

B.Sc. B.Ed. Fourth Year Integrated Course

SYLLABUS

BOTANY

B.Sc. B.Ed. I Year-2024-25

B.Sc. B.Ed. II Year-2025-26

B.Sc. B.Ed. III Year-2026-27

B.Sc. B.Ed. IV Year-2027-28



Department of Botany

JAI NARAIN VYAS UNIVERSITY JODHPUR

B.Sc. B.Ed. Four Years Integrated Course (2024-2028)

BOTANY

B.Sc. B.Ed. I Year – 2024-2025

Course/ Theory	Nomenclature	Number of Papers	Number of Periods per week	Max. Marks		Total Marks	Min. Pass Marks
				Internal	External		
Paper I	Algae, Lichens and Bryophytes	1	2	10	40	50	36
Paper II	Mycology, Microbiology and Phytopathology	1	2	10	40	50	
PRACTICAL COURSE			4	10	40	50	18

Duration of examination of each theory papers 3 hours

Duration of examination of practical (for both papers on same day) 4 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section –B and Section–C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3 Marks

Section –C: Will consist of 5 questions. Each unit will be having one questions; students will answer three questions from out 5 questions. Answer of each question shall be limited up to 500 words. Each question carries 5 Marks.

B.Sc. B.Ed. I Year – 2024 PAPER – I
ALGAE, LICHENS AND BRYOPHYTES

Unit 1: General characters, Classification and economic importance of Algae. Important features and life history of Chlorophyceae and Charophyceae. Structure and life cycle of *Volvox*, *Oedogonium*, *Coleochaete* and *Chara*.

Unit 2: Important features and life history of Xanthophyceae and Phaeophyceae. Structure and life cycle of *Vaucheria*, *Ectocarpus* and *Sargassum*.

Unit 3: Important features and life history of Rhodophyceae. Structure and life cycle of *Polysiphonia*. Lichens: Morphology and structure of the two components; biological, ecological and economic importance. Vegetative multiplication methods with special reference to *Parmelia* and *Usnea*.

Unit 4: Bryophytes: General characters, alternation of generations and classification. characters and classification of Hepaticopsida. Morphology and life history of *Riccia*, *Marchantia* and *Plagiochasma*.

Unit 5: Characters and classification of Anthocerotopsida and Bryopsida. Morphology and life history of *Anthoceros* and *Sphagnum*.

Suggested Laboratory Exercises

Algae: Microscopic preparation and study of following algal materials: *Volvox*, *Oedogonium*, *Coleochaete*, *Vaucheria*, *Chara*, *Ectocarpus*, *Sargassum* and *Polysiphonia*

Lichens: Study of Lichens

Bryophytes: Study of external morphology and microscopic preparations of following

Bryophytes: *Riccia*, *Marchantia*, *Plagiochasma*, *Anthoceros* and *Sphagnum*

Suggested Readings

Bold, H.C., Alexopoulos, C.J. and Delevoryas, T. Morphology of Plant and Fungi (4th Ed.)

Harper & Foul Co., New York, 1980.

Ghemawat, M.S., Kapoor, J.N. and Narayan, H.S. A Text book of Algae, Ramesh Book Depot, Jaipur, 1976.

Gilbert, M.S. Cryptogamic Botany, Vol. I & II (2nd Ed.), Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 1985.

Kumar, H.D. Introductory Phycology, Affiliated East–West Press, Ltd., New York, 1988.

Pandey, S.N. and Trivedi, P.S. A Text Book of Botany 2000 Volume I, Vikas Pub. House Pvt. Ltd., New Delhi.

Puri, P. Bryophytes, Atmaram & Sons, Delhi, Lucknow, 1985.

Singh, V., Pande, P.C. and Jain, D.K. A Text Book of Botany, Rastogi & Co., Meerut, 2016.

Vashista, B.R. Botany for Degree Students (Algae, Fungi Bryophyta), S. Chand & Co. Ltd., New Delhi, 2016.

B.Sc. B.Ed. I Year – 2024 PAPER – II
MYCOLOGY, MICROBIOLOGY AND PHYTOPATHOLOGY

Unit I: General characters, classification and economic importance of fungi. Important features and life history of Mastigomycotina–*Pythium* and *Albugo*; Zygomycotina–*Rhizopus*; Ascomycotina–*Saccharomyces*, *Aspergillus* and *Penicillium*.

Unit II: Important features and life history of Basidiomycotina– *Puccinia*, *Agaricus* and wild Mushroom and *Ustilago*; Deuteromycotina–*Collectotrichum* and *Alternaria*.

Unit III: Viruses: Chemical and physical nature; Structure, multiplication and transmission of plant viruses; Tobacco mosaic virus and yellow vein mosaic virus disease. General account of Viroids, AIDS and Prions.

Unit IV: Bacteria–Structure, nutrition, cell division, reproduction and economic importance. Biofilms and Quorum sensing in microbes. Cyanobacteria–Life history of *Nostoc* and *Oscillatoria*; Nitrogen fixation – by BGA (Blue green algae). General account and biology of Mycoplasma and Phytoplasma.

Unit V: Causes and symptoms of plant diseases with special reference to green ear disease of Bajra, smut of wheat, citrus canker, little leaf of brinjal and root knot disease. A brief account of principles of plant protection.

