

S.S. Jain Subodh P.G. College Jaipur

(Autonomous)

Affiliated to University of Rajasthan, Jaipur



(Three/Four Year Bachelor of Science)

(Bio Group)

Subject: Botany

Syllabus

Session 2026-27

(From the Academic Year 2026-27 onwards)

Vision:

To create potential and competent professionals in Botany through the courses with Practical training and advanced technical skills, equipped with knowledge and aptitude for higher education and research.

Mission:

- Dissemination of global demand-based knowledge through teaching with technical professionalism.
- Creation of individuals with social and environmental concern.
- Training the students to create economically and environmentally
- viable solutions in the field of plant science.

Programme Outcomes

- PO1. Developing the potential for vertical career growth in plant sciences, academic and service sectors and related fields.
- PO2. Development of in-depth analytical and critical thinking, so that students would be able to identify and solve problems with the help of botany.
- PO3. Proficient knowledge in the major domains of plant sciences including plant identification, plant diseases, microbiology, Plant biotechnology etc.
- PO4. Students can successfully learn tools and techniques related to plant research.
- PO5. After completion of the course, students would be able to execute their professional roles in society as botanists, plant taxonomists, plant pathologists, etc.
- PO6. Students will be able to learn skills to work as a team with people from multidisciplinary environment.
- PO7. To design and develop sustainable solutions to major biological problems by applying appropriate tools.
- PO17. Develop skills, attitude and values required for self-directed, lifelong learning and professional development.
- PO8. Acquire knowledge and understanding of norms and ethics in the field of Botany.

B.Sc. Biology Botany

Course Structure under C.B.C.S. And NEP-2020

Examination Scheme for EoSE for Semester I

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-T-101 –Cell Biology and Diversity of Plant Kingdom I	CIA	1Hrs	CIA	30Marks	CIA	12 Marks
		EoSE	3Hrs	EoSE	70Marks	EoSE	28 Marks
Practical	BOT-P–Practical I	CIA	1Hrs	CIA	20Marks	CIA	8 Marks
		EoSE	3Hrs	EoSE	30Marks	EoSE	12 Marks

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-T-102 –Molecular Biology, Genetics and Diversity of Plant Kingdom II	CIA	1Hrs	CIA	30Marks	CIA	12 Marks
		EoSE	3Hrs	EoSE	70Marks	EoSE	28 Marks
Practical	BOT-P–Practical II	CIA	1Hrs	CIA	20Marks	CIA	8 Marks
		EoSE	3Hrs	EoSE	30Marks	EoSE	12 Marks

B.Sc. Biology Botany

Course Structure Under C.B.C.S. And NEP-2020

Examination Scheme for EoSE for Semester I & II

Course code		Course Title	Credit	Marks	External	Internal
SEM I	BOT-101	Paper-I Cell Biology and Diversity of Plant Kingdom I	4	100	EoSE 70	CIA 30
	BOT- P	PRACTICAL	2	50	30	20
SEM II	BOT-102	Paper- II	4	100	EoSE 70	CIA 30
		Molecular Biology, Genetics and Diversity of Plant Kingdom II				
	BOT- P	PRACTICAL	2	50	30	20

Examination Scheme

- 1 credit = 25 marks for examination/ evaluation
- There will be Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (30% weightage) and End-of-Semester Examination (EoSE (70% weightage)).
- 75% Attendance is mandatory for appearing in the EoSE.
- To appear in the EoSE examination of a course/ subject, a regular student must appear in the mid-semester examination.

B.Sc. Sem. I

Cell Biology and Diversity of Plant Kingdom I

BOT--101

1 Credit -25 marks

4 Credit-100 Mark

Max.Marks -70

Internal Marks-30

Objectives:

- To impart knowledge of cell types their structure and functions of cell organelles.
- To understand structure of Nucleic acids
- To understand the basics of plant diversity.
- To understand structure and reproduction in Algae.
- To understand structure and reproduction in Bryophytes.
- To have a basic idea of Lichen.

