



UNIVERSITY OF GOUR BANGA

(Established under West Bengal Act XXVI of 2007)

N.H.-34 (Near Rabindra Bhawan), P.O.: Mokdumpur,
Dist.: Malda, West Bengal, Pin-732 103

UG Syllabus and Question Pattern (Honours & General) (Botany)

(Under 1+1+1 System)

Main Feature of the Syllabus

Botany (Honours)

| Part / Course | Paper | Revised Paper Code | MCQ / Descriptive | Marks | Time | Total Marks | Total Time |
|---------------|---------|--------------------|-------------------|-------|---------|-------------|------------|
| Part-I | I | I-A | MCQ | 14 | 20 Min | 70 | 3.00 Hr |
| | | I-B | Descriptive | 56 | 2.40 Hr | | |
| | II | II-A | MCQ | 14 | 20 Min | 70 | 3.00 Hr |
| | | II-B | Descriptive | 56 | 2.40 Hr | | |
| | III | III | Practical | 60 | 4.00 Hr | 60 | 4.00 Hr |
| | Part-II | IV | IV-A | MCQ | 14 | 20 Min | 70 |
| IV-B | | | Descriptive | 56 | 2.40 Hr | | |
| V | | V-A | MCQ | 14 | 20 Min | 70 | 3.00 Hr |
| | | V-B | Descriptive | 56 | 2.40 Hr | | |
| VI | | VI | Practical | 60 | 4.00 Hr | 60 | 4.00 Hr |
| Part-III | | VII | VII-A | MCQ | 16 | 30 Min | 80 |
| | VII-B | | Descriptive | 64 | 3.30 Hr | | |
| | VIII | VIII-A | MCQ | 16 | 30 Min | 80 | 4.00 Hr |
| | | VIII-B | Descriptive | 64 | 3.30 Hr | | |
| | IX | IX-A | MCQ | 16 | 30 Min | 80 | 4.00 Hr |
| | | IX-B | Descriptive | 64 | 3.30 Hr | | |
| | X | X | Practical | 80 | 6.00 Hr | 80 | 6.00 Hr |
| | XI | XI | Practical | 80 | 6.00 Hr | 80 | 6.00 Hr |

Botany (General)

| Part / Course | Paper | Revised Paper Code | MCQ / Descriptive | Marks | Time | Total Marks | Total Time |
|---------------|-------|--------------------|-------------------|-------|---------|-------------|------------|
| Part-I | I | I-A | MCQ | 16 | 30 Min | 50 | 2.00 Hr |
| | | I-B | Descriptive | 34 | 1.30 Hr | | |
| | II | II-A | MCQ | 16 | 30 Min | 50 | 2.00 Hr |
| | | II-B | Descriptive | 34 | 1.30 Hr | | |
| | III | III | Practical | 50 | 3.00 Hr | 50 | 3.00 Hr |
| Part-II | IV | IV-A | MCQ | 16 | 30 Min | 50 | 2.00 Hr |
| | | IV-B | Descriptive | 34 | 1.30 Hr | | |
| | V | V-A | MCQ | 16 | 30 Min | 50 | 2.00 Hr |
| | | V-B | Descriptive | 34 | 1.30 Hr | | |
| | VI | VI | Practical | 50 | 3.00 Hr | 50 | 3.00 Hr |
| Part-III | VII | VII-A | MCQ | 16 | 30 Min | 50 | 2.00 Hr |
| | | VII-B | Descriptive | 34 | 1.30 Hr | | |
| | VIII | VIII | Practical | 50 | 3.00 Hr | 50 | 3.00 Hr |

❖ Revised Paper Code as treated Official Paper Code.

- The University of Gour Banga offers B. Sc. Degree course (Honours and General, 1+1+1 system) in Botany in its affiliated colleges perusing Science stream. Candidates who have passed the 10+2 standard (Science) or Higher Secondary Examination (Science) with Biology as combination are eligible for admission to the course. Selection of candidates is done on the basis of merit following the norms of Government of West Bengal.
- The duration of the course is **three academic years** and the examinations are to be held in **annual basis** for a **total of 800 marks for Honours degree and 400 for General degree**.
- The students will participate in the proposed educational tours like:
 - local excursion
 - visit to other phyto-geographical regions, and
 - visit to industrial units / research institutions during the respective year.

The distribution of papers, subjects, and marks are given below:

Subject distribution in the syllabus for B.Sc. Degree (Honours) in Botany

| PART – I | | TOTAL MARKS = 200 | |
|--------------------------------|--|--|-------------------|
| THEORETICAL MARKS = 140 | | | |
| Paper Number | Title of paper | Subjects | Full marks |
| I | Phycology, Lichenology, Mycology and Plant Pathology | Module I: MCQ questions based on Paper I | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Phycology, Lichenology | 28 |
| | | Group B: Mycology and Plant Pathology | 28 |
| II | Bryology, Pteridology, Gymnosperm, and Paleobotany | Module I: MCQ questions based on Paper II | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Bryology and Pteridology | 28 |
| | | Group B: Gymnosperm and Paleobotany | 28 |
| PRACTICAL MARKS = 60 | | | |
| III | Phycology, Lichenology, Mycology and Plant Pathology, Bryology, Pteridology, Gymnosperm, and Paleobotany | | 60 |
| PART – II | | TOTAL MARKS = 200 | |
| THEORETICAL MARKS = 140 | | | |
| Paper Number | Title of paper | Subjects | Full marks |
| IV | Morphology, Palynology, and Taxonomy of Angiosperms | Module I: MCQ questions based on Paper IV | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Morphology and Palynology | 28 |
| | | Group B: Taxonomy of Angiosperms | 28 |
| V | Plant Ecology, Plant Biodiversity and Conservation Biology, Anatomy and Embryology | Module I: MCQ questions based on Paper V | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Plant Ecology, Plant Biodiversity and Conservation Biology | 28 |
| | | Group B: Anatomy and Embryology | 28 |
| PRACTICAL MARKS = 60 | | | |
| VI | Morphology, Palynology, Embryology, Taxonomy of Angiosperm, Plant Ecology, and Anatomy | | 60 |
| PART – III | | TOTAL MARKS = 400 | |
| THEORETICAL MARKS = 240 | | | |
| Paper Number | Title of paper | Subjects | Full marks |
| VII | Cell Biology, Genetics, Plant Breeding, and Biostatistics | Module I: MCQ questions based on Paper VII | 16 |
| | | Module II: Broad answer type questions | 64 |
| | | Group A: Cell Biology | 32 |

| | | | |
|--------------------------------|---|--|-----------|
| | | Group B: Genetics, Plant Breeding and Biostatistics | 32 |
| VIII | Plant Physiology, Plant Biochemistry and Pharmacognosy | Module I: MCQ questions based on Paper VIII | 16 |
| | | Module II: Broad answer type questions | 64 |
| | | Group A: Plant Physiology | 32 |
| | | Group B: Plant Biochemistry and Pharmacognosy | 32 |
| IX | Microbiology and Plant Biotechnology | Module I: MCQ questions based on Paper IX | 16 |
| | | Module II: Broad answer type questions | 64 |
| | | Group A: Microbiology | 32 |
| | | Group B: Plant Biotechnology | 32 |
| PRACTICAL MARKS = 160 | | | |
| X | Microbiology, Cell Biology, Genetics, Plant Breeding, and Biostatistics | | 80 |
| XI | Plant Physiology, Plant Biochemistry and Pharmacognosy | | 80 |
| GRAND TOTAL MARKS = 800 | | | |

Duration of Theory Examinations (Honours): 4 Hours for 70 or above marks

Duration of Practical Examinations (Honours): 6 Hours for 80 marks & 4 Hours for 60 marks

Subject distribution in the syllabus for B.Sc. Degree (General) in Botany

| PART – I | TOTAL MARKS = 150 | | |
|--------------------------------|---|---|------------------|
| THEORETICAL MARKS = 100 | | | |
| Paper Number | Title of paper | Subjects | Full marks 50 |
| I | Microbiology, Phycology, Mycology and Plant Pathology | Module I: MCQ questions based on Paper I | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Microbiology and Phycology | 17 |
| | | Group B: Mycology and Plant Pathology | 17 |
| II | Bryology, Pteridology and Gymnology and Paleobotany | Module I: MCQ questions based on Paper II | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Bryology and Pteridology | 17 |
| | | Group B: Gymnology and Paleobotany | 17 |
| PRACTICAL MARKS = 50 | | | |
| III | Practical based on Paper I and II | | 50 |
| PART – II | TOTAL MARKS = 150 | | |
| THEORETICAL MARKS = 100 | | | |
| Paper Number | Title of paper | Subjects | Full marks 50 |
| IV | Plant Ecology, Anatomy, Morphology, and Taxonomy of Angiosperm | Module I: MCQ questions based on Paper IV | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Plant Ecology and Anatomy | 17 |
| | | Group B: Morphology and Taxonomy of Angiosperm | 17 |
| V | Plant Physiology, Plant Biochemistry, and Pharmacognosy | Module I: MCQ questions based on Paper V | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Plant Physiology | 17 |
| | | Group B: Plant Biochemistry and Pharmacognosy | 17 |
| PRACTICAL MARKS = 50 | | | |
| VI | Practical based on Paper IV and V | | 50 |
| PART – III | TOTAL MARKS = 100 | | |
| THEORETICAL MARKS = 50 | | | |
| Paper Number | Title of paper | Subjects | Full marks 50 |
| VII | Cytogenetics, Plant Breeding, Biostatistics and Plant Biotechnology | Module I: MCQ questions based on Paper VII | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Cytogenetics and Plant Breeding | 17 |
| | | Group B: Biostatistics and Plant Biotechnology | 17 |
| PRACTICAL MARKS = 50 | | | |
| VIII | Cytogenetics, Plant Breeding, Biostatistics and Plant Biotechnology | | 50 |
| GRAND TOTAL MARKS = 400 | | | |

Duration of Theory Examinations (General): 2 Hours for 50 marks.