Suggested Laboratory Exercises

Microscopic preparation and study of following fungal materials: *Albugo*, *Rhizopus*, *Saccharomyces*, *Aspergillus*, *Penicillium*, *Ustilago*, *Agaricus*, local Mushroom, *Colletotrichum* and *Alternaria*.

Viruses: Study of disease symptoms caused by Tobacco mosaic virus and yellow vein mosaic virus.

Bacteria: Gram staining of bacteria. *Nostoc*, *Oscillatoria* and study of bacteriological specimens. Study of symptoms of following diseases: (specimen or photographs)

Green ear disease of bajra

Smut of wheat

Citrus canker

Rust of wheat

Little leaf of brinjal

Root knot nematode.

Suggested Readings

Alexopoulos, C.J. and Mims. Introductory Mycology, John Wiley and Sons, New York, 2000.

Bilgrami, K.S. and Dube, H.C. A Text Book of Modern Plant Pathology, Vikas Publ. House, New Delhi, 1976.

Biswas, S.B. and Biswas, A. An Introduction to Viruses, Vikas Publ. House, New Delhi, 2000.

Clifton, A. Introduction to Bacteria, McGraw Hill Co., New York, 1985.

Dube, H.C. Fungi, Rastogi Publication, Meerut, 1989.

Kaushik, P. Microbiology, Emkay Publication, 2001.

Madahar, C.L. Introduction to plant viruses, S. Chand & Co. Ltd., New Delhi, 1978.

Palezer, Chan and King. Microbiology, McGraw Hill Book Co., London, 1995.

Pathak, V.N. Fundamentals of Plant Pathology, Agro Botanica. 2000.
Purohit, S.S. Microbiology, Agro. Bot. Publication, Jodhpur, 2002.
Sharma, O.P. Fungi, Today and Tomorrow Publication, 2000.
Sharma, P.D. Microbiology and Plant Pathology, Rastogi Publ. Meerut, 2003.
Singh, V. and Srivastava, V. Introduction to Bacteria, Vikas Publication, 1998.
Vashista, B.R. Botany for Degree Student Fungi, S. Chand & Co., New Delhi, 2016.

**DEPARTMENT OF BOTANY
CENTER OF ADVANCED STUDY
JAI NARAIN VYAS UNIVERSITY, JOHDPUR
(B.Sc. B.Ed. Part-I Practical Examination)**

Time: 4 Hours

Max. Marks: 50

Min. Pass. Marks: 18

Q. 1. Make suitable preparation of the given material A (Bryophyta) 8
Identify and comment upon your preparation
Leave your preparation for inspection.

Q. 2. Make suitable preparation of the given material B (Fungi) 6
Identify and comment upon your preparation
Leave your preparation for inspection.

Q. 3. Make suitable preparation of the given material C (Algae) 6
Identify and comment upon your preparation
Leave your preparation for inspection.

Q. 4. Make suitable preparation of the given material D (Microbiology) 3
Identify and comment upon your preparation
Leave your preparation for inspection.

**Q. 5. Identify and comment upon the given spots 1 to 6 (covering
all disciplines of both Theory Papers) 2x6 = 12**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Q. 6. Viva Voce 5

Internal Assessment 10

TOTAL 50

BOTANY
B.Sc. B.Ed. II Year – 2025-2026

Course/ Theory	Nomenclature	Number of Papers	Number of Periods per Week	Max. Marks		Total Marks	Min. Pass Marks
				Internal	External		
Paper I	Palaeobotany, Pteridophytes and Gymnosperms	1	2	10	40	50	54
Paper II	Taxonomy and Embryology of Angiosperms	1	2	10	40	50	
Paper III	Anatomy of Angiosperms, Economic Botany and Ethnobotany	1	2	10	40	50	
PRACTICAL COURSE			6	15	60	75	27

Duration of examination of each theory papers 3 hours
Duration of examination of practical's (for three papers on same day) 5 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section –B and Section–C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3 Marks

Section –C: Will consist of 5 questions. Each unit will be having one questions; students will answer three questions from out 5 questions. Answer of each question shall be limited up to 500 words. Each question carries 5 Marks.

B.Sc. B.Ed. II Year PAPER – I
PALAEOBOTANY, PTERIDOPHYTES AND GYMNOSPERMS

Unit I: Geological time scale, Fossilization. General characters and classification and Pteridophytes. Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Stelar systems in Pteridophyta. Structure and reproduction in *Rhynia*.

Unit II: Occurrence, structure and life history of *Lycopodium*, *Selaginella* and *Equisetum*.

Unit III: Occurrence, structure and life history of *Adiantum*, *Marsilea* and *Azolla*. Heterospory in Pteridophyta.

Unit IV: Characteristics of seed plants, evolution of the seed habit. General features of gymnosperms and their classification; evolution, diversity and economic importance of Gymnosperms. *Cycas*: Morphology of vegetative and reproductive parts, anatomy of root, stem and leaf; Reproduction and life cycle.

Unit V: *Pinus* and *Ephedra*: Morphology of vegetative and reproductive parts, anatomy of root, stem and leaf, reproduction and life cycle.

Suggested Laboratory Exercises

Palaeobotany: Microscopic examination of slides of *Rhynia*.