Course Learning Outcomes:

After the course completion, the student would be able to:

1. Learn, understand and develop skills and hands-on training in the basics of cell biology.
2. Acquire basic knowledge of here dietary material and chromosomes.
3. Know all the kinds of plant groups and understand relationships between them.
4. Understand the diversity of lower plant presents on various habitats.
5. Identify the microscopic to macroscopic view of the plants.
6. Apply the economic importance of lower plants.
7. Promote shared learning through practical classes, presentations and assignments.

The question Paper will consist of two parts A & B

Part A: 14 Marks

Part A will be compulsory having 10 very short answer type questions (with a limit of 20 words) of two marks each and candidate have to attempt only seven out of it.

Part B: 56 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. Candidate has to attempt one question from each unit of their choice. Each Carry 14 Marks.

Unit – I

Cell and Cytoskeleton: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Plant and animal cells; Chemistry, structure and function of Plant cell wall. Overview of plasma membrane: fluid-mosaic model; Chemical composition of membranes;

Membrane transport—Passive, active and facilitated transport, endocytosis and exocytosis. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filaments. **Cell Organelles:** Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semi-autonomous nature of mitochondria and chloroplast. Lysosomes and Vacuoles. Endomembrane system: Endoplasmic Reticulum – Types and Structure. Golgi Apparatus—organization, protein glycosylation, protein sorting and export from Golgi Apparatus . 15 Hrs.

Unit – II

Nucleic acids: DNA as genetic material (Griffith's transformation experiment and Hershey and Chase blender experiment); Structure and function of DNA (Watson and Crick Model); Structure and function of different types of RNA (rRNA, mRNA, tRNA, snRNA).

Chromosomes: Chromosome number, structure and function, types of chromosomes (metacentric, sub-metacentric, acrocentric, telocentric); Chromosome organization according to Nucleosome model; Special types of chromosomes: Lamp brush and Polytene chromosomes. **Cell Division:** Phases of eukaryotic cell cycle; Different stages of mitosis; Different stages of Meiosis I and Meiosis II, synaptonemal complex, chiasmata formation and Crossing over. 15 Hrs.

Unit – III

Plant Kingdom : Introduction to plant kingdom-Basic idea of hierarchy in all groups of plants

Algae: General characteristics; Diverse Habitats; Range of thallus organization; methods of reproduction (Vegetative, Asexual, Sexual); Economic importance. Criteria and classification system of Fritsch (1935) (distinguishing features upto classes). Morphology and life history of: Cyanophyceae: *Nostoc*; Chlorophyceae: *Volvox*; Xanthophyceae: *Vaucheria*; Phaeophyceae: *Ectocarpus*; Rhodophyceae: *Polysiphonia*.

Lichen: General characteristics; Habitat; Structure; Reproduction; Ecological and Economic Importance.

Unit – IV

15 Hrs

Fungi: General characteristics; Thallus organization; Different hyphal forms; Heterokaryosis and Para sexuality; Nutrition and Reproduction in fungi; Economic importance. Classification (Alexopoulos & Mims, 1996); Morphology and life history of : Zygomycota: *Rhizopus*, Ascomycota: *Peziza*, Basidiomycota: *Agaricus*.

Bryophytes: General characteristics ;affinities with algae and pteridophytes; Distribution; Range of thallus structure; Reproduction (Vegetative and Sexual); Alternation of generations and evolution of sporophytes. Classification (Proskauer, 1957); Structures of gametophyte. Sporophyte and life history (Development details not included) of : Hepaticopsida: *Marchantia*, Anthocerotopsida: *Anthoceros* and Bryopsida: *Funaria* 15 Hrs.

