with reference to wood, resin, essential oil and drugs..

PALAEOBOTANY

1. Definition, process of fossilisation, fossil types- trace fossil, chemical fossil, Petrifaction and Compression.
2. Index fossil. Radio Carbon dating. Nomenclature, Economical and ecological importance.
3. Geological time scale and major events of plant life through geological time, Dominant plant groups through ages.

Section III

PALYNOLOGY

1. Definition of Palynology, different branches of Palynology, importance of study.

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2. Spores, Pollen morphology with special reference to polarity, size, shape, symmetry, aperture and sculpture. NPC classification.

EMBRYOLOGY

1. Development of male and female gametophyte of Angiosperms.
2. Development and structure of endosperm - nuclear, hellobial and cellular types.
3. Development of a typical dicot embryo and Monocot embryo.

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Part II

Paper- III (Theory)

Section – I

Taxonomy of Angiosperms

Section – II

Ecology, Economic Botany, Ethnobotany, Floriculture

Section – III

Pharmacognosy, Phytogeography

Section - I

TAXONOMY OF ANGIOSPERMS

a) Taxonomy and Systematics, aims and objectives, phases of Taxonomy.

b) The concept of primitive and advanced characters, Monophyly and Polyphyly, Parallelism and Convergence, ideas about Alpha & Beta taxonomy, units of classification and taxonomic keys (indented and bracketed).

c) Botanical Nomenclature:
Elementary Knowledge of ICBN (ICN)
Principles, the type methods, rules of Priority, effective and valid publications, citation of author's name, rejection of names.

d) Major systems of Plant classification like Betham and Hooker, Arthur Cronquist (1988), Idea of APG I, II, III (2009).

e) Herbarium: Collection of specimens, preparation, preservation and maintenance of herbarium. Important herbaria in India; roles of herbarium; Botanic gardens: Roles and some important gardens in India. Digital Herbarium.

f) Modern evidences in Taxonomy: Anatomy, Cytology, Palynology, Chemotaxonomy, and Numerical taxonomy (Definition, purpose and use only).

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g) Diagnostic features and systematic position (Bentham & Hooker, Cronquist) including all economic plants of

Dicot :- Magnoliaceae, Nymphaeaceae, Brassicaceae, Malvaceae, Fabaceae (ss), Caesalpiniaceae, Mimosaceae, Rutaceae, Anacardiaceae, Euphorbiaceae, Apiaceae, Asclepiadaceae, Apocynaceae, Solanaceae, Verbenaceae, Lamiaceae, Scrophulariaceae, Acanthaceae, Rubiaceae, Cucurbitaceae, Asteraceae.

Monocot: Alismataceae, Liliaceae, Zingiberaceae, Arecaceae, Poaceae, Cyperaceae, Orchidaceae.

h) Origin of Angiosperm: Basic idea.

Section II

ECOLOGY, PLANT GEOGRAPHY, BIODIVERSITY.

1. Modern Concepts of Ecology: Shallow and Deep Ecology (Basic ideas only).
2. Ecological factors: their impact on plant life, Different types of plant adaptations (Mesophyte, Xerophyte, Halophyte, Hydrophyte).
3. Concepts of Ecosystem, Ecotone, Edge effect.
4. Concepts of population and its characteristics, Ecological niche and habitat, principle of competitive exclusion, r-and K-strategies.
5. Biogeochemical cycles: Basic ideas of different biogeochemical cycles and their importance (C, N, S, P only).
6. Community Ecology: History and definition, Characteristics of community, community composition, methods of study of the community structure.
7. Pollution: Air, water and soil, effects of pollutants on organisms.
8. An elementary knowledge of Green House effect and Global Warming, Acid precipitation, Ozone depletion.

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9. Deforestation-its causes and consequences, Chipko movement, Joint Forest Management.
10. Concept of Social Forestry.
11. Biomonitoring: the state of environmental pollution.
12. Natural Resources and Waste Management (including phytoremediation), Reclamation of wasteland.
13. Basic ideas of Ecotoxicology, Environmental Impact Assessment (EIA) and Biopesticides.
14. Biodiversity: Definition, importance, degeneration and conservation.

ECONOMIC BOTANY

1. Classification of economically important plants based on uses.
2. Scientific names, family and morphological nature of plant parts used, purpose of use of the following.

i)	Cereals & Millets	:	Rice, Maize, Wheat
ii)	Pulses	:	Soyabean, Mung, Lentil.
iii)	Oils & Fats	:	Sunflower, Mustard, Cocoanut, Ground nut.
iv)	Fibres	:	Cotton, Jute, Coir (Cocoanut).
v)	Timber	:	Teak, Sal, Gumhar.
vi)	Latex	:	Rubber, Purging nut (Jatropha).
vii)	Aromatic/ Volatile Oil	:	Lemon grass, Eucalyptus, Clove oil.
viii)	Beverage	:	Tea, Coffee.
ix)	Spices	:	Turmeric, Ginger, Cumin, Coriander.

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x)	Medicinal Plants	:	Serpentine root *(Rauvolfia),* Creat *(Andrographis)* Ipecac, Aljun, Yew *(Taxus),* Red periwinkle *(Catharanthus),* Margosa.
xi)	Narcotics	:	Ganja, Opium.
xii)	Fruits	:	Jackfruit, Banana, Litchi, Orange. :
xiii)	Vegetables	:	Potato, Pumpkin, Cauliflower, Lady's finger.
xiv)	Methods of cultivation, yield and uses of	:	Rice, Tea, Cashew nut.

xv) Method of cultivation of Lemon grass and oil extraction method. Methods of cultivation, propagation and trading of Rose, Tuberose, Marigold, *Chrysanthemum* in India.

ETHNOBOTANY

1. Ethnobotany: Definition, scope and relevance.
2. Study of plants used by the different tribes in one or more of the following aspects - as food, clothing, shelter, medicine, beverages and agricultural implements.