Pteridophytes: Study of external morphology of *Lycopodium*, *Selaginella*, *Equisetm*, *Adiantum*, *Marsilea* and *Azolla*. Microscopic study of temporary double stained preparations of stem/rhizome of *Lycopodium*, *Selaginella*, *Equisetum* and *Marsilea*. Study of temporary single stained microscopic preparations of cone of *Selaginella* and T.S. of Sporophyll of *Adiantum* and sections of sporocarp of *Marsilea*.

Gymnosperms: Study of external morphology of plant parts of *Cycas*: young and old foliage leaf, scale leaf, bulbils, male cone, microsporophyll, megasporophyll and mature seed (if material is not available show photographs). Microscopic temporary double stained preparations of rachis and leaflet of *Cycas*. Study of T.S. of normal and coralloid root by permanent slides. Study of external morphology of plant parts of *Pinus*: long and dwarf shoot, male cone; female cone; winged seeds. Microscopic temporary preparation of pollen grains (W.M.) of *Pinus*. Study through permanent slides T.S. stem: young and old; male/female cone of *Pinus*. Study of habit and structure of whole male and female cone of *Ephedra*. Microscopic preparation of male and female flowers of *Ephedra*.

Suggested Readings

Bold, H.C., Alexopolous, C.J. and Delevoryas, T. Morphology of plant and fungi (4th ed.), Harper and Foul, Co., New York, 1980.
Gifford, E.M. and Foster, A.S. Morphology and Evolution of Vascular Plants, W.H. Freeman and Company, New York, 1988.
Pandey, S.N., Mishra, S.P., Trivedi, P.S. A Text Book of Botany Vol. II, VikasPub.House Pvt. Ltd., New Delhi 2000.
Raven, P.H. Evert, R.F. and Eichhom, S.C. Biology of plants, (5th ed.), W.H. Reema and Co., Worth Publication, New York, U.S.A., 1999.
Sharma, O.P. Pteridophytes, Today and tomorrow Publication, 2000.
Sporne, K.R. The Morphology of Gymnosperms, B.I. Publ. Pvt., Bombay, Calcutta, Delhi, 1991.

Vashista, P.C. Gymnosperm, S. Chand & Co. Ltd., New Delhi, 2016.
Vashista, P.C. Pteridophyta, S. Chand & Co. Ltd., New Delhi, 2016.
Wilson, N.S. and Rothewall, G.W. Palaeobotany and evolution of Plants, (2nd ed.), Cambridge University Press, U.K., 1993.

B.Sc. B.Ed. II Year PAPER – II
TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit I: Diversity in plant form in annuals, biennials and perennials, Canopy architecture in angiosperms: tree-origin, development, arrangement and diversity in size and shape, Flower-modified shoot, structure and development of flower, Inflorescence-types of Inflorescence.

Unit II: Angiosperms: Origin and evolution. Some examples of primitive angiosperms. Angiosperm taxonomy; (Alpha-taxonomy, Omega-taxonomy, holotaxonomy) Taxonomic literature. Botanical nomenclature; principles and rules; taxonomic ranks, type concept, principle of priority. Classification of angiosperms; salient features of the systems proposed by Bentham and Hooker and Engler and Prantl.

Unit III: Major contributions of cytology and molecular biology, phytochemistry and taximetrics to taxonomy. Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Papaveraceae, Caryophyllaceae, Capparidaceae, Cucurbitaceae, Rutaceae and Apiaceae.

Unit IV: Diversity of flowering plants as illustrated by members of the families Asteraceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Scrophulariaceae, Lamiaceae, Euphorbiaceae, Musaceae and Poaceae.

Unit V: Embryology: Structure of anther and pistil. Development of the male and female gametophytes; pollen-pistil interactions, self-incompatibility; Double fertilization; Development of endosperm and embryo; Brief account of experimental embryology. Basics of gene imprinting.

Suggested Laboratory Exercises

Field study of diversities found in leaf shapes, size, thickness and surface properties.

The following families are for detailed taxonomic studies:

1. Ranunculaceae: *Ranunculus*, *Delphinium*
2. Papaveraceae: *Papaver*, *Argemone*
3. Caryophyllaceae: *Dianthus*, *Gypsophylla*, *Saponaria*
4. Capparidaceae: *Capparis*, *Cleome*
5. Rutaceae: *Murraya*, *Citrus*
6. Apiaceae: *Coriandrum*, *Foeniculum*, *Anethum*
7. Cucurbitaceae: *Luffa* or any Cucurbit
8. Asteraceae: *Helianthus*, *Calandula*, *Sonchus*
9. Acanthaceae: *Adhatoda*, *Barleria*
10. Apocynaceae: *Catharanthus*, *Thevetia*, *Nerium*
11. Asclepiadaceae: *Calotropis*
12. Scrophulariaceae: *Linaria*, *Antirrhinum*
13. Euphorbiaceae: *Euphorbia*, *Phyllanthus*
14. Lamiaceae: *Ocimum*, *Salvia*
15. Musaceae: *Musa*
16. Poaceae: *Avena*, *Triticum*, *Hordeum*, *Poa*, *Sorghum*

