

B.Sc. Part I BOTANY (HONOURS)

There shall be two theoretical (Paper-I and Paper-II). Each carrying 75 marks and one practical paper carrying 50 marks in 1st year examination of Three year Integrated Degree Course

Time: 3 Hours]

Instructions for Paper-I and Paper-II

[Full Marks: 75

1. Question no. I will be compulsory consisting of 15 items of objective type Questions covering both Group A and Group B parts of the syllabus. The objective type question will have a statement and four possible responses marked a, b, c and d, out of which only one will be the correct answer. **15 Marks**
2. Each Group (A and B) will have both short answer type questions and Long answer type questions. Candidates are required to answer both types of questions in each group.
3. Short answer type questions will have 8 items, out of which 5 items are to be answered preferable in four/five sentences. **30 Marks**
4. Long answer type questions will be conventional type and one question has to be answered out of 3 options provided. **30 Marks**

PAPER – I

GROUP - A: CRYPTOGRAMS

Algae: (1) General characteristics & classification of algae, (2) General characteristics of Cyanophyceae with reference to *Oscillatoria* and *Rivularia*, *Nostoc*, *Anabaena*, (3) Structure and life history of the following genera with reference to alternation of generation: *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*, *Ectocarpus*, *Fucus*, *Batrachospermum* and *Polysiphonia*. (4) Study of Economics importance of Algae.

Fungi: (1) General Characters classification and Economic importance of Fungi, (2) Structures and life history of the following genera : *Synchytrium*, *Albugo*, *Erysiphe*, *Peziza*, *Ustilago*, *Puccinia*, *Alternaria*, & *Cercospora*.

Lichen: General Account.

GROUP – B

Bryophytes : (1) General characteristics, classification and Economic importance of Bryophytes. (2) Structures and life history of the following genera with reference to comparative studies of gametophytes and sporophytes : *Marchantia*, *Pellia*, *Anthoceros*, *Sphagnum* and *Polytrichum*.

Pteridophytes : (1) General characters and classification. (2) Stelar evolution. (3) Structures and life history of the following: *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Marselia* and *Azolla*.

Fossils : Study of *Rhynia*, *Lepidodendron* and *Calamites*.

Paper-II

MICROBIOLOGY AND PLANT PATHOLOGY

Time: 3 Hours]

[Full Marks: 75

Ten questions to be set, six from Group-A and four from Group-B, five to be answered, three from Group-A and two from Group-B.

GROUP-A

1. Historical background of Microbiology.
2. Techniques of isolation for micro-organisms and culture media preparation.
3. Modern concepts about bacterial cell.
4. Structure and nature of TMV and Bacteriophage.
5. Role of microbes in nitrogen fixation.
6. Industrial Importance of bacteria and fungi.
7. Microbial degradation of agricultural produce in storage.

GROUP-B

8. Role of Toxins and Enzymes in Plant Diseases.
9. Important plant diseases of Bihar, Etiology, symptoms and control of the following diseases:
(a) Late blight of potato (b) Loose smut of wheat
(c) Rust of linseed (d) Red rot of sugarcane

- (e) Citrus canker (f) Tobacco mosaic virus
 (g) Tundu disease of wheat (h) Little leaf of brinjal.
10. Transmission of Plant viruses and control measures.

PRACTICAL PAPER

Time: 4 Hours]

Cryptogams + Microbiology

[Full Marks: 50

1. Morphology and structural details of the forms prescribed in the syllabus and their temporary stained microscopic slide preparations.

Pteridophyte	7	}	20
Algae	5		
Bryophyte	5		
Lichen/Fungi	3		
2. Study of bacterial and viral diseases and staining technique of Gram (+) and Gram (-) bacteria. **Or**
 Preparation of a solid culture medium. **Or**
 Technique of isolation and inoculation of fungi.
3. Study of local fungal diseases.
4. Comment upon sports (5) from the syllabus
5. Class Record.
6. Viva-voce

B. Sc. Part – I BOTANY (GENERAL COURSE)

Each Year: There shall be one paper consisting of theory of 75 marks and practical carrying 25 marks, each of three hours duration.