Duration of Practical Examinations (General): 4 Hours for 50 marks.

Syllabus for B.Sc. (Honours) in Botany (PART - I) (Revised Copy)

| PART – I | | TOTAL MARKS = 200 | |
|-------------------------|--|--|------------------|
| THEORETICAL MARKS = 140 | | | |
| Paper Number | Title of paper | Subjects | Full marks 70 |
| I | Phycology, Lichenology, Mycology and Plant Pathology | Module I: MCQ questions based on Paper I | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Phycology, Lichenology | 28 |
| | | Group B: Mycology and Plant Pathology | 28 |
| II | Bryology, Pteridology, Gymnosperm, and Paleobotany | Module I: MCQ questions based on Paper II | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Bryology and Pteridology | 28 |
| | | Group B: Gymnosperm, and Paleobotany | 28 |
| PRACTICAL MARKS = 60 | | | |
| III | Phycology, Lichenology, Mycology and Plant Pathology, Bryology, Pteridology, Gymnosperm, and Paleobotany | | 60 |

Detailed syllabus

Part – I:: THEORY

| | | |
|--|----------------|----------------|
| PAPER –I (Phycology, Lichenology, Mycology and Plant Pathology) | FM = 70 | LP = 70 |
|--|----------------|----------------|

GROUP: A::Phycology and Lichenology (30 LP)

Phycology

1. General account: Thallus organization, Ultrastructure of Plastids and Flagella, Origin and evolution of sex, Life cycle patterns.
2. Classification: Classification by Lee (1999) up to division (phylum) with examples; Salient features of Cyanophyceae, Chlorophyceae, Charophyceae, Bacillariophyceae, Xanthophyceae, Phaeophyceae, Rhodophyceae.
3. Blue Green Algae: Chromatic adaptation; Ultra Structure of cell; Heterocyst: ultra structure and role in N₂ fixation; Reproduction; Life cycle pattern of *Anabaena* (Asexual cycle); Reasons for renaming the group as cyanobacteria and affinities with Rhodophyceae.
4. Chlorophyceae: Life histories of *Oedogonium* and *Coleochaete*.
5. Charophyceae: Life history of *Chara*.
6. Diatom: Cell structure, Cell division, Auxospore formation in Centrales and Pennales.
7. Phaeophyceae: Morphology, reproduction and life cycle of *Ectocarpus*.
8. Rhodophyceae: Morphology, reproduction and life cycle of *Polysiphonia*
9. Economic Importance: Food, Phycocolloid (Agar-agar, Algin, Carrageenan), Diatomite, Algal Biotechnology – potential of microalgae for SCP, β-carotene, Biofertilizer, Biodiesel; Principles of mass cultivation of microalgae; Algal toxins.

Lichenology (10 Marks: 05LP):

1. Lichen: - Thallus: structure, morphology and anatomy; Reproduction; Economic importance. Role of Lichens in plant succession and pollution monitoring.

GROUP: B:: Mycology and Plant Pathology

Part Marks = 35

LP = 40

Mycology (20 LP)

1. General Account: Habits; Ultra-structure of cell; Cell wall, Growth and nutrition; Hyphal forms, Fungal spore forms and mode of liberation; Sexual reproduction and degeneration of sex; Homothallism and heterothallism; Life cycle patterns, Anamorphic and Teleomorphic fungi and parasexuality; Mycotoxins with emphasis on aflatoxin.
2. Classification: Classification of Fungi (Ainsworth, 1973) upto sub-division with diagnostic characters and examples.
3. Life history: *Synchytrium*, *Rhizopus*, *Ascobolus*, *Agaricus*.
4. Mycorrhiza: Types with salient features; Role in Agriculture & Forestry.
5. Role of fungi as decomposers and bioremediation.
6. Fungal Biotechnology: Mushroom – Food value and cultivation of *Pleurotus*, Industrial production of Cheese and Ethanol (brief outline); Fungal sources and uses of Mycoproteins (SCP), Baker's yeast, Enzymes (Amylase and Cellulase), Amino acid (Tryptophan), Vitamin (Riboflavin), Antibiotic (Griseofulvin), Pharmaceuticals (Cyclosporin-A).
7. Medical Mycology - Definition of Mycosis; Causal Organisms and Antibiotic used in the mycoses as 'Ring worm' or Trichophytosis and Candidiasis.

Plant Pathology (15 Marks: 20 LP)

1. Terms and Definitions: Disease concept; Symptoms; Etiology & causal complex; Primary and secondary inocula, Infection, Pathogenecity and pathogenesis, susceptibility, Necrotroph and biotroph, Koch's postulates, Endemic, Epidemic, Pandemic and Sporadic disease, Disease triangle, Disease cycle (monocyclic, polycyclic and polyetic).
2. Host – Parasite Interaction: Mechanism of infection (Brief idea about Pre-penetration, Penetration and Post-penetration), Pathotoxin (Definition, criteria and example), Defence mechanism with special reference to Phytoalexin, & Phytoanticipins; Resistance-Systemic acquired and induced systemic; Disease forecasting.
3. Plant Disease Management: Quarantine, Chemical, Biological, Integrated.
4. Symptoms, Causal organism, Disease cycle and Control measures of: Tungro Virus disease of rice, Late blight of Potato, Bacterial blight of rice, Black stem rust of wheat, Stem rot of jute.

PAPER –II (Bryology, Pteridology, Gymnology, and Paleobotany)

FM = 70

LP = 70

Group A: Bryology and Pteridology(35 LP)

Bryology (20LP)

1. General account: - 1.1 Characteristic features; Origin of bryophytes, Amphibian nature; an outline idea of classification system following Proskauer (1957) upto class with diagnostic characters and examples.
2. Hepaticopsida: Characteristic features of gametophytes and sporophytes of *Marchantia*.
3. Anthocerotopsida: Gametophytic and Sporophytic features of *Anthoceros*. Development of sporophyte.
4. Bryopsida: Characteristic features of gametophytes and sporophytes of *Sphagnum* and *Funaria*.
5. Phylogeny: Origin of Alternation of Generations (Homologous and Antithetic theory), Evolution of Sporophytes (Progressive and Regressive concept).
6. Role of bryophytes in Plant succession and Pollution monitoring.

Pteridology (25 LP)

1. General account: Characteristics; colonisation and rise of early land plants, Classification of vascular plants by Sporne (1975) upto class with diagnostic characters and examples.

- Life History: Morphology and Anatomy of vegetative body, and reproductive organs of sporophytes, and alternation of generations in - *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Marsilea* and *Dryopteris*.
- Fossil Pteridophytes: Structural features, Geological and geographical distribution and evolutionary significance of: *Rhynia*, *Lepidodendron* (Reconstructed); *Calamites* (Reconstructed).
- Telome and enation concepts and their significance in the origin of different organs of Pteridophytes.
- Heterospory and origin of seed habit.
- Economic importance as food, medicine and Agriculture.

Group B: Gymnology and Paleobotany (FM = 35; LP = 35)

Gymnosperms (20 LP)

- General characters and economic importance of Gymnosperms.
- Classification of Gymnosperms by Stewart and Rothwell (1993).
- Progymnosperms: General characters, vegetative and reproductive features of *Archeopteris*, Phylogenetic significance of the group.
- Vegetative morphology, anatomy, reproductive structures, development of gametophytes and embryogeny of *Cycas*, *Pinus*, *Ginkgo* and *Gnetum*.
- Fossil gymnosperms: Structural features, geographical and geological distribution of reconstructed genera: *Lyginopteris*, *Williamsonia* and *Cordaites*.

Paleobotany (10 LP)

Paleobotany

- Fossil: types and modes of preservation (Schopf, 1975), conditions of preservations, fossilization process.
- Geological time scale and major events of plant life through geological ages.
- Indian Gondwana system with major megafossil assemblages.
- Importance of study of fossil.

PART – I:: PRACTICAL

PAPER –III (Phycology, Lichenology, Mycology and Plant Pathology, Bryology, Pteridology, Gymnosperm, and Paleobotany)

FM = 60

Phycology

- Work out of algal specimens (Genera included in the theoretical syllabus except *Coleochaete*) through preparation of semi-permanent slides (stained with cotton blue) and drawing of reproductive structures with proper magnification using camera lucida drawing prism.
- Identification from permanent slides: entire thallus or reproductive structures (to be supplied) of the following specimens: *Oscillatoria*, *Spirulina*, *Microcystis*, *Volvox*, *Hydrodictyon*, Nanandrium of *Oedogonium*, terminal sporangium of *Pithophora*, spermocarp of *Coleochaete*, pinnate and centric diatoms, male and female conceptacle of *Sargassum*, cystocarp of *Polysiphonia*, sex organ of *Vaucheria*.

Lichenology

- Morphological identification of Lichen thallus types.

Mycology

1. Work out and staining (semi-permanent slide preparation), drawing and microscopic measurement of the following genera with reproductive structures –*Rhizopus* (asexual), *Ascobolus* and *Agaricus*.
2. Study from permanent slides of the following - Zygospore 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 Fungi (fruit body of *Polyporus*, *Cyathus*).