Suggested Readings

- Bhandari, M.M. Flora of Indian Desert 1990.
- Bhojwani, S.S. and Bhatnagar, S.P. The Embryology of Angiosperms, 4th Revised and enlarged edition, Vikas Publ., New Delhi, 2016.
- Davis, P.H. and Heywood, V.H. Principles of Angiosperm Taxonomy, Oliver and Boyd, London, 1963.
- Fegerig K. and Vender PifiThe Principles of Pollination Ecology, Pergamon Press, 1979.
- Gifford, E.M. and Foster, A.S. Morphology and Evolution of Vascular Plants, W.H. Freeman and Company, New York, 1979.
- Heywood, V.H. and Moore, D.M. (eds.) Morphology and Evolution of Vascular Plants, W.H. Freeman and Company, New York, 1984.
- Jeffrey, C. An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London, 1982.
- Jones, S.D. Jr. and Suchsinger, A.E. Plant Systematic (2nd ed.) McGraw-Hill Book Co., New York, 1986.
- Maheshwari, J.K. Flora of Delhi, CSIR, New Delhi, 1963.
- Redford, A.E.: Fundamentals of Plant Systematics, Harper and Row, New York, 1986.
- Sharma, O.P. Taxonomy: Tata McGraw Hill Pub. Company Ltd., New Delhi 2000.
- Singh, G. Plant Systematics – Theory and Practices, Oxford and IBH Pvt. Ltd., New Delhi, 1999.
- Singh, V., Pandey, P.C. and Jain, D.K. Angiosperms, Rastogi Pub., Meerut, 2016

B.Sc. B.Ed. II Year PAPER – III

ANATOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNOBOTANY

Unit I: Anatomy of Angiosperms: Concept of stem cell in plants. Root system; Root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

Unit II: Shoot system: The shoot apical meristem and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; cambium and its functions; formation of secondary xylem, a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; secondary phloem-structure, function relationship; Periderm.

Unit III: Abnormal secondary growth and Leaf: Abnormal secondary growth in stems due to abnormal origin and activity of cambium. Leaf: Internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

Unit IV: Economic Botany, Food plants: Rice, wheat, maize, potato, sugarcane. Fibers: Cotton and Jute. Vegetable oils: Groundnut, mustard and coconut, General account of sources of firewood, timber and bamboos. Beverages: Tea and coffee; Rubber.

Unit V: Spices and Condiments: General account. Medicinal plants with special reference to Rajasthan: *Aloe*, *Asparagus*, *Commiphora*, *Boswellia*, *Pedaliu*m, *Ziziphus*, *Haloxylon*, *Tribulus*, *Vitex*, and *Withania*. Ethnobotany: Aims and Scope of Ethnobotany, potential applications of ethnobotany, methods of Ethnobotanical studies, Bishnoi of Rajasthan, knowledge of indigenous peoples in Rajasthan, ethnobotany and famine food crops of Marwar/deserts.

Suggested Laboratory Exercises

Anatomy:

- (i) Types of simple and complex tissues: (Sunflower, Cucurbit stem)
- (ii) **Dicot stem:** *Sunflower, Cucurbita, Capparis, Nyctanthes, Bignonia, Leptadenia, Salvadoria, Boerhavia and Achyranthes*
- (iii) **Monocot stem:** *Maize/Triticum and Dracaena*
- (iv) **Dicot root:** *Tinospora*
- (v) **Monocot root:** *Maize*
- (vi) **Dicot leaf:** *Nerium and Ficus*
- (vii) **Monocot leaf:** *Maize*

Economic Botany: Food plants: Study of morphology and structure. Simple microchemicals tests of the food storing tissues in rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (except sugarcane).

Fibers: Study of cotton fiber, tests for cellulose.

Vegetable oils: study of hand sections of Groundnut, Mustard and Coconut and staining of oils droplets by Sudan III and Sudan Black

Field visits: To study sources of firewood (10 plants), timber-yielding trees (10 trees) and bamboos. A list to be prepared mentioning special features

Medicinal plants & Spices: Black pepper, cloves, cardamom - describe them in briefly. Study of 10 medicinal plants. Write their botanical and common names, parts used and diseases/disorders for which they are prescribed.

Beverages & Rubber: Coffee, Tea & Rubber

Ethnobotany: Ethnobotanically important plants of Rajasthan (*Abrus, Leptadenia, Calotropis, Prosopis cineraria, Tecomella, Commiphora, and Ephedra*)

Suggested Readings

Cutter, E.G. Plant Anatomy: Experiment and Interpretation, Part II. Organs, Edward Arnold, London, 1971.

Esau, K. Anatomy of Seed Plants, 2nd John Wiley & Sons, New York, 1977.

Fahn, A. Plant Anatomy. 2nd ed. Pergamon Press, Oxford, 1974.

S. S. Katewa & Anita Jain, Ethnobotany, Phytogeography, Plant Resource Utilization & Conservation. Apex Printing House, Udaipur, 2007

Kocchar, S.L. Economic Botany in Tropics. 2nd ed. Mac-millan India Ltd., New Delhi, 1998.

Mauseth, J.D. Plant Anatomy, The Benjamin/Cummings Publ. Company Inc., Menlo Park, California, USA, 1988.