1st Year Paper- I-(Group-I-Cryptogams) (Group-II-Phanerogams)

The examination are to be set five questions from each of the two groups out of which the candidates will be required to answer five question attempting at least two questions from each group.

GROUP-I: CRYPTOGAMS

Structure reproduction diagnostic features and economic importance of algae, fungi and lichens based on the types when ever mentioned.

1. **Algae:** *Nostoc, Oedogonium, Chara, Vaucheria, Sargassum and Batrachospermum.*
2. **Fungi:** *Albugo, Peziza, Puccinia.*
3. **Lichens:** General account and Economic importance.
4. **Bryophytes:** Structure and life history of the following types: *Marchantia, Anthoceros and Sphagnum.*
5. **Pteriophytes:** *Selaginella, Equisetum and Marselia.*

GROUP-II: PHANEROGAMS

1. **Gymnosperm:** Pinus: (Morphology, anatomy & reproduction).
2. **Taxonomy of Angiosperms.**
 - (i) Classification of angiosperm with reference to the system of Bentham and Hooker, Hutchinson.
 - (ii) Important rule of plant nomenclature.
 - (iii) An account of the diagnostic, features and economic importance of the families-Ranunculaceae, Euphorbiaceae, Cucurbitaceae, Apocyanaceae, Acanthaceae, Laminaceae, Amaranthaceae, Cyperaceae and Poaceae.
3. **Anatomy:**
 - (i) Meristems
 - (ii) Initiation activity and function of cambium
 - (iii) Anomalous secondary growth in *Boerhaavia, Tinospora* and *Dracaena*
 - (iv) Root Stem Transition.
4. **Emoryology:**

- (i) Development of anther, pollen, embryo sac, fertilization, endosperm and embryo.
- (ii) An idea about experimental embryology.

PRACTICAL

Time: 3 Hours]

[Full Marks: 50

GROUP: Cryptogams and Phanerogams

1. Morphology and structural details of Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms included in the Syllabus and their temporary/permanent slides preparation.
2. Description of Angiospermic plant belonging to the family prescribed in the syllabus. Identification up to the family level.
3. Study of the primary and secondary (both normal and abnormal) structures of roots and stems of angiospermic plants.
4. To identify and comment upon forms included in paper-I & II (Six spots).
5. Practical record.

BOTANY (SUBSIDIARY COURSE)

Time: 3 Hours]

[Full Marks: 75

Paper-I (Theory)

Microbiology, Thallophyta, Bryophyta, Pteridophyta, Gymnosperms, Cytology, Genetics and Economic Botany.

A total of ten questions to be set out of which candidates are required to answer five questions.

1. A general account of bacteria, viruses and their economic importance. Role of microbe of in fermentation and nitrogen fixation.
2. Structure functional diagnostic features of Algae, Fungi and lichens based on the types wherever mentioned. The developmental cycles on comparative bases should reflect Evolutional sequence. The students should be acquainted with economic importance of these groups.
Thallophyta: Algae (*Nostoc*, *Oedogonium*, *Chara*, *Vaucheria*, *Fucus* and *Batrachospermum*,
Fungi: *Albugo*, *Peziza*, *Puccinia*.)
3. Lichens: General account and economic importance.
4. Structure and life history of following types:
Bryophyta: *Marchantia*, *Anthoceros* and *Sphagnum*.
Pteridophyta: *Selaginella*, *Equisetum* and *Marselia*
Gymnosperms: *Pinus*.
5. Cytology, Genetics and plant breeding.
 - (a) Structure of the cell as seen under Electron Microscope.
 - (b) Mitosis and meiosis.
 - (c) Structure of chromosome, crossing over and mutation.
 - (d) Nature, Structure and replication of genetic material (DNA).
6. Economic Botany: Botany of under noted plants belonging to the following groups.
 - (a) Cereals: Wheat, Maize and Rice.
 - (b) Oils: Mustard, Groundnut, Linseed
 - (c) Sugars: Sugarcane.
 - (d) Spices: Coriander, Chili, Turmeric.
 - (e) Beverages: Tea.
 - (f) Drugs: Rauwolfia.

- (g) Fibers: Cotton and Jute.