Plant Pathology

1. Preparation of PDA and Czapek-Dox Agar (CDA), sterilization and sub-culturing.
2. Isolation of pathogen from diseased leaf.
3. Work out of the pathological specimens (diseased plant) of Late blight of potato, Loose smut of wheat. Stem rot of jute, Red rot of sugarcane, Black stem Rust of *Justicia*.
4. Identification: Permanent slides showing uredial, telial, pycnidial & aecial stages of *Puccinia graminis* (any variety); pathological herbarium specimens of Citrus canker, Brown spot of rice, Tikka disease of ground nut, Wart of potato (museum specimen), Tungro disease of rice in addition to work out specimens.

Bryology

1. Morphological study of the plant body: Genera as mentioned in theoretical syllabus and *Riccia*, *Porella*.
2. Work out for reproductive structures: *Marchantia*, *Anthoceros*, *Funaria*.
3. Study from permanent slides : *Riccia* (V.S. of thallus with sporophyte), *Marchantia* (L.S. through gemma cup, antheridiophore, archegoniophore), *Anthoceros* (L.S. of sporophyte), *Funaria*(L.S. of capsule), *Sphanum* (L.S. of sporophyte).

Pteridology

1. Morphological study of the sporophytic plant body: Genera as mentioned in the theoretical syllabus and *Ophioglossum* and *Pteris*.
2. Workout of the reproductive structures: *Lycopodium*, *Selaginella*, *Equisetum*, *Pteris* and *Marsilea*.
3. Study from permanent slides: *Psilotum* (T.S. of synangium), *Lycopodium* (L.S. of strobilus), *Ophioglossum* (L.S. of spike), *Dryopteris* (gametophyte), *Marsilea* (L.S. of sporocarp).
4. Field records, collection and preservation of common taxa (Maximum 10).

Gymnosperm

1. Study of leaflet and microsporophyll of *Cycas*; leaf and male cone of *Pinus*.
2. Morphological studies of reproductive structures of the genera mentioned in the theoretical syllabus.
3. Study from permanent slides: L.S. of ovule of *Cycas* and *Gnetum*; L.S. of male and female strobili of *Pinus*, *Ginkgo*, and *Gnetum*.

Paleobotany

1. Morphological study: Ptilophyllum, Vertebraria, and Glossopteris leaf fossils.
2. Study from permanent slides: T.S. of stem of *Rhynia*, *Lepidodendron*, *Calamites*, *Lyginopteris*, *Cordaites*, and *Medullosa*.

Note: Field records, plant specimens of different groups to be submitted as preserved or herbariums sheet / dry form.

| Distribution of Marks for Paper – III (Practical) | | | | | Full Marks = 60 |
|---|---|------|---|------------------|--|
| Topics | Work out (36) | | Identifications (10) | Submissions (09) | Viva-voce (05) |
| Phycology | Camera-Lucida drawing with proper measurement and magnification | = 12 | Any three from the following groups: 1. Thallus type or reproductive structure. | 2.0x1 = 02 | Note Book = 04 Slides = 2.0 Field records and Herbarium sheets / Preserved specimens=3.0 |
| Bryology | Work out for vegetative and / reproductive structures | | | | |
| Mycology | Work out any one fungi with microscopic measurements of reproductive structures as per syllabus | = 12 | 2. Morphological types of Lichen (any one). 3. Identification with reasons of any one microscopic or macroscopic fungus as per syllabus. | 2.0x1 = 02 | |
| Plant Pathology | Work out on histopathology of any one disease as per syllabus | | | | |
| Pteridology | Work out for morphology and anatomy of reproductive structures | = 12 | Morphological and anatomical structures | 2.0x1 = 02 | |
| Gymnology | Work out for morphology and anatomy vegetative / reproductive structures | | Morphological and anatomical structures | | |
| Paleobotany | -- | -- | Identification with reasons of any one microscopic and / or any one macroscopic paleo-specimens as per syllabus. | 2x2 = 4.0 | |

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Paleobotany

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2. Andrews, Jr. H.N.Studies in Paleobotany [John Wiley & Sons Inc.]
3. Stewart, W.N. & Rothwell, G.W.Paleobotany and evolution of plants [Cambridge University Press]
4. Agashe, S.N.Palaeobotany [Oxford & IBH]
5. Taylor, T.N.Paleobotany-An introduction to fossil plant biology [McGraw Hill]
6. Meyen, S.V.Fundamentals of Paleobotany [Chapman & Hall]

Syllabus for B.Sc. (Honours) in Botany (PART- II) (Revised Copy)

| PART – II | | TOTAL MARKS = 200 | |
|--------------------------------|--|--|-------------------|
| THEORETICAL MARKS = 140 | | | |
| Paper Number | Title of paper | Subjects | Full marks |
| IV | Morphology, Palynology, and Taxonomy of Angiosperms | Module I: MCQ questions based on Paper IV | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Morphology and Palynology | 28 |
| | | Group B: Taxonomy of Angiosperms | 28 |
| V | Plant Ecology, Plant Biodiversity and Conservation Biology, Anatomy and Embryology | Module I: MCQ questions based on Paper V | 14 |
| | | Module II: Broad answer type questions | 56 |
| | | Group A: Plant Ecology, Plant Biodiversity and Conservation Biology | 28 |
| | | Group B: Anatomy and Embryology | 28 |
| PRACTICAL MARKS = 60 | | | |
| VI | Morphology, Palynology, Embryology, Taxonomy of Angiosperm, Plant Ecology, and Anatomy | | 60 |

Detailed syllabus

PART – II:: THEORY

PAPER – IV (Morphology, Palynology, and Taxonomy of Angiosperms)

FM = 70

LP = 70

Group A: Morphology and Palynology

Morphology of Angiosperms (25 LP)

1. Leaf: types, margin, apex, base, texture, venation and phyllotaxy.
2. Inflorescence: types with examples.
3. Flower: symmetry, sexuality, insertion of floral parts on thalamus; Corolla- forms, aestivation; Stamen- types, anther shape, fixation, connective and dehiscence; Carpel- types; Placentation-types; Ovule-structure and forms.
4. Fruit: types with examples.

Palynology (10 LP)

1. Palynology and its branches.
2. Spore and pollen morphology: polarity, symmetry, shape, forms of apertures and their functions; structure and sculpture of sporoderm, NPC system (Erdtman).
3. Applied palynology: Application of neopalynology and palaeopalynology; melissopalynology; medical palynology; forensic palynology.

Group B: Taxonomy of Angiosperms (FM = 50; LP = 50)

1. Introduction: Definitions of terms: taxonomy, classification, identification, nomenclature, aims and scope of taxonomy, history and phases of taxonomy.
2. Tools of Taxonomy: Functions of field, herbarium-concepts and techniques, botanic gardens, floras / literature. Dichotomous key (indented and bracketed keys).
3. Concepts of Taxonomical Hierarchy: Species/genus/family and other categories.

4. Nomenclatural types: ICBN: Principles and rules, changes, addition and alternation of latest code, names of taxa, nomenclature types, priority of publication and limitations; effective and valid publication; author citation; changes, rejections and conservation of names.
5. Data sources of Taxonomy: Concepts of character, relevance of cytology, anatomy, embryology, palynology and phytochemistry in taxonomy.
6. Numerical taxonomy: Principles, methods, merits and demerits.
7. Phylogenetic taxonomy: concept of phylogeny, heterobathmy, polarity and morphocline; anagenesis and cladistics, cladogenesis; pleisomorphy, apomorphy, synapomorphy, symplesiomorphy; parallelism and convergence; monophyly, paraphyly, polyphyly; and cladistics- cladogram construction, principles of parsimony.
8. Major systems of Angiosperms classification: Outline of classification of Linnaeus (1753), Bentham and Hooker (1862-1883) and Takhtajan (2009) up to subclasses/ super orders.
9. A general survey of the following families of angiosperms with salient features, inter-relationships, systematic position (according to Bentham and Hooker) and economic importance: Dicotyledons- Magnoliaceae, Nymphaeaceae, Brassicaceae, Malvaceae, Leguminosae (sensu lato) Eupobiaceae, Apiaceae, Solanaceae, Apocynaceae (sensu lato), Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae, Cucurbitaceae, Rubiaceae and Asteraceae. Monocotyledons- Alismataceae, Poaceae, Areceae, Liliaceae, Zingiberaceae, and Orchidaceae.

PAPER –V (Plant Ecology, Phytogeography, Plant Biodiversity and Conservation Biology, FM = 70 LP = 70 Anatomy and Embryology)

Group A: Plant Ecology, Plant Geography, Plant Biodiversity and Conservation Biology (FM= 35 LP = 35)

Plant Ecology (30 LP)

1. The Environment: Physical environment; biotic environment; biotic and abiotic interactions.
2. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; ecotone and edge effect; Microclimate; Ecads, ecotype and ecoclines; carrying capacity.
3. Ecosystem: Concept, components and organization, energy flow, Models of energy flow; characterization and structure of ecosystem, the biotic and abiotic components and their inter relationship. Food chains and food webs; ecological pyramids.
4. Ecological succession: Mechanism and types (Hydrosere and Xerosere).
5. Biogeochemical cycles (cycling of C, N and P).
6. Plant indicators and their role in environmental monitoring.
7. Phytogeography: General principles; phytogeographic regions of India (Chatterjee, 1960); Vegetation of Eastern & Western Himalayas and Sunderban vegetation. Endemism, theories of endemism (Age & Area hypothesis of Willis, (1920) for Indian endemic flora).