Sambamurthy, A.V.S.S. and Subramanyam, N.S. A Text book of Economic Botany, Wiley Eastern Ltd., New York, 1989.

Sharma, O.P. Hill's Economic Botany (Late Dr. A.F. Hill, Adapted by O.P. Sharma), Tata McGraw Hill Co., Ltd., New Delhi, 1996.

Simpson, B.B. and Conner-Ororzaly, M. Economic Botany Plants in Our World, McGraw Hill, New York, 1986.

**DEPARTMENT OF BOTANY
CENTER OF ADVANCED STUDY
JAI NARAIN VYAS UNIVERSITY, JOHDPUR
(B.Sc. B.Ed. Part-II Practical Examination)**

Time: 5 Hours

Max. Marks: 75

Min. Pass. Marks: 27

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|---|----------|
| Q. 1. Cut a T.S of the given material “A” (Pteridophyta/ Gymnosperm) and make double stained temporary mount of the same. Draw labeled diagram. Identify the material giving reasons. Leave your preparation for inspection. | 7 |
| Q. 2. Make suitable preparation of the reproductive parts of the given material “B” (Pteridophyta/ Gymnosperm). Draw labeled diagram. Identify and comments upon the features of interest. Leave your preparation for inspection. | 7 |
| Q. 3. Describe the given flower in semi technical language with floral diagram and floral formula, mentioning special features of identification. | 7 |
| Q. 4. Prepare a temporary slide of the given Gynoecium / Androecium/Embryo material. Draw a Labeled Diagram and comment on it from Embryological point of view. | 4 |
| Q. 5. Cut T.S./V.S. of given stem/root/leaf and make a double stained preparation of the same. Draw a labeled diagram (outline & cellular) and identify with special features. | 7 |
| Q. 6. Identify and comment upon the given spots 1 to 6 (covering all disciplines of Three Theory Papers) | 3x6 = 18 |
| 1. _____
2. _____
3. _____
4. _____
5. _____
6. _____ | |

Q. 7. Viva-voce	10
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Internal Assessment	15
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TOTAL 75

BOTANY
B.Sc. B.Ed. III Year – 2026-2027

Course/ Theory	Nomenclature	Number of Papers	Number of Periods per week	Max. Marks		Total Marks	Min. Pass Marks
				Internal	External		
Paper I	Cell Biology, Genetics, Plant Breeding and Evolution	1	2	10	40	50	36
Paper II	Ecology and Environmental Biology	1	2	10	40	50	
PRACTICAL COURSE			4	10	40	50	18

Duration of examination of each theory papers 3 hours

Duration of examination of practical (for both papers on same day) 4 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section –B and Section–C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3 Marks

Section –C: Will consist of 5 questions. Each unit will be having one questions; students will answer three questions from out 5 questions. Answer of each question shall be limited up to 500 words. Each question carries 5 Marks.

CELL BIOLOGY, GENETICS, PLANT BREEDING AND EVOLUTION

Unit I: History of cell biology: Concept of cell and cell theory. Cell cycle and its regulation. Mitosis and meiosis. Structural and molecular organization of cell. Structure and function of cell wall; plasmodesmata, plasma membrane; golgi complex, plastid, mitochondria, endoplasmic reticulum, peroxisomes, vacuoles and nucleus.

Unit II: Chromatin organization: Organization and structure of chromosomes. Concept of Nucleosomes, chromatin remodeling, Types of chromosomes and determination of sex in plants. Chromosome alteration: Structural alteration; deletion, duplication, translocation, inversion; numerical variation: aneuploidy and polyploidy. Molecular basis of mutation: Spontaneous and induced, brief account of DNA damage and repair. Introduction to epigenetics.

Unit III: Nature of inheritance; Laws of Mendelian inheritance and its exceptions. Crossing over and linkage analysis. DNA the genetic material: Structure and replication, brief account of DNA- protein interaction. Definition of a gene-modern Concept of gene (Promoter, coding sequences, terminator). RNA polymerases and general transcription. Regulation of gene expression in prokaryotes and basics of gene regulation in eukaryotes.

Unit IV: Origin of Agriculture, Centers of origin of crop plants and centers of Diversity. Concepts of Centers and Non-center (Harlan Hypothesis) Principles of plant breeding-Domestication, Introduction, Selection, Clonal propagation, Hybridization, Mutation breeding; Breeding work done on wheat; Green revolution; Assessment and Consequences; Biodiversity and Conservation of germplasm.

Unit V: Theories of Evolution: Catastrophism, The Lamarck's theory, Darwin's theory, Evidences of organic evolution, mechanism of evolution. Origin of basic biomolecules evolution of prokaryotic and eukaryotic cell and Origin of species. Population genetics: Allele and genotype frequency, Hardy- Weinberg principles.