Section III

PHARMACOGNOSY

i. Phannacognosy: Definition, Importance, Classification of drug - Chemical and Phannacological, Drug evaluation.

ii. Organoleptic and microscopic studies with reference to nature of active principles and common adulterants of *Alstonia (bark), Adhatoda (leaf), Strychnos (seed), Rauvolfia (root),* and *Zinziber (rhizome).*

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iii. Secondary Metabolites: Definition of primary and secondary metabolites and their differences, major types - terpenes, phenolics and alkaloids.

iv. A brief idea about extraction of alkaloids.

PHYTOGEOGRAPHY

1. Definition, its relation to other branches of science, importance of study, phytogeographical regions of India according to D. Chatterjee.
2. Biogeographical Provinces of World, Forest types of India (major types of Champion & Seth's revised classification).
3. A brief idea about GIS (Geographical Information System) in vegetational study.
4. Endemism in India, Study of the vegetation of the following types (a) Eastern Himalayas (b) Gangetic plain and (c) Sundarbans.

Paper IV (Theory)

Section I

Plant Physiology, Biochemistry

Section II

Applied Botany

Section III

Anatomy

Section-I:

PLANT PHYSIOLOGY

1. **Plant water relation:** Role of water in plant life, water potential in plant system, unique physico-chemical properties of water, imbibition, diffusion, osmosis, plasmolysis, osmotic relation ofa plant, types of water in soil and their availability to the plants, soil-plant-atmospherecontinuum (SPAC) concept; Stomatal regulation

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of transpiration, role of CO_2 potassium ion, ABA and blue light on stomatal movement, antitranspiratns.

2. **Mineral nutrition:** Essential elements and criteria of essentiality, physiological roles of mineral elements, mechanism of ion uptake.
3. **Organic translocation:** Phloem loading and unloading mechanism, mass flow and pressure flow hypotheses.
4. **Plant pigments:** Chlorophylls, Carotenes, Xanthophylls, Biliprotein anthocyanin; Phytochrome-elementary nature and properties.
5. **Photosynthesis:** Definition, basic concept about the mechanism of light and dark reaction, photosynthetic reaction centre, concept of photosynthesis, regeneration of RuBP in dark phase, comparison between C_3, C_4 and CAM cycles; Bacterial photosynthesis; Photorespiration - organelles involved, mechanism.
6. **Respiration:** Types, Mechanism of aerobic and anaerobic respiration, electron transport, oxidative phosphorylation; Pentose Phosphate pathway and its significance. RQ and its significance. Cyanide resistant respiration.
7. **Nitrogen fixation:** Types of nitrogen fixers, methods of nodulation, biochemistry of nitrogen fixation, (inclusive of concept of nitrogenase, leg haemoglobin, nitrate reductase) elementary idea of 'nif' and 'nod' genes, nitrate assimilation.
8. **Protein synthesis:** Transcription and Translation.
9. **Plant growth regulators:** Classification, natural and synthetic plant growth regulators with examples, chemical nature and physiological roles of Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid, mode of action of IAA, application of plant growth regulators in Agrihoritculture.
10. **Seed Physiology:** Definition of dormancy, quiescence and germination; types, causes and significance of dormancy, methods of breaking seed dormancy, phases of seed germination.

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11. **Flowering physiology:** Photoperiodism, concept of CDL, classification of plants on the basis of photoperiodic response Phytochrome-chemical nature, role, concept of biological clock and biorhythm.
12. **Vernalization:** Basic concept.
13. **Stress Physiology**: Elementary idea of water, temperature and salinity stress.

BIOCHEMISTRY

1. Bioenergetics: Concepts of free energy, Structure and properties of water.
2. Forces stabilizing atomic and molecular interactions: Formation, properties and biological significance of Van der Walls force, hydrogen bond, ionic bond, covalent bond and hydrophobic interaction, free radicals.
3. pH and buffer: derivation of upper and lower limits of pH; biological significance of pH, Characteristics of buffer, principal buffers of extracellular and intracellular fluids and their function.
4. Oxidation – reduction reaction.
5. Carbohydrate chemistry: Classification and properties of carbohydrates with emphasis on stereoisomerism, optical isomerism, epimerization, mutarotation and reducing action of sugars.
6. Protein chemistry: Classification of proteins, primary, secondary, tertiary and quaternary structure of proteins; Properties of proteins with emphasis on isoelectric pH, biuret test and heat coagulation.
7. Lipid chemistry: Classification and properties of lipids, hydrogenation and rancidity of fats. Fatty acid synthesis, oxidation of fats, alpha and beta oxidation pathways. PUFA and MUFA.

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8. Nucleic acid chemistry: Elementary concept of nucleoside, nucleotide, polynucleotide, elementary concept of RNA, chemical properties of DNA.
9. Enzyme: Definition of Apoenzyme Cofactors, Isoenzyme and Prosthetic groups with examples, enzyme classification, mechanism of enzyme action.

Section - II
APPLIED BOTANY
Applied Microbiology & Immunology

I. Source, function and uses of enzymes (amylase, protease, cellulase).
II. General idea and importance of antibiotics (Penicillin. streptomycin, tetracycline, chloramphenicol).
III. Microbiological basis of potable water, detection of water contamination, presumptive, confirmative and completed test.
IV. Harmful Bacteria (spoilage of milk, food).
V. Preservation of milk and food product. Phosphatase test.
VI. Microorganisms in industry (curd, tofu, beer production).
VII. Immunology in Diagnostic methods, Vaccine.

Applied Algology :
I. Algae as food, pharmaceutical.
II. Harmful algae - toxic Cyanophytes, preliminary idea about algal bloom.
III. Role of algae in soil reclamation.

Applied Mycology and plant pathology
I. Mycorrhizae : Types, distribution and their beneficial role in Forestry and Agriculture.

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II. Modern approaches to plant disease management, including concept of integrated pest management.
III. Mushroom cultivation and its food value.

Forensic Botany: An idea

Plants used in industry: Importance and applications of *Stevia rebaudiana* (sweetener), *Panax ginseng* (vitalizer), *Chlorophytum borivilianum* (aphrodisiac), *Cryptomeria japonica* (packaging), *Shorea robusta* (leaf plate).