Plant Biodiversity and Conservation Biology (05 LP)

1. Biodiversity and Conservation: Biodiversity – definition, types (genetic, species and ecosystem), importance and threats; Threatened plants (IUCN Categories); knowledge on Red Data Book; Hotspots.
2. *In situ* and *ex situ* conservation strategies for rare and endangered plants with emphasis on National parks, Sanctuaries and Biosphere reserves, seed banks, cryopreservation in India.

Group B: Anatomy and Embryology (FM = 35; LP = 35)

Plant Anatomy (25 LP)

1. Apical meristem – Organization of shoot apex (Tunica-carpus concept) & organization of root apex (Körper -Kappe concepts).
2. Plant cell wall: primary and secondary wall – structure and chemical composition. Pits - development, types and distribution.
3. Structure of Xylem and Phloem tissue, ontogeny of tracheary elements & sieve elements.
4. Types (Metcalfe & Chalk, Pant and Stebbins & Khush), structure & ontogeny of stomata.
5. Types and evolution of stele; Mechanical tissue and the principles governing their distribution in plants.
6. Types, structure, origin & function of cambium.
7. Ecological Anatomy with reference to Hydrophytes, Xerophytes, Halophytes and Epiphytes.
8. Root-Stem transition & its significance.
9. Normal secondary growth (interstellar & extrastelar) in dicot stem.
10. Anomalous secondary growth in *Bignonia*, *Boerhaavia*, *Dracaena*, *Tecoma* & root of *Tinospora*.

Embryology of Angiosperms (10 LP)

1. Embryology: Sporogenesis and Gametogenesis– Microsporogenesis and Microgametogenesis; Megaspores and Megagametogenesis (monosporic, bisporic and tetrasporic types).
2. Fertilization; Development of Embryo in *Capsella bursapastoris* (Brassicaceae).
3. Development of Endosperms.

PART – II:: PRACTICAL

PAPER –VI (Morphology, Palynology, Taxonomy of Angiosperm, Plant Ecology, and Anatomy)

FM = 60

Morphology

1. As per theoretical syllabus.

Palynology

1. Study from pollen types: Colpate, porate, and colpate from *Leonurus sibiricus*, *Hibiscus rosa-sinensis*, and *Cassia sophera*, respectively.

Taxonomy of Angiosperm

1. Taxonomical work out of a member belonging to the families: Brassicaceae, Malvaceae, Leguminosae (sensu lato,) Euphorbiaceae, Solanaceae, Apocynaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae and Rubiaceae.
2. Spot identification of botanical names and families of Angiospermic plants as per theoretical syllabus.
3. Field note book (authenticated) with ecological notes on the plants of the area of excursion and voucher specimen book.
4. Herbarium specimen: Preparation of 30 Angiospermic specimens (identified with author citation, voucher no., and arranged following Bentham and Hooker's system of classification) to be submitted in the term end examination.
5. Laboratory note book of each section must be signed by the respective teacher with date during practical classes and Slides (prepared during practical classes).

Plant Ecology

1. Study of morphological and structural adaptations of locally available hydrophytes, mesophytes, and correlate to their particular habitats.
 - a. Hydrophyte: *Eichhornia*, *Nymphaea*, *Hydrilla*, *Pistia*, *Ludwigia adscandens*.
 - b. Xerophyte: *Nerium*, *Casuarina*, *Opuntia*, *Euphorbia tirucali*.
2. Assessment of water characteristics:
 - (i) Determination of dissolved carbon dioxide in different water samples.
 - (ii) Determination of phosphate in different water samples.

Anatomy

1. Work out with double staining of T. S. of stem of *Bignonia*, *Boerhaavia*, *Dracaena*, *Tecoma* & root of *Tinospora* and Orchid.
2. Anatomical identification of any one from the following: type of stomata, sclerides, raphides, cystoliths, aleurone grains, laticiferous ducts, oil glands and lenticels.

| Distribution of Marks for Paper – VI (Practical) | | | | | Full Marks = 60 | |
|--|---|----|--|------------|--|----------------|
| Topics | Work out (31) | | Identifications (14) | | Submissions [Note Book, slides & field records] (10) | Viva-voce (05) |
| Morphology | -- | -- | Morphological identification of any three specimens with reasons as per theoretical syllabus | 2.0x3 = 06 | Note Book = 04 Slides = 2.0 Field records and Herbarium sheets / Preserved specimens = 4.0 | |
| Palynology | -- | -- | | | | |
| Taxonomy of Angiosperm | Taxonomical work out of a member belonging to the families mentioned in the practical syllabus = 15 | | Spot identification of botanical names and families of four Angiosperm plants as per theoretical syllabus (one from monocot and three from dicot) | 1.5x4 = 06 | | |
| Plant Ecology | Estimation of either CO ₂ or phosphate from water sample = 06 | | -- | -- | | |
| | Anatomical features of ecological adaptations of any one specimens as mentioned in the practical syllabus staining by aqueous saffranin, draw, label and comment = 10 | | -- | -- | | |
| Anatomy | T. S. of stem or root of any one as mentioned in the practical syllabus, staining by aqueous saffranin, draw, label and comment | | Anatomical identification of any one from the following: types of stomata, sclerides, raphides, cystoliths, aleurone grains, laticiferous ducts, oil glands and lenticels. | 2.0x1 = 02 | | |

Bibliography

Morphology and Anatomy

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2. Esau, K.Plant Anatomy [Wiley Eastern]
3. Fahn, A.Plant Anatomy [Pergamon press]
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5. Ganguly, H.C. & Kar, A.K.College Botany Vol. I [New Central Book Agency]
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7. Mauseth, J.D.Plant Anatomy [Benjamin Cummings Publications]
8. Mitra, D., Guha, J. & Chowdhury, S.K....Studies in Botany, Vol.I [Moulik Library]

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]

Taxonomy of Angiosperm

1. Lawrence, G.H.M.Taxonomy of Vascular Plants [Oxford & IBH]
2. Datta, S.C.Systematic Botany [Wiley Eastern]
3. Mukherjee, S.College Botany Vol. III [New Central Book Agency]
4. Mitra, D., Guha, J. & Chowdhury, S.K...Studies in Botany, Vol. I [Moulik Library]
5. Naik, V.N.Taxonomy of Angiosperms [Tata McGraw Hill]
6. Heywood, V.H.Flowering Plants of India [Oxford University Press]
7. Stace, C.A.Plant Taxonomy and Biosystematics [Arnold Publishers]
8. Prain, D.Bengal Plants Vol. I & II [Bishen Singh, Mahendra Pal Singh]
9. Sivarajan, V.V.Introduction to Principles of Plant Taxonomy [Oxford & IBH]
10. McNeill, J. (Chairman), Barrie, F. R., Burdet, H. M., Demoulin, V., Hawksworth, D. L., Marhold, K., Nicolson, D.H., Prado, J., Silva, P. C, Skog, J. E., Wiersema, J. H. (Members) & Turland, N. J. (Secretary) - the Editorial Committee of the IAPT 2006 -International Code of Botanical Nomenclature – VIENNA CODE 2005...Regnum Vegetabile 146 [Gantner Verlag K.G., ISBN 0080 - 0694]

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]

Plant Ecology, Plant Biodiversity and Conservation Biology

1. Odum, E.P.Fundamentals of Ecology [Saunders]
2. Ambasht, R.S and Ambasht, N.KA Text book of plant Ecology [CBS Publ.]
3. Sukla, R.S. & Chandal, P.S.Plant Ecology [S. Chand & Co.]
4. Verma, P.S. & Agarwal, V.K.Concept of Ecology [S. Chand & Co.]
5. Kumar, H.D.Modern Concept of Ecology [Vikas Pub House]
6. Dhaliwal, G.S., Sangha, G.S and Ralhan, P.KFundamentals of Environmental Sciences [Kalyani Pub.]
7. Asthana, D.K and Asthana M.Environmental Problems and Solutions[S. Chand & Co.]
8. Cox, C.B & Moore, P.DBiogeography –An Ecological and Evolutionary Approach [Blackwell Scientific Publ.]
9. Mani, M.S.Biogeography of India [Springer-Verlag]
10. Mitra, D., Guha, J. & Chowdhury, S.K.....Studies in Botany Vol. II[Moulik Library]
11. Sharma, P.D.Elements of Ecology [Rastogi Publ.]