Suggested Books and References

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6th Ed.). New York: Garland Science
2. Cooper, G.M., and Hausman, R.E. (2013). **The Cell: A Molecular Approach** (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. **Cell and Molecular Biology. Concepts and experiments.** John Harris, D., Wiley & sons, New York
4. VeerBalaRastogi. **Genetics.** Medtech
5. Veer Bala Rastogi. **A Textbook of Cell Biology and Genetics.** Kedarnath Ramnath
6. Alexopoulos, C.J. and Mims, C.W.: **Introductory Mycology**, John Wiley and Sons, New York, 2000
7. Singh, Pande and Jain. **A Textbook of Botany**, Rastogi Publications
8. Dube, H.C.: **Fungi**, Rastogi Publication, Meerut, 1989.
9. Vashishtha, **B.R. Botany for Degree Students-Fungi**, S. Chand & Co., New Delhi, 2001.
10. Gilbert, M. Smith: **Cryptogamic Botany, Vol. I & II (2nd Ed.)** Tata McGraw Hill. Publishing Co., Ltd., New Delhi, 1985.
11. Puri, P.: **Bryophytes**, Atmaram & Sons. Delhi, Lucknow, 1985.
12. Aneja, K.R.: **Experiments in Microbiology, Plant Pathology and Biotechnology.** New Age International (P) Ltd., Publishers, New Delhi 2003.
13. Pandey B.P. (2022) **Algae, Bryophytes and Lichens.** S Chand Publication

Suggested E-resources:

1. <https://youtu.be/K2teJ6-DBLw>
2. <https://archive.nptel.ac.in/courses/102/108/102108086/>
3. <https://archive.org/details/cellmolecularapp6edcoop>

B.Sc. Semester- I (Bio Group)

Botany Practical-I

Syllabus

Cell and Cell Organelles

- Study of electron microphotographs of prokaryotic and eukaryotic cell.
- Study of electron microphotographs of virus, bacteria and eukaryotic cells for comparative study of cellular organization.
- Study of cell structure in Onion, *Hydrilla* and *Spirogyra*.
- Study of plastid for pigment distribution in *Lycopersicon*, *Cassia* and *Capsicum*.

Cell Division and Chromosomes

- Study of permanent slides /photographs of different stages of mitosis and meiosis sex chromosomes, polytene chromosome and salivary gland chromosomes.
- Study of different stages of mitosis and meiosis in root-tip cells and flowerbuds respectively of onion.
- Calculate the mitotic index of onion root tip cells.
- Study of induced aberrations in onion root tips employing chemicals and plant extracts.

Algae and Lichen

- **Algae**-Study of morphology and anatomy of *Nostoc*, *Volvox*, *Chara*, *Vaucheria*, *Ectocarpus* and *Polysiphonia* (vegetative and reproductive structures) by preparing temporary slides and studying permanent slides.
- **Lichens**:Study of growth forms of lichens (crustose, foliose and fruticose)

Fungi and Bryophyta

- **Fungi**- Microscopic observation of vegetative and reproductive structures of *Rhizopus*, *Peziza* and *Agaricus* through preparation of temporary slides and permanent slides.
- **Bryophytes**- Study of morphology, anatomy, vegetative and reproductive organs of *Marchantia*, *Anthoceros* and *Funaria* by preparing temporary slides and studying permanent slides.
- Study of renowned Indian scientists in the fields of phycology (M.O.P Iyengar), mycology (K. C. Mehta), bryology (S.R.Kashyap) and lichens (D.D.Awasthi).
- Make a list of national and international institutes of repute in the fields of cytology, phycology, mycology, bryology and lichens.

B.Sc. Semester- I (Bio Group)
Botany Practical-I Scheme of Practical
Examination and Distribution of marks

Duration- 3 Hrs

Max.Marks:30

S.No.	Exercise	Regular
1.	Exercise based on cell structure and types.	3
2.	Make a suitable acetocarmine preparation of the given material. Draw a well-labelled diagram of any one stage of nuclear division.	3
3.	Make a suitable stained preparation of the given material A . Draw a labelled diagram and identify giving reasons.(Algae)	3
4.	Make a suitable stained preparation of the given material B . Draw a labelled diagram and identify giving reasons.(Fungi)	3
5.	Make a suitable stained preparation of the given material C (vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons. (Bryophyte)	3
6.	Comment up on the spots-identify giving reasons.(1to5)	10
7.	Viva-voce	5
	Total	30

B.Sc. Sem. II

Molecular Biology, Genetics and Diversity of Plant Kingdom-II

BOT--201

1 Credit -25 marks

4 Credit-100 Marks

Max.Marks -70, Internal Marks-30

Objectives of the Course:

Marks

- To understand the Mendel's laws and its deviations.
- To impart knowledge on DNA replication, Mendel's laws of inheritance, mutations.
- To understand functions of genes, linkage and crossing over.
- To understand morphology and anatomy of the Pteridophytes and Gymnosperms.
- To understand reproduction in the Pteridophytes and Gymnosperms.
- To have a basic idea of Fossil plants.