Section - III

ANATOMY

a. Plant cell wall: Gross structure and ultra structure, chemical composition and function.
b. Organisation of shoot and root apex and theories.
c. Mechanical tissue system and its distribution.
d. Stomatal types and ontogeny.
e. Stelar types and evolution, nodal positions.
f. Root - stem transition and its significance.
g. Secondary growth in stem and root (Normal).
h. Anomalous Secondary growth in Stem: *Bignonia, Tecoma, Boerhavia, Strychnos,* and *Dracaena and in root of Tinospora*
i. Wood anatomy of *Tectona, Mangifera,* and *Azadirachta.*

PAPER – V (Practical)

Microbiology (10), Algae (10), Fungi (10), Pathology (5), Bryophyte (10), Pteridophyte (10), Morphology (12), Submission of specimen (5), Identification of slides (6), Practical Note Book (7), Tour report (3), Slide submission (2), Viva voce (10)

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1. MICROBIOLOGY **10**

i. Bacteria - Gram staining/ Capsule Staining.
ii. Ennumeration of soil bacteria by dilution plate method.

2. ALGAE **10**

Work out, Camera lucida drawing (with magnification), description and identification of the following genera:
Anabaena, Oedogonium, Chara, Vaucheria, Ectocarpus & *Polysiphonia.*

3. FUNGI **10**

Dissection, mounting, drawing, measurement of reproductive structures, description and identification of the following genera (i) *Rhizopus,* (ii) *Penicillium,* (iii) *Ascobolus,* (iv) *Agaricus.*

4. PLANT PATHOLOGY* **5**

i. Identification of causal organism by cutting section of diseased plant parts - Black stem rust of wheat (uredospore, teleutospore); Brown spot of rice; Tikka disease of ground nut.
ii. Pahological techniques: Demonstration on: Preparation of media (PDS) -Slant, Stab, Petri plates, Sterilization by Autoclave and Hot air oven; Inoculation of culture media.

* Question may be set from part I (A/ B) or part II.

5. BRYOPHYTES **10**

Dissection, mounting, drawing, description and identification of the following genera.
Riccia, Marchantia, Anthoceros, Funaria.

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6. PTERIDOPHYTES **10**

Dissection, mounting, drawing, description and identification of the following genera: i) *Lycopodium,* (ii) *Selaginella,* (iii) *Equisetum,* (iv) *Marsilea.*

7. MORPHOLOGY **12**

a. Morphological Studies of the following specimens: *Nymphaea* flower, *Hypanthodium* inflorescence, *Calotropis* flower, *Capitulum* inflorescence *(Tridax* sp. and *Eupatorium* sp.), *Canna* flower; *Oryza* Spikelet.
b. Comment with reasons on the types of inflorescence, modification of leaves, types of stipules, types of cohesion and adhesion of stamens and carpels, types of fruits.

8. SUBMISSION of preserved or dry specimen. **5**

9. IDENTIFICATION: **6**

Microscopic and macroscopic specimen (Algae, Fungi, Bryophyta, Pteridophyta).

Algae: *Anabaena, Oedogonium, Chara, Vaucheria, Ectocarpus, Polysiphonia.*

Fungi: *Rhizopus, Penicillium, Ascobolus, Agaricus, Polyporus.* Bryophyta: *Riccia, Marchantia, Anthoceros, Funaria.* Pteridophyta: *Lycopodium, Selaginella, Equisetum, Marsilea, Pteris..*

10. PRACTICAL NOTE BOOKS (not exeeding three). **7**

i) Microbiology, Algae.
ii) Fungi, Plant Pathology.
iii) Morphology, Anatomy.

11. **TOUR REPORT + SLIDE** **3+2= 05**

12. **VIVA-VOCE** **10**

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Part III

Paper VI (Theory)

Section I

Cell Biology and Molecular Biology

Section II

Genetics and Bioinformatics

Section III

Biotechnology

Section IV

Plant Breeding and Biometry

Section - I

CELL BIOLOGY

1. Brief introduction of Microscopy: Light, Phase contrast, Fluorescence and Electron microscope - working principles.
2. Structure and functions of cell membrane, cytoskeleton and cell organelles: Chloroplast, Mitochondria, Ribosomes, Endoplasmic reticulum.
3. Cell cycle: phases and a brief account of the control mechanism; the concept of MPF, its chemical nature and the regulatory points with reference to Yeast.
4. Fundamental differences between mitosis and meiosis. Synaptonemal complex, mitotic spindle, significance of meiosis.
5. Nuclear membrane and Nucleolus: Structure and functions (brief account).
6. Chromosome: General features, chromatin, nucleosome structure, higher order structure of chromatin (upto 30nm fiber), euchromatin and heterochromatin; Structure and significance of polytene and salivary gland chromosomes; brief knowledge of chromosome

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banding (only definitions of C-, G-and Q-bands) and its applications.

MOLECULAR BIOLOGY

1. DNA: Structure and different forms.
2. DNA replication: proof of semiconservative replication (Experiment of Meselson and Stahl), mechanism of replication (only prokaryotic with a schematic approach).
3. RNA: structure, types (m-RNA, t-RNA, r- RNA), functions.
4. DNA sequencing (Sanger's method)

Section II

GENETICS:

1. Mendelism, Sum rule and product rule; Chromosomal basis of inheritance.
2. Gene interaction and deviation of Mendelism; incomplete dominance, codominance, dominant epistasis (12:3:1**),** supplementary gene action (9:3:4), polygenic action (9:6:1), complementary gene action (9:7), inhibitory gene action (13:3), duplicate gene action (15:1).
3. Definition and examples of multiple alleles and polygenic control.
4. Linkage: types of linkage, linkage group, linkage map (three point cross), interference and coincidence.
5. Crossing over: cytological proof of crossing over in maize (McClintock's expt.), molecular basis of recombination (Holliday model).
6. The concept of gene: classical to modem, one gene-one polypeptide concept, the complementation test, cistron, recon and muton. Split gene,
7. Transposable elements (IS elements - structure), significance of transposable elements.