Syllabus for B.Sc. (Honours) in Botany (PART- III) (Revised Copy)

| PART – III | | TOTAL MARKS = 400 | |
|--------------------------------|---|--|---------------------------|
| THEORETICAL MARKS = 240 | | | |
| Paper Number | Title of paper | Subjects | Full marks 80 each |
| VII | Cell Biology, Genetics, Plant Breeding, and Biostatistics | Module I: MCQ questions based on Paper VII | 16 |
| | | Module II: Broad answer type questions | 64 |
| | | Group A: Cell Biology | 32 |
| | | Group B: Genetics, Plant Breeding and Biostatistics | 32 |
| VIII | Plant Physiology, Plant Biochemistry and Pharmacognosy | Module I: MCQ questions based on Paper VIII | 16 |
| | | Module II: Broad answer type questions | 64 |
| | | Group A: Plant Physiology | 32 |
| | | Group B: Plant Biochemistry and Pharmacognosy | 32 |
| IX | Microbiology and Plant Biotechnology | Module I: MCQ questions based on Paper IX | 16 |
| | | Module II: Broad answer type questions | 64 |
| | | Group A: Microbiology | 32 |
| | | Group B: Plant Biotechnology | 32 |
| PRACTICAL MARKS = 160 | | | |
| X | Microbiology, Cell Biology, Genetics, Plant Breeding, and Biostatistics | | 80 |
| XI | Plant Physiology, Plant Biochemistry and Pharmacognosy | | 80 |

Detailed syllabus

PART – III :: THEORY

PAPER – VII (Cell Biology, Genetics, Plant Breeding, and Biostatistics)

FM = 80

LP = 80

Group A: Cell Biology (LP = 40)

1. Cytoskeleton: Components and Motor proteins: a brief idea; Microtubules and its organization during cell division.
2. Cell organelles: ultra-structure of nucleus, nucleolus, and nuclear envelope; mitochondria- ultra structure, mt-DNA; chloroplast- ultra structure, cp-DNA; ribosome-ultra structure and biogenesis, peroxisome and endoplasmic reticulum and Golgi bodies – ultra structure and function.
3. Cell division: Different stages of mitosis and meiosis: significance.
4. Cell cycle: cell cycle events; check points and control: role of cyclins and kinases - a brief idea. Apoptosis: Definition, mechanism and significance.
5. Changes in chromosome number and structure: Euploidy and aneuploidy, chromosomal rearrangements deletion, duplication, inversion, and translocation-their origin, meiotic behaviour and genetic effects.
6. Chromatin structure: nucleosome morphology and higher level organization.
7. Chromosome organization: Structure of centromere and kinetochore, telomere; heterochromatin and euchromatin.
8. Specialized Chromosomes: Polytene, Lampbrush and B-chromosome.

Group B: Genetics, Plant Breeding and Biostatistics (FM = 40; LP = 40)

Genetics (25 LP)

1. Laws of inheritance: Mendel's Laws, concepts of dominance, segregation, independent assortment, deviation from Mendelian inheritance (Co-dominance, incomplete dominance, epistasis, hypostasis, complementary gene factor, polygenic inheritance).

2. Linkage - types and detection; crossing over and chromosome mapping: Crossing over as the physical basis of recombination (McClintock's experiment); molecular basis of recombination (Holliday model); chromosome mapping: three point test cross.
3. Sex linked inheritance: Sex chromosomes and sex determination in plants, sex linked inheritance.
4. Concept of gene: Fine structure of gene, split genes, overlapping gene, pseudogene and cryptic genes and multi-gene family, concept of allele, multiple allele, pseudoallele.
5. Population genetics: population, gene frequency in population, genetic equilibrium, Random mating population, Hardy-Weinberg Principle.

Plant Breeding and Biostatistics (15 LP)

1. Concept of plant breeding; types of variety selection – mass selection, pure line selection, clonal selection, bulk and pedigree selection and hybridization.
2. Heterosis and Hybrid vigour.
3. Male sterility in plants- types and application.
4. Sampling methods-concept of sampling of population, measures of central tendency and dispersal: determination of mean, mode, median, variance, standard deviation and standard error.
5. Rules of probability (Addition and Multiplication theorem), Null-hypothesis, Tests of significance: chi-square test, t-test (student and paired t-test).

PAPER – VIII (Plant Physiology, Biochemistry and Pharmacognosy)

FM = 80

LP = 80

Group A: Plant Physiology (40 Marks; 40 LP)

1. Plant water relationship: Diffusion, Osmosis, Concept of water potential and its components; water movement mechanism through plants (apoplastic and symplastic movement). Absorption of water – mechanism, symplastic and apoplastic pathway. Ascent of sap – path, cohesion-tension theory and its critical evaluation. Soil-Plant-Atmosphere continuum concept, Cavitation and embolism.
2. Phloem Transport: Source & Sink; Phloem loading & unloading, and composition of phloem sap; Mass flow hypothesis and its critical evaluation.
3. Transpiration: Stomata - micellation of guard cell; Role of CO₂, K⁺ - ion, blue light & abscisic acid in stomatal movement; Anti-transpirant.
4. Photosynthesis: Pigments - Structure of chlorophyll a & b, importance of carotenoids, and nature of phycobilins and anthocyanins; Absorption and Action spectra, Red drop & Emerson effect, Hill reaction, Photosystems & Photochemical reaction centres, Water splitting mechanism, and Cyclic and non-cyclic electron transport and photophosphorylation; Calvin cycle and Photorespiration (mechanism & significance); C₄ cycle (variants, mechanism and significance), and efficiency of C₃ & C₄ plants on crop productivity; CAM and its ecological significance.
5. Respiration: Glycolysis & its significance, and synthesis of acetyl Co-A; oxidation of cytosolic NADH + H⁺ (Glycerol 3-Phosphate shuttle pathway); Anaerobic respiration pathway leading to ethyl alcohol and lactic acid formation; Krebs' cycle and its significance; brief idea about glycolysis and Krebs' cycle regulation; Oxidative pentose phosphate pathway and its significance; Electron transport system and mechanism of Oxidative Phosphorylation (chemosmotic theory); P/e ratio; Stoichiometry of glucose oxidation, Respiratory Quotient and its significance.
6. Nitrogen metabolism: Source of nitrogen for plants, Nitrification and denitrification, Assimilation of nitrate by plant and general principle of amino acid biosynthesis (GS/GOGAT enzyme system). Nitrogen fixing organisms and biochemistry of dinitrogen fixation and process of nodule formation; a general idea about *nif* and *nod* genes.

- Growth regulators: Auxin – discovery, chemical nature (natural and synthetic); bio -synthesis, physiological roles; Gibberellins – Discovery, chemical nature, physiological roles; Cytokinins – Discovery, chemical nature (natural and synthetic), physiological roles; Abscisic acid and ethylene – Discovery, chemical nature, physiological roles.
- Physiology of flowering: Photoperiodism: Classification of plants based on photoperiod responses, critical day length, concept of night length monitoring. Perception of photoperiodic stimulus; Phytochrome – chemical nature and biosynthesis, role in circadian rhythm; Role of GA and florigen concept. Vernalization: Role of cold temperature in flowering.
- Seed Dormancy: Types, causes and methods of breaking seed dormancy.
- Stress physiology: Plant responses to water, temperature and salt stress; brief idea about stress induced gene expression (HSPs).

Group B: Biochemistry (30 LP)

- Fundamental concepts of: Covalent, non-covalent & hydrogen bonds, van der Waals interactions; Structure & properties of water; pH and buffer, Henderson-Hasselbalch equation; Isoelectric point.
- Biomolecules: Proteins - structure and classification of amino acids; Primary, Secondary, Tertiary & Quaternary structures of proteins; Ramachandran plot; Carbohydrates - structures of mono- , di-, oligo-& poly-saccharides; stereoisomers, enantiomers, epimers and anomers; sugar derivatives; Lipids - structures of triglycerides, phospholipids and glycolipids; saturated and unsaturated fatty acids; β -oxidation of fatty acids.
- Membrane chemistry (composition and structure- Fluid Mosaic model); Membrane transport (uniport, symport, antiport), mechanism of ion uptake; Signal transduction pathway and second messenger concept - G-protein and Ca^{2+} as messenger.
- Bioenergetics: Laws of thermodynamics, Open and closed systems; Exergonic and endergonic reactions; Standard free energy (ΔG°) change and free energy ($\Delta G'$) change; Relation between ΔG° and K'_{eq} ; Energy rich bond with reference to ATP; Electromotive force, half-reaction and conjugate redox pair; Standard reduction potential (ΔE°) and its relationship with ΔG° .
- Enzymology: Definition, mechanism of action (lock and key, and induced fit hypothesis) and classification (only major groups - according to IUBMB); Concept of: Co-factor, coenzyme, prosthetic group, apoenzyme, holoenzyme, active site, activation energy; Enzyme kinetics - steady state, velocity, and equilibrium, Michaelis-Menten equation and Lineweaver-Burk plot, and enzyme inhibition and simple problems; Allosteric regulation with examples.

Pharmacognosy (10 LP)

- General account: Pharmacognosy and its importance in modern medicine.
- Crude drugs; Pharmacological and chemical classification of drugs; Drug evaluations - (Definitions with examples of the following) - organoleptic, microscopic, chemical & physical evaluation.
- Bioassay of drug - Definition and examples.
- Secondary metabolites of plants: Definitions of, and difference in between, Primary and Secondary Metabolites; Secondary metabolites and plant protection; Utilization of major types of metabolites as drug - phenolics & quinones, terpenoids, flavonoids and alkaloids.
- Active constituents: - Source plants, parts used, chemical nature & uses of the following - Glycosidic anthraquinone (Barbaloin); Tannic acid derivative (Catechin); Resins (Curcuminoids); Steroids (Diosgenin, Digitoxin); Alkaloids (Caffeine, Quinine, Reserpine).

Group A: Microbiology (40 Marks; 40 LP)**Virus (10 periods):**

1. Salient features and nature of viruses. Virus types according to capsid symmetry and nucleic acid. Structural organization and chemistry of TMV, T4 and influenza virus.
2. Replication/multiplication of Lytic cycle (T4 phage) and Lysogenic cycle (Lambda phage), Significance of lysogeny.
3. Outline the mechanism of plant virus transmission and its control.
4. Brief idea about – Viroids, Prion and HIV.

Bacteria (30 LP):

1. Distinguishing features of Archaea and Bacteria, Glycocalyx- nature and function; Flagella (ultrastructure) & Pili, Cell wall – chemical structure and differences between Gram +ve & Gram – ve bacteria; Bacterial membrane – Eubacteria and Archaea; Bacterial genome and plasmid; Endospore - formation , structure and function,
2. Genetic Recombination (a) Transformation – with special emphasis on Natural and Induced competence and DNA uptake, (b) Conjugation – F⁻ factor, F⁺ x F⁻, Hfr x F⁻, concept of F', chromosome mobilization, (c) Transduction– Generalised and specialized.
3. Brief idea about binary fission and budding; Bacterial growth curve; Definition and generation time; Growth kinetics – Physical and nutritional conditions.
4. *Applied Microbiology*: Industrial Production of Vinegar and Streptomycin (brief outline); Microbial sources and uses of Enzyme (Amylase, Protease), Amino acid (Glutamic acid, Lysine), Polysaccharides (Dextran), Use of microbes as Biofertilizer, Bioplastic and Biopesticides.