PRACTICAL

Time: 3 Hours]

[Full Marks: 25

(Subsidiary Course)

1. Morphological and Structural details of Algae, Fungi and Bryophytes included in the Syllabus and their temporary stained Microscopic slide preparation.
2. Morphological and Anatomical study of Pteridophytes/ Gymnosperms included in the Syllabus and their microscopic preparation (Temporary/ Permanent).
3. To Identify and Comment upon spots.
4. Class record.

B.Sc. Botany Hons Part II Paper-III and Paper-IV (Phanerogams)

Time: 3 Hours]

[Full Marks: 75

1. Questions No. 1 will be compulsory consisting of 15 items of objective types questions both covering both Group A and Group B parts of the syllabus. The objective type question will have a statement and four plausible responses marked a, b, c and d out of which only one will be the correct answer. 15 marks
2. Each group (A and B) will have both Short answer type questions and Long answer type questions. Candidates are required to answer both type of questions in each group.
3. Short answer type questions will have 8 items, out of which 5 items are to be answered preferably in four/five sentences. 15 x 2 = 30 Marks
4. Long answer type questions will be of conventional type and one question has to be answered out of a options provided. 15 x 2 = 30 Marks

Paper-III

Group-A: Gymnosperms

1. Comparatives study of the morphological, anatomical and embryological features of the following taxa -*Pinus*, *Taxus*, *Gnetum*.
2. Fossils-Definition and scope, conditions for fossilization and mode of preservation, uses of fossils.
3. Type study of *Lyginopteris* and *Cycadeoides*.
4. A brief idea of the plant fossils of Bihar.

Group-B: Angiosperm Taxonomy

1. Principles of Plant classification with emphasis on modern trends in taxonomy.
2. A knowledge of system of classification of plant proposed by Bentham and Hooker, Hutchinson and Cronquist.
3. Rules of Botanical Nomenclature
4. A comparative account of the diagnostic features, relationship and economic importance of the following families :
Ranunculaceae, Capparidaceae, Caryophyllaceae, Cucurbitaceae, Oxalidaceae, Rubiaceae, Apocynaceae, Verbenaceae, Acanthaceae, Lamiaceae, Convolvulaceae, Scrophularaceae, Amaranthaceae, Nyctaginaceae, Euphorbiaceae, Commelinaceae , Cyperaceae and Poaceae.

Paper-IV

Time: 3 Hours]

[Full Marks: 75

Group-A: Anatomy

1. Meristematic tissue - their structure, distribution and function.
2. Mechanical tissue -their structure, distribution & function.
3. Organization of tissue in relation to environment, (Ecological and Anatomy).
4. Anomalous secondary growth in-Bignonia, Nyctanthes, Achyranthes, Boerhaavia , Tecoma, Dracaena .
5. Root-stem transition.

Embryology

1. Various development processes in Microsporogenesis, male gametophyte megasporogenesis in female gametophyte, Endosperm, Embryogenesis.
2. Importance of anther and embryo culture.

Group-B: Applied Botany

1. Use of plants in medicine and idea about important drug yielding plants.
2. Agricultural and horticultural products of Bihar with special reference to oil seeds pulses, cereals, fruits, fibres and timber especially found in Bihar.
3. Idea of tissue culture with special reference to plant propagation.
4. Utilization of wastes and Biogas resources.

Paper-III & IV (Practical)

Time: 4 Hours]

[Full Marks: 50

(Phanerograms & Applied Botany)

1. Study of the living and fossil Gymnosperms (Vegetative and reproductive parts).
2. Description and identifications of an angiospermic plant up to genus only from the families prescribed in the course.
3. Test of carbohydrates, lipids and proteins in oil seeds, pulses, fruits and vegetables.
4. Internal anatomy of primary and secondary (Both normal and abnormal) of angiospermic plant.
5. Comment upon spots (4) from the syllabus.
6. Class Record.
7. Viva-voce .

B. Sc. Part – II BOTANY (GENERAL COURSE)

The examiners are to set five questions from each of the two groups out of which the candidates are required to answer five questions attempting at least two questions from each group.