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8. Genetic code: triplet code, experiments. leading to the deciphering of the genetic code, properties of genetic code.
9. Mutation: gene mutation, definition, types (spontaneous, induced, somatic, germinal, missense, nonsense, transition, transversion, frameshit), mutation- a random nonadaptive process (Replica plating technique of Josuha Lederberg); physical and chemical mutagens, effects of chemical mutagens (5-Bromouracil, Nitrous acid), detection of sex-linked lethal mutation (CIB method). Practical applications of mutation.
10. Structural alteration of chromosomes: deletion, duplication, inversion and translocation.
11. Polyploidy: Autopolyploids, allopolyploids, segmental allopolyploids - definitions and examples, cytology of autopolyploids. Aneuploidy - different types and examples (including humans); induction of polyploidy, practical applications of polyploidy and its significance in evolution.
12. Gene regulation: Operon concept *(lac* operon).

BIOINFORMATICS:

1. Bioinformatics: definition and scope.
2. Genomics and proteomics : Basic idea.
3. Sequence alignment.

Section - III
BIOTECHNOLOGY

1. Genetic engineering: Recombinant DNA and gene cloning - elementary knowledge of restriction endonucleases, DNA ligase, host cell types, types of cloning vectors, major characteristic features of plasmid vector PBR322, genomic library and c-DNA library - basic idea and purpose.

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2. Ti-plasmid : Structure and its role in plant genetic engineering. Transgenic plants - basic concept with some examples.
3. Biofertilizers: brief account of different types *(Rhizobium,* BGA, *Azolla*), their production and importance.
4. Applications of recombinant DNA technology in agriculture and human welfare (An overview).
5. Definitions: Axenic culture, Cellular totipotency, explants, callus, recalcitrance, embryoids, synthetic seeds, organogenesis, germplasam, cryopreservation. Tissue culture media - a general idea, different components and their functions (with reference to White's and MS medium).
6. Types of culture: definitions and preliminary ideas (excluding methodology) - Organ culture, cell culture, callus culture, micropropagation, anther culture. Embryo culture techniques and its importance. Elementary knowledge of protoplast culture and its importance.

Section - IV

PLANT BREEDING AND BIOMETRY

1. Aims and methods of plant breeding: a broad outline, different methods for autogamous and allogamous species with special reference to mass selection, clonal selection, and pure line selection.
2. Methods of propagation: Vegetative - cutting, grafting, layering. Definition and examples of apomixis, apogamy, apospory, haploid and diploid parthenogenesis.
3. Hybridization: definition, types, an outline procedure, application and objectives.
4. Inbreeding depression: effects of inbreeding. Heterosis - manifestations of heterosis, genetical and physiological basis, commercial applications of heterosis.

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5. Ideotype concept: types, characteristics of a crop ideotype (Rice and sunflower).
6. Introduction to Biostatistics: Variable and attribute: Population Vs Sample, Census vs. sample survey, Arrangement of data, Frequency distribution.
7. Graphical presentation of data: Line diagram, Bar diagram, Pie chart, Histogram.
8. Biometrical techniques in plant breeding and their utilities: preliminary knowledge of sampling, mean, mode, median, coefficient of variation, standard deviation, standard error.

Testing of hypothesis and goodness of fit: Null hypothesis, level of significance, Normal distribution, probability, additive and multiplicative rules, Student's t-test, Chi-square test. Correlation: basic concept.

Paper- VII (Practical)

Taxonomy (18), Pharmacognosy (7), Ecology (10), Anatomy (20)
Identification (15), Submission (6)
Lab Note Book (10), Field report (4), Viva voce (10)

TAXONOMY **18**

a) Taxonomic study of locally available plants of the following families including floral formula, floral diagram and their identification upto genus by published Standard Keys (e.g. Bengal Plants by D. Prain, Flora of Bihar and Orissa by Haines etc.)

Malvaceae, Fabaceae (ss), Euphorhiaceae, Apocynaceae, Acanthaceae, Solanaceae, Scrophulariaceae, Lamiaceae, Verbenaceae, Rubiaceae, and *Poaceae.*

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PHARMACOGNOSY **7**

a) Organoleptic and powder microscopy of *Alstonia* bark, *Adhatoda* leaf, *Strychnos* seed and *Zinziber* rhizome.

b) Chemical tests for Tannin *(Terminalia chebula)* and Alkaloid *(Catharanthus roseus)*.

5. Spot identification of angiospermic plants, included under the theoretical syllabus, up to species (mentioning the names of family, genus, species).

ANATOMY **20**

a) Study of internal structure of the following plants (with double stained method):

Stems of *Cucurbita, Dracaena, Bignonia, Boerhaavia,* and *Tecoma;* Leaves of *Bambusa* and *Nerium* and roots of *Vanda* and *Tinospora.*

b) WOOD ANATOMY

Study of anatomical sections (T.S., R.L.S. and T.L.S.) of the wood of the following species *Tectona, Mangifera,* and *Azadirachta.*

ECOLOGY **15**

1. Determination of minimum size and number of the quadrat.
2. Determination of Density, Abundance and Frequency of a herbaceous community.
3. Determination of organic carbon content of soil sample.
4. Comparative study of ecologically significant anatomy in plants: Aquatic (*Eichhornia crassipes* root, *Ipomoea carnea* stem); Xerophytic (*Peperomia pellucida* leaf, *Bambusa* sp. leaf).

IDENTIFICATION: **15**

Microscopic and macroscopic specimen (Gymnosperm including Palaeobotany).

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Gymnosperm: *Cycas* - Male cone and microsporophyll, megasporophyll, T.S. of leaflet, *Pinus* - T.S. needle, male cone, female cone, stem (T.S., T.L.S. & R.L.S.)

Gnetum - L.S. of ovule.