Group B: Plant Biotechnology (FM = 40; LP = 40)

1. Brief history of plant tissue culture, Cellular totipotency, Basic requirements for tissue culture laboratory, formulation of tissue culture medium, growth regulators.
2. Micropropagation: methods and stages, advantages, disadvantages and application, organogenesis and embryogenesis (zygotic and somatic, induction of somatic embryogenesis, role of plant growth regulators, application – synthetic seeds); callus culture; application of plant tissue culture in agriculture and forestry.
3. Protoplast culture – isolation technique, fusion, selection of hybrid cells culture and application.
4. Plant genetic engineering: gene delivery systems in plants (concepts only).
5. Recombinant DNA technology: restriction enzymes, cloning using vectors (plasmids (pBR322), DNA sequencing, PCR.
6. Techniques in the study of chromosomes and their applications: Karyotype concept, principle of chromosome banding technique, chromosome labelling, in situ hybridization, GISH and FISH techniques.

PART –III :: PRACTICAL**Microbiology**

1. Preparation of bacterial media – (a) Nutrient agar and nutrient broth; (b) Preparation of slants and pouring Petri -plates.

2. Sub-culturing of bacterial culture.
3. Microscopic examination of bacteria by simple staining of root nodule (Ziel's Carbol Fuchsin stain; Methylene blue stain) and Gram staining from bacterial culture and curd.

Cell Biology

1. Chromosome preparation: Pre-treatment, Fixation, Staining, Squash and Smear preparation, Preparation of permanent slides.
2. Study of Mitotic Chromosomes: Metaphase chromosome preparation, free hand drawing, determination of 2n number and comment on chromosome morphology of *Allium cepa*, *Aloe vera* and *Lens esculenta*.
3. Determination of mitotic index in pre-fixed root tips of *Allium cepa*, *Lens esculenta*.
4. Study of meiotic chromosome: Smear preparation of meiotic cells, identification of different stages and free hand drawing of the following specimens from flower buds: *Allium cepa*.
5. Identification from permanent slides: Meiosis – (i) normal stages (ii) abnormal stages – laggard, anaphase bridge, ring chromosome (*Rhoeo discolor*); Mitosis –(i) normal stages, (ii) abnormal stages- early separation, late separation, multipolarity, sticky bridge, fragmentation, (ii) pollen mitosis.

Genetics and Biostatistics

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).

| Distribution of Marks for Paper – X (Practical) | | | | Full Marks = 80 | |
|---|---|--|------------------|------------------------------------|--|
| Topics | Work out (58) | Identifications (06) | Submissions (08) | Viva-voce (10) | |
| Microbiology | Microscopic examination of bacteria by simple staining of root nodule (Ziel's Carbol Fuchsin stain; Methylene blue stain); Gram staining from bacterial culture and curd. = 14 | -- | -- | Note Book = 06 Slides = 2.0 | |
| Cell Biology | 1. Free hand drawing, determination of 2n number and comment on chromosome morphology of metaphase chromosome of the supplied sample (Squash: 04; drawing: 05; labelling: 02; comment: 05) = 16 | Identification with reasons of normal mitotic and meiotic stages, normal stages of pollen mitosis; abnormal, mitotic and meiotic stages. | 3.0x2 = 06 | | |
| | Smear preparation of meiotic cells, identification of any two stages and its free hand drawing from the flower bud of <i>Allium cepa</i> (Smear: 04; drawing and labelling: 06; identification of stage: 02; comment: 04) = 16 | | | | |
| Genetics and Biostatistics | Determinations of goodness of fit in normal and modified mono and dihybrid ratios by Chi-square analysis and comment on the nature of inheritance. (Calculation: 08 and Comment: 04) = 12 | -- | -- | | |
| | Univariate analysis of statistical data from statistical tables: calculation of mean mode, median, standard deviation, and standard error (using seedling population / leaflet size). (Calculation: 10 and Comment: 02) | -- | -- | | |

Plant Physiology

Major [16 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 by Ganong's respirometer or respiroscope.
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.
7. Effect of temperature on absorption of water by storage tissue and determination of Q_{10} .
8. Effect of detergent (SDS) on the permeability of plasma membranes.
9. Effect of temperature on the permeability of plasma membranes.
10. Effect of light quality on the rate of photosynthesis.

Minor [12 Marks]

1. Determination of stomatal frequency.
2. Relationship between evaporation and transpiration.
3. Separation of chloroplast pigments by paper chromatography method.
4. Comparison of imbibitions of water by starchy, proteinaceous and fatty seeds.
5. Comparison between transpiration rate of mesophytic and xerophytic leaves.
6. Comparison between transpiration and absorption.

Biochemistry

A. Qualitative [12 Marks]

1. Detection of organic acids - citric, oxalic, malic & tartaric from laboratory / plant 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 [16 Marks]

1. Estimation of amino-nitrogen in an amino acid (glycine) 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 (08)

1. Microscopic evaluation of powder drugs (*Adhatoda vasica* leaf powder; *Hollarhena* bark).
2. Histochemical tests starch in non-lignified vessel (*Zingiber* sp.) and alkaloid (stem of *Catharanthus* sp.).

| Distribution of Marks for Paper – XI (Practical) | | | | | Full Marks = 80 | |
|--|--|------|---------------------|----|------------------|----------------|
| Topics | Work out (64) | | Identifications (0) | | Submissions (06) | Viva-voce (10) |
| Plant Physiology | One major physiological experiment as per syllabus. (Requisition: 03; experiment set up: 02; Principle: 02; Result: 06; Comment: 03) | = 16 | -- | -- | Note Book = 06 | |
| | One minor physiological experiment as per syllabus. (Requisition: 02; experiment set up: 02; Principle: 02; Result: 04; Comment: 02) | = 12 | -- | -- | | |
| Biochemistry | One qualitative biochemical experiment as per syllabus. (Requisition: 03; Procedure: 05; Observation: 02; Comment: 02) | = 12 | -- | -- | | |
| | One quantitative biochemical estimation as per syllabus. (Requisition: 02; Procedure: 04; Results and calculation: 08; Comment: 02) | = 16 | -- | -- | | |
| Pharmacognosy | Microscopic evaluation of crude powder drugs as per practical syllabus | = 08 | -- | -- | | |

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Syllabus for B.Sc. (General) in Botany (PART - I) (Revised Copy)

| PART – I | | TOTAL MARKS = 150 | |
|--------------------------------|---|--|---------------------------|
| THEORETICAL MARKS = 100 | | | |
| Paper Number | Title of paper | Subjects | Full marks 50 each |
| I | Microbiology, Phycology, Mycology and Plant Pathology | Module I: MCQ questions based on Paper I | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Microbiology and Phycology | 17 |
| | | Group B: Mycology and Plant Pathology | 17 |
| II | Bryology, Pteridology, Gymnology and Paleobotany | Module I: MCQ questions based on Paper II | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Bryology and Pteridology | 17 |
| | | Group B: Gymnosperm and Paleobotany | 17 |
| PRACTICAL MARKS = 50 | | | |
| III | Practical based on Paper I and II | | 50 |

Detailed syllabus

Part – I: THEORY

PAPER – I (Microbiology, Phycology Mycology and Plant Pathology)

FM = 50

LP = 50

GROUP: A:: Microbiology and Phycology (Part Marks = 25; LP = 25)

Virus (05 periods):

- Salient features and nature of viruses. Virus types according to capsid symmetry and nucleic acid. Structural organization and chemistry of TMV, T4; Replication of Lytic cycle (T4 phage) and Lysogenic cycle (Lambda phage).

Bacteria (10 periods):

- Distinguishing features of Bacteria, Flagella (ultra structure) & Pili, Cell wall – chemical structure and differences between Gram +ve & Gram –ve bacteria;
- Genetic Recombination over view of (a) Transformation, (b) Conjugation, (c) Transduction.
- Brief idea about binary fission and budding; Bacterial growth curve.
- Applied Microbiology: Uses of microbes as Biofertilizer, Bioplastic and Biopesticides.

Phycology (10 LP)

- General account: Thallus organization, Origin and evolution of sex.
- Classification: Classification by Bold and Wynne (1978) upto division (phylum) with examples; Salient features of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Xanthophyceae, Phaeophyceae, Rhodophyceae.
- Life cycle pattern of *Oedogonium* and *Chara*.
- Economic Importance: Food, Phycocolloid (Agar-agar, Algin, Carrageenan), Diatomite.

GROUP: B:: Mycology and Plant Pathology

Part Marks = 25

LP = 25

Mycology (20 LP)

8. General Account: Hyphal forms, Fungal spore forms; Sexual reproduction and degeneration of sex; Homothallism and heterothallism; Life cycle patterns, Mycotoxins with emphasis on aflatoxin.
9. Classification: Classification of Fungi (Ainsworth, 1973) upto sub-division with diagnostic characters and examples.
10. Life history: *Rhizopus*, *Ascobolus*, *Agaricus*.