Suggested Laboratory Exercises

Cytology

1. Study of cell structure from onion leaf peels
2. Comparative study of cell structure in onion cells and *Hydrilla*
3. Smear preparation of root tips for different stages in *Allium* root tip
4. Cytological examination special types of chromosomes (Slides)
5. Examination of electron micrographs of eukaryotic cells and cell organelles

Genetics

1. Working out laws of inheritance using seed mixtures
2. Monohybrid, dihybrid and test crosses using seed samples

Plant Breeding

1. Demonstration of Emasculation techniques.

Suggested Readings

- Alberts, B., Bray, D. Lewis, J., Raff, M., Roberts, K. and Watson, I.D. *Molecular Biology of cell*. Garland Publishing Co., New York, USA
- Chaudhary, H.K. Elementary Principles of Plant Breeding, Oxford & IBH Publishing New Delhi.
- Gupta, P.K. A Textbook of cell and Molecular Biology, Rastogi Publications, Meerut, 2016.
- Gupta, P.K. Cytology, Genetics, Evolution and plant Breeding, Rastogi, Publication Meerut, 2016.
- Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. Molecular Cell Biology, W.H. Freeman & Co. New York, USA
- Miglani, G.S. Advanced Genetics. Narosa publishing Co., Inc., USA
- Russel, P.J. Genetics. The Benjamin/ Cummings Publishing Co., Inc., USA
- Shukla, R.S. and Chandel, P.S. Cytogenetics, Evolution and Plant Breeding, S. Chand & Co. Ltd., New Delhi
- Singh B.D. Textbook of plant Breeding. Kalyani Publishers, Ludhiana, 1999
- Sinha, U. and Sinha, S. Cytogenetics, Plant Breeding and Evolution, Vikas Publishing House, New Delhi, 1997
- Sunstand, D.P. and Simmons, M.J. Principles of Genetics, John Wiley & Sons Inc., USA 2000

ECOLOGY AND ENVIRONMENTAL BIOLOGY

Unit I: Plants and Environment: Atmosphere (gaseous composition), water (properties of water cycle, precipitation), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties) and biotic factor.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), Halophytes and their vegetation characteristics, Temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes)

Unit II: Population ecology: Concept and characters, growth curves, biotic potential, ecotypes and ecads. Seed: The significance, suspended animation; ecological adaptation and dispersal strategies

Community ecology and Succession: Community characteristics, frequency, density, cover, life forms and biological spectrum. Succession: concept, classification and examples (hydrosere & xerosere)

Unit III: Ecosystems and Productivity: Ecosystem — Structure, abiotic & biotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen, phosphorus and Sulphur.

Productivity: Primary productivity, its measurements and factors affecting primary productivity

Unit IV: Environmental Biology of Indian Desert: Climate, vegetation types, adaptive strategies of desert plants. Desertification: meanings, causes, critical issues & driving forces. Agroforestry and its impact on desert agriculture. Desert biodiversity, Geomorphology, threatened plants and their classification; Rare and threatened, endemic plants of Indian Thar desert and their conservation strategies, Wildlife Sanctuaries and National Parks of Rajasthan, Invasive plants: Meaning and adaptations, Natural resources exploitation and their impact on desert environment

Unit V: Pollution Ecology: Definitions, classification, air, water, land and noise pollution. Concepts of Industrial Ecology in pollution management. Global warming: Greenhouse effect, Concepts and Current status.

Phytogeography: Vegetation types of India — Forest and Grasslands. Biogeographical regions of India, Remote sensing: The basics and applications in ecological studies

Suggested Laboratory Exercises

1. To determine minimum number of quadrats required for reliable estimation of biomass in herbaceous vegetation
2. To study the frequency of herbaceous species and to compare the frequency distribution with Raunkiaer's Standard frequency diagram
3. To estimate Importance Value Index for herbaceous vegetation on the basis of relative frequency, relative density and relative biomass in protected and Gochar land
4. To measure the vegetation cover of grassland through point frame
5. To measure the above ground plant biomass in a natural field
6. To determine diversity indices (richness Simpson, Shannon-Weaver) in natural fields
7. To estimate bulk density and porosity of soil samples
8. To determine moisture contents, water holding capacity and texture of soil samples
9. To estimate qualitatively nitrate, phosphate and potassium in soil samples

10. To study the vegetation structure through profile diagram
11. To estimate transparency and pH of different water bodies
12. To measure dissolved oxygen content in polluted and unpolluted water samples
13. To estimate salinity, hardness, carbonates and bicarbonate in different water samples
14. To determine the percent leaf area injury of different leaf samples collected around polluted site
15. To estimate dust holding capacity of the leaves of different plant species
16. Invasive plants of the Campus:
 - a. Seed out put
 - b. Modes of regeneration
 - c. Adaptive ecology of: *Lantana camara*, *Parthenium hysterophorus*, *Prosopis juliflora*,
17. Plant adaptive modifications: Specimens/Slides:
 - i) Succulents: *Opuntia*, *Euphorbia*
 - ii) Salt secretion: *Atriplex*, *Chloris*
 - iii) Salt accumulation: *Suaeda*, *Salsola*, *Zygophyllum*
 - iv) Xerophytes: *Capparis*, *Leptadenia*, *Parkinsonia*
 - v) Hydrophytes: *Eichhornia*, *Nymphaea*, *Hydrilla*
 - vi) Rare/Threatened plants: *Calligonum polygonoides*, *Dipcadi erythraeum*, *Commiphora wightii*, *Tribulus rajasthanensis*, *Withania coagulans*