Fossil Slides: Palaeobotany

Lyginopteris T.S., *Vertebraria* sp., *Ptilophyllum* sp., *Calamites* stem T.S., *Lepidocarpon.*

Palynology: two pollen types (*Hibiscus* and *Tridex*).

SUBMISSION of herbarium specimens,	**6**
Laboratory note books	**10**
Field records including tour diary and slides.	**4**
Viva-voce	**10**

Note: (i) For submission of herbarium specimens the students are to submit 20 properly identified angiospermic plants of locally abundant species belonging to different families as mentioned in the Syllabus.

Field excursions: At least two field excursions on seasonal basis are to be attended by the students of which one excursion should be arranged to different agro climatic zones including A.J.C. Bose National Botanic Garden (B.S.I)., Shibpur, Howrah. Records of field observation certified by the teachers of the respective college, should be submitted during examination.

Paper VIII (Practical)

Plant Physiology (20)
Biochemistry (10)
Biometry (8)
Cytology (15)
Plant Breeding (6)
Seminar (15)

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Identification of cytological slides (6)
Laboratory Note Book (10)
Viva voce (10)

PLANT PHYSIOLOGY (Major) 15

1. Determination of DPD with the help of storage tissue.
2. Transpiration pull of twigs of mesophytic and xerophytic plants.
3. Determination of stomatal frequency and loss of water per stomata per hour.
4. Determination of the effects of CO_2 concentration on the rate of photosynthesis in aquatic plant.
5. Determination of the effect of respiratory inhibitors (Na-Fluride/ Malonic acid) on the "rate of respiration.
6. Determination of percentage of seed viability using TTC method.
7. Determination of the effect of KNO_3 on stomatal opening and closing.
8. Comparison of imbibition of water by starchy, proteinaceous and fatty seeds.

PLANT PHYSIOLOGY (Minor) 05

1. Determination of thermal death point of protoplasm.
2. Plasmolysis (using leaf tissue)
3. Experiment to prove that xylem is the path of conduction of water (anatomical demonstration using transparent plant like *Peperomia* sp.)
4. Determination of pH of soil samples with the help of pH meter.

BIOCHEMISTRY 10

1. Qualitative tests for carbohydrates - reducing and non-reducing sugars, glucose, fructose, sucrose and starch.
2. Qualitative tests for detection of proteins and amino acids.
3. Qualitative tests for citric, tartaric, oxalic and malic acids.
4. Estimation of glucose by Benedicts quantitative reagent.

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5. Estimation of protein by Lowry/ Bradford method.

BIOMETRY **08**

1. Determination of goodness of fit by chi-square method in normal and deviations of Mendelian ratios (3: 1, 1: 1, 9:7, 13:3, 15: 1, 9:6: 1)
2. Analysis of data for mean, median, mode, standard deviation and standard error (samples should be taken from seedling population leaflet size).

CYTOLOGY: **15**

1. Basic schedules for chromosome preparation: Pre-treatment, Fixation, Staining, Squash and Smear preparations.
2. Study of different mitotic stages in the pre-fixed root tips of *Allium cepa.*
3. Determination of mitotic index and frequency of different mitotic stages (to be calculated from dividing cells) in the pre-fixed root tips of *Allium cepa !Allium sativum.*
4. Study of metaphase chromosomes from scattered metaphase plates by suitable pre-treatments and determihation of 2n number in the following *specimens-Allium cepa/A. sativum* root tips.
5. Meiosis

PLANT BREEDING

06

1. Demonstration of hybridization technique in a papilionaceous flower (e.g. *Cajanas cajan)* and in a graminaceous flower (e.g. *Oryza sativa).*
2. Demonstration of T-budding, I-budding in rose.
3. Demonstration of grafting (Wedge grafting, V-grafting, tongue grafting, side grafting) and air layering (gootie) in suitable plant specimens.

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Submission of dissertation work and its presentation (any relevant topic on Botany): **15**

Identification from permanent slides: **06**

(a) Mitosis - All normal stages (b) Early separation, late separation and sticky bridge (c) Meiosis - Diplotene, Diakinesis, Metaphase-I, Anaphase I, Metaphase II, Anaphase II, Telophase II (d) Ring chromosomes and Chains, laggard, anaphase bridge.

LABORATORY NOTE BOOK: 10 marks
VIVA VOCE: 10 marks

Suggested Books:

- A Manual of Ethnobotany by S. K. Jain, Scientific Publishers, Jodhpur.
- A Text Book of Microbiology by R. C. Dubey And D. K. Maheshwari, S. Chand
- A Text Book of Plant Anatomy by P. Saxena And S. M. Das, Wisdom Press.
- Advanced Plant Taxonomy by A. K. Mondal, New Central Book Agency Pvt Ltd, Kolkata.
- Bioinformatics – Mehrotra Vikas, Vikas Publishing House Pvt. Ltd.
- Botany for Degree Students Algae by B. R. Vashishta, S. Chand, New Delhi.
- Botany for Degree Students Bryophyta by B. R. Vashishta, S. Chand, New Delhi.
- Botany for Degree Students Fungi by B. R. Vashishta, S. Chand, New Delhi.
- Botany for Degree Students Gymnosperms by P. C. Vashishta, S. Chand, New Delhi.
- Botany for Degree Students Pteridophyta by P. C. Vashishta, S. Chand, New Delhi.
- Cell & Molecular Biology – Karp. G., John Wiley & Sons; Inc