Plant Pathology (20 Periods)

5. Terms and Definitions: Disease concept; Symptoms; Etiology & causal complex; Primary and secondary inocula, Infection, Pathogenicity and pathogenesis, susceptibility, Koch's postulates, Endemic, Epidemic, Pandemic and Sporadic disease.
6. Host – Parasite Interaction; Host resistance.
7. Plant Disease Management: Chemical, Biological.
8. Symptoms, Causal organism, Disease cycle and Control measures of: Late blight of Potato, Brown spot of rice, Black stem rust of wheat.

PAPER –II (Bryology, Pteridology, Gymnology and Paleobotany)

FM = 50

LP = 50

Group A: Bryology and Pteridology (25 Marks: 25 LP)

Bryology (15 LP)

1. General account: Characteristic features; Origin of bryophytes, Amphibian nature; an outline idea of classification system following Proskauer (1957) upto class with diagnostic characters and examples.
2. Characteristic features of gametophytes and sporophytes of *Riccia*, *Anthoceros* and *Funaria*.

Pteridology (10 LP)

7. General account: Characteristics; colonisation and rise of early land plants, Classification of vascular plants by Sporne (1975) upto class with diagnostic characters and examples.
8. Life History: Morphology and Anatomy of vegetative body, and reproductive organs of sporophytes, and alternation of generations in - *Lycopodium*, *Selaginella*, and *Dryopteris*.

Group B: Gymnology and Paleobotany (25 Marks: 25 LP)

Gymnology (15 LP)

1. General characters and economic importance of Gymnosperms.
2. Overview of classification of Gymnosperms.
3. General accounts of vegetative morphology, anatomy, reproductive structures of *Cycas*, *Pinus*, and *Gnetum*.

Paleobotany (10 LP)

5. Fossil: types and modes of preservation (Schopf, 1975).
6. Geological time scale and major events of plant life through geological ages.
7. Importance of study of fossil.

PART – I:: PRACTICAL

PAPER –III:

FM = 50

Microbiology

1. Microscopic examination of bacteria from curd by simple staining (Ziel's Carbol Fuchsin stain) and Gram staining from bacterial culture and root or stem nodule.

Mycology

4. Work out and staining (semi-permanent slide preparation), drawing and microscopic measurement of the following genera with reproductive structures – *Rhizopus* (asexual), *Ascombolus* and *Agaricus*.
5. Morphological study of Fungi (fruit body of *Polyporus*, *Lentinus*).

Plant Pathology

5. Work out of the pathological specimens (diseased plant) of Black stem rust of *Justicia*, Wart of Potato, Red rot of sugarcane.

Phycology

3. Work out of algal specimens *Nostoc*, *Chara*.

Bryology

4. Work out for reproductive structures: *Riccia*, *Anthoceros*, *Funaria*.
5. Field record and plant collection to be submitted (not more than 10 herbarium specimens).

Pteridology

5. Workout of the reproductive structures: *Lycopodium*, *Selaginella*, *Pteris*.
6. Field records, collection and preservation of common taxa (Maximum 10).

Gymnology (10 LP)

1. Workout of the reproductive structures: *Cycas*, *Pinus*, and *Gnetum*.

Note: Field records, plant specimens of different groups to be submitted as preserved or herbariums sheet / dry form.

Distribution of Marks for Paper – III (Practical)

Full Marks – 50

| Distribution of Marks for Paper – III (Practical) | | | | | Full Marks = 50 | |
|---|---|------|---|-------------|--|----------------|
| Topics | Work out (27) | | Identifications (2.5 x 2 = 05) | | Submissions (12) | Viva-voce (06) |
| Microbiology | Differential staining (Gram's stain) of bacterial isolates or root / stem nodule | = 15 | 1. Identification with reasons of any one microscopic or macroscopic fungus as per syllabus. 2.Plant Pathological herbarium sheets (any one) as per syllabus | 2.5x1= 2.5 | Note Book = 06 Slides = 2.0 Field records and Herbarium sheets = 4.0 | |
| Mycology | Work out any one fungi with microscopic measurements of reproductive structures as per syllabus | | | | | |
| Plant Pathology | Work out on histopathology of any one disease as per syllabus | | | | | |
| Phycology | Camera lucida drawing with proper measurement and magnification | = 12 | Thallus type or reproductive structure (any two). Reproductive structure (any one from each group). Reproductive structure (any one from each group). | 2.5x1 = 2.5 | | |
| Bryology | Work out for reproductive morphology | | | | | |
| Pteridology | Work out for reproductive morphology | | | | | |
| Gymnology | ----- | | | | | |

Syllabus for B.Sc. (General) in Botany (PART- II) (Revised Copy)

| PART – II | | TOTAL MARKS = 150 | |
|--------------------------------|--|---|-------------------|
| THEORETICAL MARKS = 100 | | | |
| Paper Number | Title of paper | Subjects | Full marks |
| IV | Plant Ecology, Anatomy, Morphology, and Taxonomy of Angiosperm | Module I: MCQ questions based on Paper IV | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Plant Ecology and Anatomy | 17 |
| | | Group B: Morphology and Taxonomy of Angiosperm | 17 |
| V | Plant Physiology, Plant Biochemistry, and Pharmacognosy | Module I: MCQ questions based on Paper V | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Plant Physiology | 17 |
| | | Group B: Plant Biochemistry and Pharmacognosy | 17 |
| PRACTICAL MARKS = 50 | | | |
| VI | Practical based on Paper IV and V | | 50 |

Detailed syllabus

PART – II:: THEORY

| | | |
|--|----------------|----------------|
| PAPER – IV (Plant Ecology, Anatomy, Morphology, and Taxonomy of Angiosperm) | FM = 50 | LP = 50 |
|--|----------------|----------------|

Group A: Plant Ecology and Anatomy (FM = 25; LP = 25)

Plant Ecology (15 LP)

8. The Environment: Physical environment; biotic environment; biotic and abiotic interactions.
9. Habitat and niche: Concept of habitat and niche.
10. Ecosystem: Concept, components and organization, energy flow, structure of ecosystem, the biotic and abiotic components and their inter relationship. Food chains and food webs; ecological pyramids.
11. Ecological succession: Mechanism and types (Hydrosere).
12. Biogeochemical cycles (cycling of C, N).

Plant Anatomy (10 LP)

11. Plant cell wall: primary and secondary wall – structure and chemical composition. Pits - development, types and distribution.
12. Structure of Xylem and Phloem tissue.
13. Types and evolution of stele.
14. Root-Stem transition & its significance.
15. Normal secondary growth (interstellar & extrastelar) in dicot stem.

Group B: Morphology and Taxonomy of Angiosperms (FM = 25; LP = 25)

Morphology of Angiosperms (15 LP)

5. Inflorescence: types with examples.
6. Flower: symmetry, sexuality, insertion of floral parts on thalamus; Corolla- forms, aestivation; Stamen- types, anther shape, fixation, connective and dehiscence; Carpel- types; Placentation-types; Ovule-structure and forms.
7. Fruit: types with examples.

Taxonomy of Angiosperms (LP = 20)

10. Introduction: Definitions of terms: taxonomy, classification, identification, nomenclature, aims and scope of taxonomy, history and phases of taxonomy.
11. Tools of Taxonomy: Functions of field, herbarium-concepts and techniques, botanic gardens, floras / literature. Dichotomous key (indented and bracketed keys).
12. Concepts of Taxonomical Hierarchy: Species/genus/family and other categories.
13. Nomenclature: ICBN: Principles and rules.
14. Major systems of Angiosperms classification: Outline of classification of Linnaeus (1753), Bentham and Hooker (1862-1883) up to subclasses/ super orders.
15. A general survey of the following families of angiosperms with salient features, inter-relationships, systematic position (according to Bentham and Hooker) and economic importance: Dicotyledons- Brassicaceae, Malvaceae, Leguminosae (sensu lato) Euphobiaceae, Solanaceae, Lamiaceae, Cucurbitaceae, and Asteraceae. Monocotyledons- Poaceae, Liliaceae, and Orchidaceae.

PAPER –V (Plant Physiology, Plant Biochemistry, and Pharmacognosy)

FM = 50

LP = 50

Group A: Plant Physiology (25 Marks; 25 LP)

11. Plant water relationship: Diffusion, Osmosis, Concept of water potential and its components. Absorption of water – mechanism. Ascent of sap – path, cohesion-tension theory and its critical evaluation.
12. Transpiration: Stomata – mechanism of opening and closing and Antitranspirant.
13. Photosynthesis: Pigments - Structure of chlorophyll a & b, importance of carotenoids; Absorption and Action spectra, Red drop & Emerson effect, Hill reaction, Photosystems & Photochemical reaction centres, Cyclic and non-cyclic electron transport and photophosphorylation; Calvin cycle and Photorespiration (mechanism & significance); C4 cycle and significance, CAM and its ecological significance.
14. Growth regulators: Auxin – discovery, chemical nature (natural and synthetic); physiological roles; Gibberellins – Discovery, chemical nature, physiological roles; Cytokinins – Discovery, chemical nature (natural and synthetic), physiological roles; Abscisic acid and ethylene – Discovery, chemical nature, physiological roles.
15. Physiology of flowering: Photoperiodism: Classification of plants based on photoperiod responses; Phytochrome – chemical nature, role in flowering in SDP and LDP. Vernalization: Role of cold temperature in flowering.
16. Seed Dormancy: Types, causes and methods of breaking seed dormancy.