Suggested Readings

Dash, M.C. Fundamental of Ecology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1996
 Deeksha Dave, S.S. Katewa, Textbook of Environmental Studies. Cengage; 3rd edition
 Kormondy, E.J. Concepts of Ecology, Prentice – Hall of India Pvt., New Delhi, 1996
 Kumar, H.D. General Ecology, Vikash Publishing House Pvt. New Delhi, 1995
 Mukherjee, B. Environmental Biology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1997
 Odum, E.P. Basic Ecology, Saunders, Philadelphia, 1983
 Sen, D.N. Environment and Plant Life in Indian Desert, Geobios International, Jodhpur, 1982
 Sharma, P.D. Ecology and Environment, Rastogi Publications, Meerut 2018

**DEPARTMENT OF BOTANY
CENTER OF ADVANCED STUDY
JAI NARAIN VYAS UNIVERSITY, JOHDPUR
(B.Sc. B.Ed. Part–III Practical Examination)**

Time: 4 Hours

**Max. Marks: 50
Min. Pass. Mark: 18**

Q. 1. Prepare a suitable preparation of the given plant **12**
Material (A) to observe any two visible stages of mitosis.
Draw labeled diagrams of the same. Submit the slide
for evaluation.

Q. 2. Perform the Ecological experiments **8**
allotted to you by lots and report the
results in suitable form (Major).

Q. 3. Perform the Ecological experiments **4**
allotted to you by lots and report the
results in suitable form (Minor).

Q. 4. Identify and comment upon the given spots 1 to 6 (covering all
disciplines of Two Theory Papers) **2x6 = 12**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Q. 5. Viva-voce **4**

Internal Assessment **10**

TOTAL 50

BOTANY
B.Sc. B.Ed. IV Year – 2027

Course/ Theory	Nomenclature	Number of Papers	Number of Periods per week	Max. Marks		Total Marks	Min. Pass Marks
				Internal	External		
Paper I	Plant Physiology and Biochemistry	1	2	10	40	50	36
Paper II	Plant Biotechnology and Molecular Biology	1	2	10	40	50	
PRACTICAL COURSE			4	10	40	50	18

Duration of examination of each theory papers 3 hours

Duration of examination of practical (for both papers on same day) 4 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section –B and Section–C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3 Marks

Section –C: Will consist of 5 questions. Each unit will be having one questions; students will answer three questions from out 5 questions. Answer of each question shall be limited up to 500 words. Each question carries 5 Marks.

B.Sc. B.Ed. IV Year PAPER I
PLANT PHYSIOLOGY AND BIOCHEMISTRY

Unit I: Plant-water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata
Mineral nutrition: Essential macro- and micro-elements and their role, mineral uptake; deficiency and toxicity symptoms

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation

Unit II: Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C₄ pathway; CAM plants; photorespiration. Rubisco and its regulation.

Unit III: Respiration: Aerobic and anaerobic respiration; Krebs's cycle; electron transport mechanism (chemi – osmotic theory); redox potential; oxidative phosphorylation pentose phosphate pathway

Basics of enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action, Protein structures

Unit IV: Nitrogen and lipid metabolism: Biological Nitrogen fixation and metabolism. Importance of nitrate reductase and its regulation; ammonium assimilation. Structure and function of lipids; fatty acid biosynthesis; β -oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids

Unit V: Growth and development: Definitions; phases of growth and development. Seed dormancy, seed germination. Photoperiodism, physiology of flowering; florigen concept, biological clocks, vernalization. physiology of senescence, fruit ripening. Plant hormones-auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, Physiological role and mode of action. Photomorphogenesis; phytochromes and cryptochromes.

Suggested Laboratory Exercises

1. To study the permeability of plasma membrane using different concentrations of organic solvents
2. To study the effect of temperature on permeability of plasma membrane
3. To prepare the standard curve of protein and determine the protein content in unknown samples
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature
5. Comparison of the rate of respiration of various plant parts
6. Separation of chloroplast pigments by solvent method

7. Determining the osmotic potential of *vacuolar sap* by plasmolytic method
8. Determining the water potential of any tuber
9. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards
10. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material
11. To study the regulation of stomatal movement using growth regulators, KCI and antitranspirants

Suggested Readings

Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds.). Plant Metabolism (2nd ed.), Longman, Essex, England, 1997

Galston, A.W. Life processes in Plants, Scientific American Library, Springer-Verlag, New York, USA, 1989

Hopkins, W.G. Introduction to Plant Physiology, John Wiley & Sons, Inc., New York, USA, 1995

Lea, P.J. and Leegood, R.C. Plant Biochemistry and Molecular Biology, John Wiley & Sons, Chichester, England, 1999

Mohr, H. and Schopfer, P. Plant Physiology, Springer-Verlag, Berlin, Germany, 1995

Salisbury, F.B. and Ross, C.W. Plant Physiology (4th ed.), Wadsworth Publishing Co., California, USA, 1992

Srivastava, H.S. Plant Physiology, Rastogi Publication, Meerut, 2016

Taiz, L. and Zeiger, E. Plant Physiology (2nd ed.), SinauerAssociats, Inc. Publishers, Massachusetts, USA, 1998

Suggested Readings

(for Laboratory Exercises)

Amar Singh. Practical Plant Physiology, Kalyani Publishers, New Delhi, 1977

Moore, T.C. Research Experiences in Plant Physiology: A Laboratory Manual, Springer-Verlag, Berlin, 1974