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- Cell Biology by C. B. Power, Himalaya Publishing House
- College Botany by Gangulee, Das & Datta. New Central Book Agency (P) Limited.
- College Botany Practical Vol I and II by Santra, Das & Chatterjee, New Central Book Agency (P) Limited
- Ecology By P. D. Sharma, Rastogi Publications, Meerut.
- Environmental Chemistry – A. K. Dey, Wiley Eastern Ltd. New Delhi
- Genetics by P.K. Gupta, Rastogi Publications.
- Kuby Immunology by Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Freeman and Company, New York
- Laboratory Manual in Microbiology By P Gunasekaran
- Microbiology 5e, 5th Edition By Michael J Pelczar, Ecs Chan, N R Krieg, Tata Mcgrahill
- Molecular Biology of Cell – Bruce Alberts et.at, Garland Publications
- Molecular Biotechnology: Principles And Applications Of Recombinant Dna – Bernaral R. Glick And Jack J., Pastemak Asm Press, Washington, D.C.
- Plant Anatomy by A. Fahn, Pergamon Press
- Plant Pathology by P. D. Sharma, Rastogi Publications, Meerut.
- Plant Physiology by S. Mukherjee and A. K. Ghosh, New Central Book Agency (P) Limited.
- Plant Taxonomy by O. P. Sharma, Tata Mcgraw-Hill Education.
- Plant Tissue Culture by K. K. Dey
- Principles of Biochemistry – Albert L. & Lehninger, Cbs Publishers & Distributors.
- Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Sons Publications.
- Studies in Botany, Vol : I And Ii, By J. N. Mitra, Moulik Library
- Taxonomy of Angiosperms by V. N. Naik, Tata Mcgraw Hill, New Delhi.
- Taxonomy of Vascular Plants by G.H.M. Lawrence, Macmillan, New York.

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3-Tier 3 year Syllabus in Botany
B.Sc. (General)

Part – I

Paper – I (Theoretical	F.M. : 100 (90+10)*

Part – II

Paper – II (Theoretical	F.M. : 100 (90+10)*
Paper – III (Practical)	M.M. : 100

Part – III

Paper – IV (Theoretical	F.M. : 75 (67+8)**
Paper – V (Practical)	M.M. : 25

*External Assessment (University level) – 90 marks.
Internal Assessment (College level) – 10 marks
**External Assessment (University level) – 67 marks.
Internal Assessment (College level) – 08 marks

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3- Year 3-tier distribution of Syllabus in Botany General
(To be effective from 2014-2015)

No. of paper's and marks allotted to each paper and each group in a paper

For Theoretical Papers-I and II the following patterns will be followed

Full Marks 100. Questions to be set on 90 marks, 10 marks to be evaluated by the College covering the entire syllabus of the paper.

Group - A	
Ten short answer type Questions each having 02 marks covering the entire syllabus of the paper	20 marks.

Group. - B	
Five semi long answer type Questions each having maximum marks of 08 covering all the sections of the paper	40 marks.

Group - C	
Two long answer type Questions each having maximum marks of 15 covering all the sections of the paper	30 marks.

For Theoretical paper IVA the following patterns will be followed. Full marks 75. Questions to be set on 67 marks, 08 marks to be evaluated by the College covering the entire syllabus of the paper.

Group-A	
Five short answer type Questions each having 02 marks covering the entire syllabus of the paper	10 marks.

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Group- B	
Five semi long answer type Questions each having maximum marks of 06 covering all the sections of the paper	30 marks.
Group - C	
Two long answer type Questions each having maximum marks of 15 covering all the sections of the paper	27 marks. (12 + 15)

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BOTANY

(GENERAL)

No. of papers and distribution of marks

PART - I

Paper - I (Theoretical) Full Marks - 100

Section - I

Bacteria, Viruses, Algae, Fungi and Plant Pathology – 30 Lectures

Section – II

Bryophyte, Pteridophyte, Gymnosperm and Paleobotany – 30 Lectures

Section – III

Morphology and Embryology, Taxonomy of Angiosperms,
Economic Botany – 40 Lectures

Part – II

Paper – II (Theoretical)

Full Marks – 100

Section – I

Anatomy, Ecology, Ethnobotany – 35 Lectures

Section – II

Cell Biology, Genetics – 35 Lectures

Section – III

Plant Physiology and Biochemistry – 30 Lectures

PAPER - III (PRACTICAL)
DISTRIBUTION OF MARKS
Full Marks - 100, Time: 6 (six) hours.

1.	Work out: Algae/ Fungi (anyone)	10
2.	Work out: Bryophytes/ Pteridophytes (any one)	10
3.	Angiospermic plant	15
4.	Plant Physiology Experiment	12
5.	Anatomy	10
6.	Mitosis Squash Preparation	07

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7. Identification 18
   Cryptogams-2, Gymnosperm-I, Morphology-I, Cytology-I, Anatomy1, Angiosperm spotting-3 (species and family).
8. Submission 11

Laboratory note books-4, Slides-2, Herbarium Specimens-3, Field Note Book-2

9. Viva-voce 07

Part - III

Paper IV A (Theoretical), Full Marks - 75

Section - I

Genetics, Plant Breeding and Biometry - 20 Lectures.

Section - II

Medicinal Plants, Floriculture, Plant protection, Plant propagation - 12 Lectures.

Section-III

Mushroom culture, Biofertilizer - 06 Lectures.

Section - IV

Seed preservation, Biodiversity - 06 Lectures.

Paper IV B (Practical)

Full Marks - 25

DISTRIBUTION OF MARKS

1. Microbiology (staining-2, drawing-I, identification of morphological types only-2) = 05 marks.
2. Biometry (calculation-2, comment-2) = 04 marks.
3. Seed viability test (result-2, comment-2) = 04 marks.
4. Identification of Medicinal plants (1 x 4) = 04 marks.
5. Practical Note Book = 03 marks.
6. Viva-voce = 05 marks.

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Detailed Syllabus
BOTANY (GENERAL)
PART-I

PAPER - I (Theoretical)
Full marks: 100, Time - 3 hours.

Section - I
Bacteria, Viruses, Algae, Fungi and Plant Pathology
Section - II
Bryophyte, Pteridophyte, Gymnosperm and Palaeobotany
Section - **III**
Morphology and Embryology, Taxonomy of Angiosperms, Economic Botany

SECTION - I

Bacteria: Forms, Structure in brief, Typical growth curve. Reproduction - Binary fission, Endospore. Recombination - brief idea of Conjugation, Transformation, Transduction (Generalised), Economic Importance.