Group B: Biochemistry and Pharmacognosy (25 Marks; 25 LP)

Biochemistry (20 LP)

6. Fundamental concepts of: Covalent, non-covalent & hydrogen bonds, van der Waals interactions; Structure & properties of water; pH and buffer.
7. Biomolecules: Proteins - structure and classification of amino acids; Primary, Secondary, Tertiary & Quaternary structures of proteins; Carbohydrates – classification with examples; Lipids – classification with examples.
8. Bioenergetics: Laws of thermodynamics, Open and closed systems; Exergonic and endergonic reactions; Energy rich bond with reference to ATP.

9. Enzymology: Definition, mechanism of action (lock and key, and induced fit hypothesis) and classification (only major groups - according to IUBMB); Concept of: Co-factor, coenzyme, prosthetic group, apoenzyme, holoenzyme, active site, activation energy; enzyme inhibition.
10. Respiration: Glycolysis & its significance, and synthesis of acetyl Co-A; Anaerobic respiration pathway leading to ethyl alcohol and lactic acid formation; Krebs's cycle and its significance; Electron transport system and mechanism of Oxidative Phosphorylation (chemosmotic theory); Respiratory Quotient and its significance.
11. Nitrogen metabolism: Source of nitrogen for plants, Nitrification and denitrification. Nitrogen fixing organisms and process of nodule formation.

Pharmacognosy (05 Marks; 10 LP)

6. General account: Pharmacognosy and its importance in modern medicine.
7. Active constituents: - Source plants, parts used, chemical nature & uses of the following - Glycosidicanthraquinone (Barbaloin); Tannic acid derivative (Catechin); Resins (Curcuminoids); Steroids (Diosgenin, Digitoxin); Alkaloids (Caffeine, Quinine, Reserpine).

PART – II:: PRACTICAL

| | | |
|--|----------------|----------------|
| PAPER –VI (Plant Ecology, Anatomy, Morphology, and Taxonomy of Angiosperm, Plant Physiology, Plant Biochemistry, and Pharmacognosy) | FM = 50 | LP = 50 |
|--|----------------|----------------|

Plant Ecology

3. Study of morphological and structural adaptations of locally available hydrophytes, mesophytes, and correlate to their particular habitats.
 - a. Hydrophyte: *Eichhornia, Nymphaea, Hydrilla*.
 - b. Xerophyte: *Nerium, Opuntia*.

Anatomy

3. Work out with double staining of T. S. of stem of sunflower, maize and root of Orchid.

Morphology

2. As per theoretical syllabus.

Taxonomy of Angiosperms

6. Taxonomical work out of a member belonging to the families: Brassicaceae, Malvaceae, Leguminosae (sensulato) Solanaceae, Lamiaceae.
7. Herbarium specimen: Preparation of 20 Angiospermic specimens (arranged following Bentham and Hooker's system of classification) to be submitted in the term end examination.
8. Laboratory note book of each section must be signed by the respective teacher with date during practical classes
9. Slides (prepared during practical classes).

Plant Physiology

1. Determination of stomatal frequency.
2. Rate of photosynthesis under varying HCO_3^- concentration (using bicarbonate) in aquatic plants.

3. Measurement of oxygen uptake by respiring tissue (per gram / hr.) by germinating seeds.
4. Effect of light quality on the rate of photosynthesis. Relationship between evaporation and transpiration.
5. Comparison between transpiration rate of mesophytic and xerophytic leaves.
6. Comparison between transpiration and absorption.

Biochemistry

5. Detection of organic acids - citric, oxalic, malic & tartaric from laboratory / plant samples.
6. Detection of protein from plant samples.
7. Detection of nature of carbohydrate- glucose, fructose and starch from laboratory samples.

| Distribution of Marks for Paper – VI (Practical) | | | | Full Marks = 50 | | |
|--|--|---------|---|-------------------|--|-------------------|
| Topics | Work out (27) | | Identifications (2.5 x 2 = 05) | | Submissions (12) | Viva-voce (06) |
| Plant Ecology | ---- | | Morphological/ Anatomical / Ecological / Pharmaceutical identification of any three specimens with reasons as per theoretical syllabus | 2.5 x1= 2.5 | Note Book = 06 Slides = 2.0 Field records and Herbarium sheets =4.0 | |
| Anatomy | ---- | | | | | |
| Morphology | ---- | | | | | |
| Taxonomy of Angiosperm | Taxonomical work out of a member belonging to the families mentioned in the practical syllabus | = 10 | | | | |
| Plant Physiology | 1. One physiological experiment as per syllabus. (Requisition: 01; experiment set up: 01; Principle: 02; Result: 04; Comment: 02) | = 10 | --- | --- | | |
| Plant Biochemistry | 1. One qualitative biochemical experiment as per syllabus. (Requisition: 01; Procedure: 02; Observation: 03; Comment:01) | = 07 | ---- | | | |

Syllabus for B.Sc. (General) in Botany (PART- III) (Revised Copy)

| PART – III | TOTAL MARKS = 100 | | |
|-------------------------------|--|---|-------------------|
| THEORETICAL MARKS = 50 | | | |
| Paper Number | Title of paper | Subjects | Full marks |
| VII | Cytogenetics, Plant Breeding, Biostatistics, Biotechnology | Module I: MCQ questions based on Paper VII | 16 |
| | | Module II: Broad answer type questions | 34 |
| | | Group A: Cytogenetics and Plant Breeding | 17 |
| | | Group B: Biostatistics and Biotechnology | 17 |
| PRACTICAL MARKS = 50 | | | |
| VIII | Cytogenetics, Plant Breeding and Biostatistics | | 50 |

Detailed syllabus

PART – III:: THEORY

| | | |
|---|----------------|----------------|
| PAPER –VII (Cytogenetics, Plant Breeding, Biostatistics and Biotechnology) | FM = 50 | LP = 50 |
|---|----------------|----------------|

Group A: Cytogenetics and Plant Breeding (Marks = 25; LP = 25)

Cytogenetics (20 LP)

- Cytoskeleton: Ultra structure of nucleus; mitochondria- ultra structure; chloroplast- ultra structure; ribosome-ultra structure and biogenesis, peroxisome and endoplasmic reticulum – ultra structure and function.
- Changes in chromosome number and structure: Euploidy and aneuploidy, chromosomal rearrangements deletion, duplication, inversion, and translocation-their origin, meiotic behaviour and genetic effects.
- Chromatin structure: nucleosome morphology and higher level organization.
- Chromosome organization: Structure of centromere and kinetochore, telomere; heterochromatin and euchromatin.
- Laws of inheritance: Mendel's Laws, concepts of dominance, segregation, independent assortment, deviation from Mendelian inheritance (Co-dominance, incomplete dominance, epistasis, hypostasis, complementary gene factor, polygenic inheritance).
- Linkage - types and detection; crossing over.
- Concept of gene: Fine structure of gene, split genes, overlapping gene, pseudogene concept of allele, multiple allele, pseudoallele.

Plant Breeding (05 Marks; 10 LP)

- Concept of plant breeding; types of variety selection – mass selection, pure line selection, clonal selection, bulk and pedigree selection and hybridization.
- Heterosis and Hybrid vigour.

Group B: Biostatistics and Biotechnology (Marks = 25; LP = 25)

Biostatistics (05 LP)

- Sampling methods-concept of sampling of population, measures of central tendency; determination of mean, mode, median, variance, standard deviation and standard error.
- Null-hypothesis, Tests of significance: chi-square test.

Plant Biotechnology (20 LP)

- Brief history of plant tissue culture, Cellular totipotency, Basic requirements for tissue culture laboratory, formulation of tissue culture medium, growth regulators.

8. Micropropagation: methods and stages, advantages, disadvantages and application, organogenesis and embryogenesis (zygotic and somatic, induction of somatic embryogenesis, role of plant growth regulators, application – synthetic seeds); callus culture; application of plant tissue culture in agriculture and forestry.
9. Plant genetic engineering: gene delivery systems in plants (concepts only).
10. Recombinant DNA technology: restriction enzymes, cloning using vectors (plasmids (pBR322), PCR).

PART –III:: PRACTICAL

PAPER – VIII (Cytogenetics, Plant Breeding, Biostatistics and Biotechnology)

FM = 50

Cytogenetics

6. Chromosome preparation: Pre-treatment, Fixation, Staining, Squash and Smear preparation, Preparation of permanent slides.
7. Study of Mitotic Chromosomes: Metaphase chromosome preparation, free hand drawing, determination of 2n number and comment on chromosome morphology of *Allium cepa*.
8. Study of meiotic chromosome: Smear preparation of meiotic cells, identification of different stages and free hand drawing of the following specimens from flower buds: *Allium cepa*.
9. Identification from permanent slides: Meiosis – normal stages.

Biostatistics

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

| Distribution of Marks for Paper – VIII (Practical) | | | | Full Marks = 50 | | |
|--|---|------|---|-----------------|--------------------------------|----------------|
| Topics | Work out (30) | | Identifications (2.5 x 4 = 10) | | Submissions (05) | Viva-voce (05) |
| Cytogenetics | 1. Free hand drawing, determination of 2n number and comment on chromosome morphology of metaphase chromosome of the supplied sample. (Squash: 04; drawing: 04; labelling: 02; comment: 05) | = 15 | 1. Identification with reasons of normal mitotic and meiotic stages, normal stages of pollen mitosis. | 2.5x4 = 10.0 | Note Book = 03 Slides = 2.0 | |
| | 2. Smear preparation of meiotic cells, identification of any one stage and its free hand drawing from the flower bud of <i>Allium cepa</i> . | = 08 | | | | |
| Biostatistics | 3. Univariate analysis of statistical data from statistical tables: calculation of mean mode, median, standard deviation, and standard error (using seedling population / leaflet size). | = 07 | | | | |

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