GROUP-A

Plant Physiology and Biochemistry

1. Physiology of water and mineral absorption.
2. Transpiration stomata movement.
3. Mineral nutrition of the plants-role of macro nutrients.
4. Enzymes-Natures, mode of action factors affecting enzyme activity.
5. Photosynthesis- Mechanism and Factors.
6. Respiration aerobic and anaerobic (Glycolysis. Kreb's cycle and electron transport).
7. Nitrogen metabolism-Nitrate reduction amino acids, Protein Structure and types. Symbiotic and assymbiotic-nitrogen fixation.
8. Phytohormones: Auxins and Gibberllin (discovery structure and role)
9. Growth-Measurements, factors affecting growth rule of light, temperature and humidity.
10. Movements-General account.

GROUP-B

MICROBIOLOGY

1. A general account of bacteria, viruses and their economic importance.
2. Role of microbes in agriculture and industry.

3. Important plant diseases of Bihar. Etiology Symptoms and control of the following:
- (i) Late blight of potato, (ii) Rust of wheat,
 (iii) Red root of sugarcane, (iv) Tobacco mosaic virus.

PAPER-II (Practical)

Time: 3 Hours]

[Full Marks: 25

1. Experiments in Plant physiology and Biochemistry.
 - (a) Test for carbohydrate, protein, amino acids and starch seed.
 - (b) Compare transpiration, mesophytic and xerophytic leaves.
 - (c) O₂ is evolved during photosynthesis.
 - (d) Compare the rate of imbibition of fatty and starchy seeds.
 - (e) Compare the rate of absorption and transpiration.
 - (f) Moll's experiment.
2. Symptoms and morbid anatomy of the diseases prescribed in the course.
3. Comment upon the spots covering the courses of Paper-II.
4. Class record.

Time: 3 Hours]

[Full Marks: 75

BOTANY (SUBSIDIARY COURSE)

Paper-II (Theory)

(Angiosperm, Plant Physiology and Environmental Biology)

Ten questions are to be set four from Group A & B and two from Group C. Out of which two questions from each A & B Groups and one from Group C are to be answered.

GROUP-A

1. **Angiosperms:** (A) Morphology and Taxonomy.
 - (i) Importance classification of angiosperms with reference system of Bentham & Hooker and Hutchinson.
 - (ii) Naming of genus and Species.
 - (iii) Diagnostic features affinities and economic importance of the following families-(1) Ranunculaceae (2) Cucurbitaceae (3) Euphorbiaceae (4) Amaranthaceae (5) Acanthaceae (6) Lamiaceae (7) Apocynaceae (8) Poaceae (9) Cyperaceae.
2. **Anatomy:**
 - (i) Cell structure and tissue systems. (ii) Meristems. (iii) Root stem transition. (iv) Initiation and activity of cambium including abnormal behaviour, Primary and Secondary growth in roots and stems.
3. **Embryology:** (i) Life cycle of a typical flowering plant based on major events in the development of anther, Microspore ovule. Embryosac fertilization, Endosperm, Embryo and seed.

GROUP-B

4. **Plant Physiology:**
 - i. Water relation, Absorption of water and Salts
 - ii. Transpiration.
 - iii. Mineral nutrition- Role of major and minor element.
 - iv. Enzymes-Nature, properties & Classification
 - v. Photosynthesis- Photophosphorylation calvin cycles and factors affecting Photo-synthesis.
 - vi. Translocation of Organic substances.
 - vii. Respiration- Glycolysis, Krebs's Cycle and Factors affecting respiration.
 - viii. Nitrogen metabolism-Nitrogen fixation and Protein synthesis.

GROUP-C

5. **Environmental Biology:**
 - i. Pollution.
 - ii. Soil-Types, water holding capacity, reclamation.

iii. Plant communities and ecosystem. iv. Succession (Hydrosere and Xerosere).