Virus: General properties, Structure of a typical plant virus (TMV), Replication (lytic cycle in T-4 and lysogenic cycle in Lambda phage).

Algae: Classification upto class (Smith, 1955) with characters and examples of Cyanophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae, Chlorophyceae and Charophyceae. Life histories of *Volvox, Oedogonium* and *Polysiphonia.* Economic Importance of algae.

Fungi: Classification (Ainsworth, 1973) upto sub-division with characters and examples of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Life histories of *Mucor, Saccharomyces, Penicillium* and *Agaricus.* Economic importance.

Plant Pathology: Definitions - disease, pathogen, inoculum, infection, resistance, incubation period, Disease cycle, Koch's postulates. Symptoms

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- necrotic, hypoplastic and hyperplastic. Symptoms, causal organism, disease cycle, control measure of the plant diseases - Late blight of potato, Black stem rust of wheat, Bacterial blight of rice.

SECTION - II

Bryophyte: Classification (Proskauer, 1957) upto class with characters and examples of Hepaticopsida, Anthocerotopsida and Bryopsida, Life histories of *Riccia, Anthoceros* and *Funaria.*

Pteridophyte: Classification (Sporne, 1975) upto class with characters and examples of Psilopsida, Lycopsida, Sphenopsida and Filicopsida. Life histories of *Lycopodium, Selaginella* and *Pteris.*

Gymnosperm: Classification upto class (Sporne 1965). Life histories of *Cycas, Pinus, Gnetum.*

Palaeobotany: Introduction and definition, Types offossils, fossilization process, geological time scale, importance offossil study.

SECTION-III

Morphology & Embryology: Inflorescence - different types, Flower - types and forms, flower as a modified shoot, aestivation, floral diagram, floral formulas, placentation types, Ovule structure, self and cross pollination - definition, contrivances and agents, advantages and disadvantages. Fruits and seeds - types and dispersal, germination of seeds.

Embryology: Development of a typical normal (8 nucleated) embryosac, fertilization and post fertilization changes in *Capsella* sp.

Taxonomy: Definition, principles of Taxonomy, preliminary idea about Artificial, Natural and Phylogenetic systems of classification, Principles of ICBN/ ICN, an outline of Bentham and Hooker's and Takhtazan's system of classification, field and herbarium techniques and maintenance.

Distinguishing features of the following families including economically important plants - Poaceae, Liliaceae, Orchidaceae, Brassicaceae,

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Papilionaceae, Caesalpiniaceae, Euphorbiaceae, Malvaceae, Apocynaceae, Verbenaceae, Lamiaceae, Solanaceae, Rubiaceae, Asteraceae.

Economic Botany: Classification of commercially important plants. General knowledge about the cultivation of the following economically important plants - Rice, Betel leaf, Cashew nut.

BOTANY (GENERAL) PART - II
PAPER - II (Theoretical) Full Marks: 100, Time - 3 hours.

Section – I	**:**	Anatomy, Ecology, Ethnobotany.
Section – II	:	Cell Biology, Genetics, Plant Breeding.
Section – III	:	Plant Physiology and Biochemistry.

SECTION - I

Anatomy:

Plant cell wall: Gross structure, Ultra structure, Composition and function.

Tissue: Meristamatic and Permanent - structure, distribution and function.

Stele: Defination, types with example.

Normal Secondary growth in dicot stem. Stomatal types.

Ecology:

Brief knowledge on biosphere and biome, ecotype, Climatic factors, Plant succession, Stages of succession like Xerosere and Hydrosere. Ecological adaptations of hydrophyte, halophyte and Xerophyte. Carbon and nitrogen cycle. Air and water pollution: Causes and adverse effects.

Ethnobotany

Concept of ethnobotany and significance of its study.

SECTION – II

Cell biology & Genetics:

Cell cycle: Events in different phages (Excluding regulation).

Mitosis and meiosis: Stages and significance.

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Mendelism: Monohybrid and dihybrid cross, test cross, chromosomal basis of Mendelian inheritance.
Allellic and non-allelic interactions: (Dominant epistasis, complementary factor, supplementary factor).
Linkage and Crossing over: Definition, three point test cross.
Chromosome: morphology, chemical constituents. DNA structure (Watson and Crick model) Nucleosome structure.
Aneuploidy and Euploidy: types with examples, role of polyploidy in evolution.
Gene mutation: Definition, types, physical and chemical mutagens - types with examples, mechanism of action of UV and 5-Bromouracil. Genetic code: properties - termination codons.

SECTION - III

Plant Physiology

Water relation: Osmotic pressure, turgor pressure, water potential, Ascent of sap, Mechanism of ion absorption, Transpiration types, mechanism, significance, difference with guttation, Antitranspirant.
Mineral nutrition: essential elements and their roles.
Enzymes: Definition, types, properties.
Photosynthesis: Light and Dark reaction.
C_4 and CAM pathway (brief knowledge).
Respiration: Glycolysis, TCA cycle, Electron transport system. Nitrogen metabolism: Biological nitrogen fixation (symbiotic and nonsymbiotic), Ammonification, Nitrification, Nitrate assimilation.
Plant hormones: Definition and role of IAA, Gibberellins, Cytokinin, ABA and Ethylene in plant growth and developments.
Photoperiodism: Definition, elementary idea of long day and short day plants.

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Biochemistry:

Carbohydrate: Mono, di and oligo saccharides-elementary idea. Proteins: Primary, secondary and tertiary structure-elementary idea. Fats: Classification.

BOTANY (GENERAL) PART -II
PAPER - III (Practical)
Full marks: 100, Time - 6 hours.