Course Outcomes: At the completion of the course, the student would be able to:

Understanding:

- To learn, understand and develop skill and hands on training in basics of genetics.
- To understand functions of genes, linkage and crossing over.
- To interpret genetics of a large group of population.
- To understand characteristic feature and life cycle pattern of pteridophytes and gymnosperms.
- To understand adaptation of pteridophytes to land habit.

Memorizing:

- Differentiation between linkages, crossing over, allelic interactions.
- Mendel's laws of genetics.
- Classification of pteridophytes and gymnosperms.
- Evolutionary concepts in pteridophytes and gymnosperms.
- Habit, habitat, morphology and anatomy of various members.

Applying:

- Allelic and non-allelic interactions
- Possibilities of mutations and mutagens and ploidy in plants.
- Ecology and economic importance of pteridophytes and gymnosperms.

The question Paper wills consist of two parts A&B

Part A: 14 Marks

Part A will be compulsory having 10 very short answer type questions (with a limit of 20 words) of two marks each and candidate have to attempt only seven out of it.

Part B: 56 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. Candidate have to attempt one question from each unit of their choice. Each Carry 14 Marks.

UNIT-I

DNA replication: DNA replication Enzymes and mechanisms of prokaryotic DNA replication: Initiation, Elongation and Termination; Leading and lagging strands, Okazaki fragments. **Expression of Gene in Prokaryotes:** Expression of Gene in Prokaryotes Transcription, Initiation, elongation and termination. Genetic code: Meaning, types of codons, properties. Translation: Initiation, Elongation and Termination in Prokaryotes.

15 hrs

UNIT-II

Genetic inheritance: Genetic inheritance Mendel's laws of inheritance and their exceptions; allelic (incomplete dominance, co-dominance, lethality) and non-allelic interactions (complementary genes, epistasis and duplicate genes); Multiple allelism (ABO blood groups in men); Quantitative inheritance (Grain color in wheat). Cytoplasmic inheritance: Plastid inheritance (different types of leaves in *Mirabilis jalapa*); Mitochondrial inheritance (Cytoplasmic male sterility in plants). **Structural and numerical aberrations:** Deletion, Duplication, Translocation, Inversion, Aneuploidy and Polyploidy. Mutations: Types of Mutations, Spontaneous and induced Mutations, Physical and Chemical mutagens.

15 Hrs

UNIT-III

Pteridophytes: General characteristics; Affinities with bryophytes & gymnosperm; Heterospory and seed habit; Evolution of stele in Pteridophytes; Economic importance. Classification (Riemers, 1954); Study of life history of fossil Pteridophyte – *Rhynia*. Life history of Psilotopsida: *Psilotum*; Lycopsida: *Selaginella*; Sphenopsida: *Equisetum*; Pteropsida: *Marsilea*.

15 hrs

UNIT-IV

Gymnosperms : Gymnosperms General characteristics; Affinities with Pteridophytes and Angiosperms, Distribution; Economic importance. Classification (Sporne, 1965); Life history of Cycadopsida: *Cycas*; Coniferopsida: *Pinus*; Gnetopsida: *Ephedra*. **Paleobotany: Paleobotany** Introduction, Basic concept and significance, Geological time scale; Types of Fossils

15 Hrs

Suggested Books and References –

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6thEd.). New York: Garland Science
2. Cooper, G. M., and Hausman, R. E. (2013). The Cell: A Molecular Approach (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D., Wiley & sons, New York
4. Lodish, HF. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman
5. Gupta P.K. Cell and Molecular Biology 2018.5th edition Rastogi Publication India.
6. Veer BalaRastogi. Genetics.Medtech
7. Veer BalaRastogi. A Textbook of Cell Biology and Genetics.KedarnathRamnath
8. Singh, Pande and Jain. A Textbook of Botany, Rastogi publications
9. B.R. Vashishta and P.C. Vashishta. Botany for Degree Students: Pteridophyta - Vascular Cryptogams), S.Chand (G/L) & Company Ltd
10. B.R. Vashishta and P.C. Vashishta.Gymnosperms (Botany for Degree Students), S.Chand (G/L) & Company Ltd