**BOTANY PRACTICAL (Sub. Course)
PAPER-II (Practical)**

Time: 3 Hours]

[Full Marks: 25

1. To comment upon plant Physiology experiment; set up among experiment included in the Syllabus: (a) T/A ratio. (b) Ganong's Photometer- Rate of transpiration. (c) Farmer's Photometer- Rate of transpiration. (d) Unequal transpiration by CaCl_2 , method. (e) Oxygen evolution during photosynthesis. (f) Rate of Photosynthesis by Wilmott's bubbler. (g) Moll's Experiment. (h) Anaerobic respiration.
2. Description & Identification of the Plants out of the families included in the Syllabi:
3. Microscopic preparations of anatomical specimens.
4. To identify and comment upon spots covering the courses in Paper III.
5. Practical record based on class work field studies conducted through organized Botanical excursions will carry.

B.Sc. Botany Hons Part III

Part III will consist of four papers-Three papers, viz., Paper V, Paper VI and Paper VII, and one practical paper-Paper VIII, each carrying 100 marks. Each of the theory papers will be of three hours duration and the practical paper will be of six hours duration.

Instructions for each theory paper:

1. The examinees will be required to answer 5 questions out of 9 questions consisting of one compulsory objective type question, four questions of long answer type from Group A and four questions of long answer type from Group B.
2. The compulsory objective type question (numbered question no. 1) will consist of 20 items from both part (Group A & Group B) of the syllabus, and will have a statement and four plausible responses marked a, b, c and d, out of which only one will be the correct answer.
3. The questions asked from Group A and Group B separately will be of conventional long answer type and the examinees will be required to answer two questions from each group.

PAPER-V

**PLANT PHYSIOLOGY & BIOCHEMISTRY
GROUP -A (PLANT PHYSIOLOGY)**

1. Structure and composition of plasma membrane, brief account of earlier models, the fluid mosaic lipoprotein model.
2. Water potential in the Plant-diffusion, Osmosis, Osmotic relations of plant cell, determination of water potential.
3. Stomatal regulation of transpiration, Hormonal and Energy dependent hypothesis.
4. Active uptake of mineral salts-Role of ATPase as a carrier and related hypothesis.
5. Translocation of solutes-path, substances translocated and mechanism
6. Photosynthesis-Characterization of Photosystem I and II; electron flow through Cyclic and Non-cyclic photophosphorylations. Calvin Cycle: Hatch and Slack Pathway.
7. Respiration- Glycolysis, Krebs Cycle, Oxidative phosphorylation.
8. Phytohormones- Structure, mode of action and physiological responses of Auxins, Gibberellins and Cytokinins.

9. Physiology of Flowering-Photo-periodism, Role of phytochromes and Florigen.
10. Physiology of tropic movements in plants.

GROUP –B (BIOCHEMISTRY)

1. **Physico** - Chemical organisation and role of Mitochondria, Chloroplasts, Ribosomes and Glyoxisomes in metabolic pathways in plants.
2. **Carbohydrates** - Structure and classification.
3. **Lipids** - Classification, Biosynthesis of lipids, β -oxidation of fatty acids.
4. **Proteins** - Biosynthesis of amino acids and proteins.
5. **Enzymes**- Nomenclature, Classification, Catalytic properties, mode of action.
6. Outline of the secondary plant metabolites and their role.

PAPER -VI

CYTOGENETICS MOLECULAR BIOLOGY & PLANT BREEDING

GROUP -A: (Cytogenetics)

1. Structure and Physico-chemical organization of Eukaryotic chromosome with Nucleosome-Solenoid Concept; Polytene Chromosome and Lampbrush Chromosome.
2. Different stages of meiosis and its significance. 3. Linkage and Crossing Over.
4. Sex Determination. 5. Cytoplasmic Inheritance 6. Chromosomal Aberrations
7. Euploidy and Aneuploidy, Role of Polyploidy in Evolution and Plant Breeding
8. Mutation Molecular Basis, Induction and Role in Plant Improvement.

GROUP - B : (Molecular Biology & Plant Breeding)

1. Structure, replication and functions of DNA and RNA.
2. Genetic Code. 3. Gene fine structure and Gene regulation.
4. Genetic Counseling, Genetics and Cancer, Artificial synthesis of Genes and Genetic Engineering. 5. Conservation of Germplasm.
6. Plant Breeding - Objectives of plant breeding, breeding methods in self-pollinated and cross-pollinated plants 7. Breeding work done on Rice and Wheat in India.
8. Importance and scope of statistical methods in experimentation, Standard Error, Standard Deviation and Chi-Square. Test.