1. Description and identification (including microscopic preparation) of the following specimens:
   Volvox, Oedogonium, Mucor, Penicillium, Agaricus, Riccia, Funaria, Selaginella and *Pteris.*
2. Morphology: different types of stipules, inflorescences and fruits.
3. a) Dissection, drawing, description of some angiospermic plants under the following prescribed families. Study of their flowers with parts, floral diagram, floral formula and identification of the family with reasons.
   Papilionaceae, Caesalpiniaceae, Malvaceae, Apocynaceae, Verbenaceae, Lamiaceae, Solanaceae, Rubiaceae.
   b) Referring plants to their families from the prescribed theoretical syllabus.
4. Plant physiology experiments:
   1. To determine the transpiration pull of a twig of mesophytic plant.
   2. Determination of the rate of transpiration per unit area of leaf by weighing method.
   3. Determination of the rate of oxygen evolution during photosynthesis.
   4. Determination of the DPD with the help of storage tissue.
   5. Imbibition of water by Starchy and Proteinaceous seeds.

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5. Plant Anatomy: Making permanent stained preparation (double staining method) of the following plant parts with drawing, labelling, description of the anatomical features.

   Root - Gram, Arum, Orchid.

   Stem - Sunflower, Maize, *Cucurbita.*

   Leaf - *Nerium, Bambusa*.
6. Cytology: Study of mitotic stages by Aceto-orcein squash preparation in *Allium cepa* root tips.
7. Identification with reasons: Identification of microscopic and macroscopic specimens as prescribed in the theoretical syllabus.
8. Laboratory Records: Signed Laboratory note books and slides are to be submitted at the time of Practical Examination.
9. Field Excursions: At least two local field excursions are to be attended by the students.
10. Field Records: Field notebook certified by the teachers should be submitted during examination. The students are to submit Herbarium specimens of angiospermic weeds at the time of Practical Examination.

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DISTRIBUTION OF MARKS (PAPER - III)
Full Marks - 100, Time: 6 (six) hours

1.	Work out: Algae/ Fungi (anyone)	10
2.	Work out: Bryophytes/ Pterodophytes (anyone)	10
3.	Angiospermic plant	15
4.	Plant Physiology Experiment	12
5.	Anatomy	10
6.	Mitosis Squash Preparation	07
7.	Identification Cryptogams-2, Gymnosperm-1, Morphology-1, Cytology-1, Anatomy-1, Angiosperm spotting-3 (species and family).	18
8.	Submission Laboratory note books-4, Slides-2, Herbarium specimens-3, Field Note Book – 2	11
9.	Viva-voce	

BOTANY (GENERAL) PART -III
PAPER IV (A) (Theoretical)
Full marks - 75, Time - 3 hours.

Section-I	Genetics, Plant Breeding and Biometry.
Section-II	Medicinal plants, Floriculture, Plant protection, Plant propagation. .
Section-III	Mushroom culture, Biofertilizer.
Section-IV	Seed preservation, Biodiversity.

1. **Genetics:** Brief knowledge of DNA replication, (prokaryotic), gene regulation in prokaryotes (lac operon).

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Deviation of Mendelian laws: incomplete dominance, dominant epistatis and complementary factor.

Brief idea of - Recombinant DNA, Restriction enzymes, (only types - details not required) vector, plasmid - only properties of plasmid as a vector (genetic map not required), idea on gene cloning. Transgenic plants – definition and applications.

2. **Plant Breeding and Biometry**: Definition, aims and objectives. Plant introduction. Principles of hybridization, Heterosis. Elementary knowledge of pure line selection, mass selection and clonal selection. Goodness off it (Chi-square test).
3. **Plant tissue culture**: Introduction, cellular totipotency, preliminary idea of callus culture and their significance, idea on somatic embryo and synthetic seeds. Application of plant tissue culture in the improvement of crop plants.
4. **Medicinal plants**: Importance of study, General knowledge about the cultivation and uses of medicinal plants - *Adhatoda vasica, Rauvolfia serpentina* and *Dioscorea alata.*
5. **Floriculture:** Definition, impact of study, classification of ornamental plants; methods of cultivation and propagation of Rose, Tuberose and Jasmine.
6. **Plant Protection:** Types of protection (preventive and therapeutic). Preventive-isolation, exclusion, quarantine. Therapeutic-Physical (heat and rays), Chemical (pesticides) and Biological (virus, bacteria and fungi).
7. **Plant propagation:** Knowledge about procedures for cutting, grafting, budding and layering with reference to economical plants.
8. **Mushroom culture:** Cultivation technique of *Pleurotus,* food value of mushrooms.
9. **Biofertilizer:** Definition, idea of production and applications of: Bacterial *(Rhizobium),* BGA and *Azolla.* Significance of biofertilizers over chemical fertilizers.

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10. **Seed preservation:** General principle of seed storage; concept of modern techniques of seed storage.
11. **Biodiversity:** Brief knowledge, definition of in-situ and ex-situ conservation. Methods of in-situ conservation of threatened plants (including medicinal plants).

BOTANY (GENERAL) PART - III
PAPER - IV B (Practical) Full marks - 25 :: Time 2 hours.

1. Study of laboratory equipments: autoclave, Hot air oven, Incubator, pH meter.
2. Preparation of solutions: Normal, Molar, Molal, Percentage (of Sucrose).
3. Identification of medicinal plants: *Ocimum sanctum*, *Adhatoda vasica*, *Andrographis paniculata*, *Tinospora cordifolia*, *Azadirachta indica*, *Hygrophila spinosa (Asteracantha longifolia)*, *Vinca rosea*, *Vitex negando*, *Boerhaavia repens*, *Holarrhena antidysenterica*.
4. Bacterial staining by simple staining method (methylene blue/crystal violet) from curd.
5. Learning of hybridization technique with the members of *Papilionaceae* available in the locality.
6. Learning of viability test of seeds by TTC method.
7. Determination of goodness of fit of normal monohybrid ratios (3: 1, I: 1) by Chi-square method.

Distribution of marks, Full marks - 25

1. Microbiology (staining-2, drawing-1, identification of morphological types only-2) = 05 marks.
2. Biometry (calculation-2, comment-2) = 04 marks

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3. Seed viability test (result-2, comment-2) = 04 marks
4. Identification of Medicinal plants (1 x 4) = 04 marks
5. Practical note book = 03 marks
6. Viva-voce = 05 marks

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