Nifa, A.J. and Ballou, D.P. Fundamental Laboratory Approaches for Biochemistry and Biotechnology, Fitzreriald Science Press, Inc., Maryland, USA, 1998

Robalts and Tucker, G.A. (Eds.) Plant Hormone Protocols, Humana Press, New Jersey, USA, 2000

Scot, R.P.W. Techniques and Practice of Chromatography Marcel Dekker, Inc., New York, 1995

Wilson, K. and Goulding, K.H. A Biologists Guide to principles and techniques of Practical Biochemistry, Ed-ward Arnold, London, 1986

PLANT BIOTECHONOLGY AND MOLECULAR BIOLOGY

Unit I: Cell theory and concept of totipotency and pluripotency. Introduction, History and application: plant tissue culture and biotechnology.

Genes, genomics and proteomics: General introduction. Basic tools and techniques of molecular biology: History of genetic manipulation, restriction enzymes, ligases, electrophoresis (Agarose and PAGE) and PCR. General introduction and applications of DNA finger printing, bioinformatics and NanoBiotechnology.

Unit II: Bacterial and viral genome organization (with special reference to plasmids and phage): Genetic recombination in bacteria. Vectors for gene cloning: p-BR322, p-UC18, Cosmids, Phagemids, BAC, PAC, YAC and HAC; c-DNA libraries. Detection and screening of recombinant DNA.

Unit III: General techniques of micropropagation: Fundamental and molecular aspects of organogenesis-somatic embryogenesis and androgenesis. Genetic basis of somaclonal variations and its applications. Protoplast isolation, fusion and somatic hybridization. Cryopreservation of germplasm.

Various types of bioreactors. Industrial production of secondary metabolites with special reference to *Ephedra* alkaloids, Shikonin, Diosgenin and *Vinca* alkaloids. Strategies used to optimize secondary metabolite production.

Unit IV: Genetic engineering of plants: *Agrobacterium* as a natural genetic engineer, molecular organization of genetic makeup, t-DNA transfer mechanism integration and expression in plants. Genetic engineering of nitrogen fixation; basic biology, prospects and future challenges. Direct method of gene transfer in plants: Chemical methods electroporation, particle gun delivery, lipofection, microinjection, macroinjection, pollen transformation, laser induced and silicon fiber mediated. Reporter (Luciferase, GUS and GFP) and marker genes.

Unit V: Biotechnology and society: Development of transgenic crop plants against biotic and abiotic stresses. Genetically modified crops: Golden rice, Bt cotton and Bt brinjal (as a model system). Molecular marker assisted plant breeding. Plant Breeder's Rights (PBR) and Intellectual Property Right (IPR) in current regime of WTO. Impact of GM crops on society and environment.

Suggested Laboratory Exercises

1. Surface sterilization and aseptic inoculation of suitable explants for activation of axillary shoot bud/induction of cell or callus culture (haploid or somatic cell)
2. Plant (Cauliflower/Onion) DNA extraction by Rapid Method

Suggested Readings

Bhojwani, S.S. Plant Tissue Culture: Application and Limitation, Elsevier Science Publishers, New York, USA, 1990

Old, R.W. and Primrose, S.B. Principles of Gene Manipulation, Black well Scientific Publications, Oxford, U.K., 1986

Raghavan, O. Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University, Press, New York, USA, 1986

Vasil, I.K. and Thorpe, T.A. Plant Cell and Tissue Culture, Kluwer Academic Publishers, The Netherlands, 1994

**Suggested Readings
(for Laboratory Exercises)**

Ball, R.D. (ed.) Plant Cell Culture Protocols, Humana Press, Inc. New Jersey, USA, 1999

Dixon, R.A. (ed.) Plant Cell culture: A Practical Approach, IRL, Press Oxford, 1987

Glick, B.R. and Thompson, J.E. Methods in Plant Molecular Biology and Biotechnology, CRC Press, Boca Raton, Florida, 1993

Roberts, J. and Tucker, G.A. (eds.) Plant Hormone Protocols Humana Press, New Jersey, USA 2000.

**DEPARTMENT OF BOTANY
CENTER OF ADVANCED STUDY
JAI NARAIN VYAS UNIVERSITY, JOHDPUR
(B.Sc. B.Ed. Part-IV Practical Examination)**

Time : 4 Hours

**Max. Marks: 50
Min. Pass. Marks: 18**

- | | |
|--|-----------------|
| Q. 1. Perform the Physiological experiments allotted to you by lots and report the results in suitable form (Major) | 8 |
| Q. 2. Perform the Physiological experiments allotted to you by lots and report the results in suitable form (Minor) | 4 |
| Q. 3. Prepare culture medium and aseptically inoculate explants and DNA extraction from the given plant material. (Two experiments 6+6) | 12 |
| Q. 4. Identify and comment upon the given spots 1 to 6 (covering all disciplines of Two Theory Papers) | 2x6 = 12 |
| 1. _____ | |
| 2. _____ | |
| 3. _____ | |
| 4. _____ | |
| 5. _____ | |
| 6. _____ | |
| Q. 5. Viva-voce | 4 |
| Internal Assessment | 10 |

TOTAL 50