PAPER –VII (Environmental Biology)

GROUP A

1. Ecosystem and its concept with reference to grassland, freshwater and forest ecosystems. Productivity and Energy Flow- Concepts, methods of productivity measurements and energy flow models, Biogeochemical Cycling (Water, carbon and nitrogen Cycles) Ecological Pyramids.
2. Population Ecology-Population Attributes, Population Regulation (r and k selection).
3. Qualitative and Quantitative Characteristics of Plant Community.
4. Ecological Succession, Changes during succession, types, characteristics of Pioneer and climax species, Climax concept and stability.
5. Ecological Adaptations in Hydrophytes, Xerophytes and Halophytes.
6. Ecological Adaptations in C₃, C₄ and CAM Plants.

GROUP -B

1. Environmental Pollution--types (air, water and soil), effects on plants, control with emphasis on biological methods, cumulative effects on global environment-green house effect, depletion of ozone layer.
2. Vegetational types and Floristic regions of India. 3. Phyto-geographical Regions.
4. Soil Development, soil profile, physical, chemical and biological characteristics of soil.
5. Natural Resources-types, Biomass as a source of energy, non-conventional sources of energy. 6. Principles of conservation.
7. Biological diversity and ecological stability, conservation of biological diversity.

8. Brief account of the following:- MAB Programme, Biosphere reserves, Aquaculture, Wild life management, social forestry.

PAPER - VIII (PRACTICAL)

PHYSIOLOGY, BIOCHEMISTRY, ENVIRONMENTAL BIOLOGY, CYTOGENETICS

1. Detection of Alkaloids, steroids, flavonoids and tannins. **10 marks**
2. Experiments on
 - (i) Osmosis, Diffusion, Transpiration, Photo synthesis and Respiration.
 - (ii) Separation of chloroplast pigments by paper chromatography or by solvents. **20 marks**
3. (i) Determination of minimum size of the quadrat by species area curve methods- **20 marks.**
 - (ii) Determination of the water holding capacity of the soil. (iii) Determination of frequency and density in local flora.
4. (i) Study of chromosomes at different stages of mitosis/ meiosis by smear and or squash technique- **20 marks.**
 - (ii) Experiments on modification of Mendelian ratios with the help of coloured seeds.
 - (iii) Emasculation and pollination technique.
5. Viva-voce- **10 marks**
6. Class record- **10 marks.**

B. Sc. Part – III BOTANY (GENERAL COURSE)

PAPER-I (Theory)

Time: 3 Hours]

[Full Marks: 75

The examiners are to set four questions from group I and three questions with each from group II out of which candidates are required to answer five questions attempting at least one question from each group.

GROUP - I: CYTOGENETICS AND MOLECULAR BIOLOGY

1. Structure of the cell and cell organelles. 2. Mitosis and Meiosis. 3. Structure of chromosome (Physical & Chemical). 4. Mendelian laws of inheritance. 5. Physical basis of heredity. 6. Structure, replication and function of DNA and RNA, 7. Mutation.

GROUP - II: ENVIRONMENTAL BIOLOGY

1. Plant communities and ecosystem. 2. Succession (Hydrosere and Xerosere). 3. Factors affecting vegetation. 4. Major vegetational belt of India. 5. Pollution.

GROUP -III: ECONOMIC BOTANY

1. Forest wealth of Bihar with reference to timber yielding plants. 2. Important agricultural and horticultural products of Bihar with reference to pulses, oil seeds, fruits, sugarcane and vegetables. 3. Uses of plants in medicine and idea about important drug yielding plants of Bihar.

B.sc. Botany General Course

PAPER-II (Practical)

Time: 3 Hours]

[Full Marks: 25

1. Ecological adaptations in Hydrophytes xerophytes, Mesophytes, Parasites and Epiphytes. 2. Study of pH of different types of soil with the help of pH meter. 3.

Study of different stages of mitosis and meiosis. **4.** Comment upon the sports (5). **5.**
Practical records