B.Sc. Semester- II (Bio Group) BOT- P Botany

Practical-II Syllabus

Practicals related to DNA

- Isolation of Genomic DNA from Onion/Banana/Pineapple/etc.
- Demonstration of Gel-electrophoresis

Practicals related to Genetics

- To solve genetic problems based upon Mendel's laws of inheritance: Monohybrid cross, Dihybrid cross, back cross and test cross.
- Induction of polyploidy using colchicines
- Emasculation, Bagging and Tagging

Pteridophytes-

- Study of vegetative and reproductive stages of *Selaginella*, *Equisetum* and *Marsilea* by preparing temporary slides and studying permanent slides.
- Study of fossil plant: *Rhynia*

Gymnosperms

- Study of Vegetative and reproductive stages of *Cycas*, *Pinus* and *Ephedra* by preparing temporary slides and studying permanent slides.

**B.Sc. Semester- II (Bio Group) Botany Practical-II Scheme
of Practical Examination and Distribution of Marks**

Duration-3hrs

Max.Marks:30

S.No.	Exercise	Regular
1.	Exercise based on Nucleic acids	3
2.	Exercise based on Genetics	4
3.	Make a suitable stained preparation of the given material A (vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons. (Pteridophyte)	4
4.	Make a suitable stained preparation of the given material B (vegetative/Reproductive part). Draw a labeled diagram and identify, giving reasons.(Gymnosperm)	4
5.	Comment upon the spots- identify giving reasons. (1to5)	10
6.	Viva-voce	5
	Total	30

SYLLABUS
(Three /Four Year Bachelor of Science) (Bio Group)

Subject: Botany

B.Sc. Semester III & IV

Examination Scheme for EoSE for Semester III & IV

Course code	Course Title	Credit	Marks	External	Internal
BOT-301	Paper Microbiology and Plant Pathology	4	100	EoSE 70	CIA 30
BOT- P	PRACTICAL	2	50	30	20
BOT-401	Paper Plant Taxonomy and Economic Botany	4	100	EoSE 70	CIA 30
BOT-P	PRACTICAL	2	50	30	20

Examination Scheme for EoSE for Semester III

CIA-Continuous Assessment EoSE -End of Semester Examination

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT--301 Microbiology and Plant Pathology	CIA	2Hrs	CIA	30 Marks	CIA	Marks
		EoSE	3Hrs	EoSE	70 Marks	EoSE	Marks
Practical	BOT P Practical-III	Internal	1Hrs	Internal	20 Marks	CIA	Marks
		EoSE	3Hrs	External	30 Marks	EoSE	Marks

Semester	Code of the Course		Credits			
III	BOT-301	6	4			
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		

Intermediate	Major	4	2	6	60 lectures with diagrammatic and presentations and informative assessments during lecture hours
---------------------	--------------	----------	----------	----------	---

B.Sc. Sem. III

BOT--301-Microbiology and Plant Pathology

COURSE OUTCOMES

On completion of the course the student would be able to develop the following:

Understanding	• To gain in-depth knowledge about bacteria, viruses and other microorganisms, including their structure, function, genetics, and role in ecosystems. • To learn about the interactions between plants and microorganisms, • To understand the beneficial relationships (e.g., symbiosis) and harmful interactions (e.g., plant diseases) between plants and microorganisms.
Memorizing	• Different types of microbes with structure, function and their economic importance. • Host pathogen interaction and its effects on plants. • Symptomology, disease cycle and control of different pathogens causing diseases.
Applying	• Acquire proficiency in various laboratory techniques, such as culturing microorganisms, gram staining, microscopy, and biochemical assays. • Will be helpful for students in further developing interest in agricultural research, crop protection, and pest management to improve crop yield and quality. • Work in disease prevention and control, focusing on plant diseases that impact food safety and public health.

The theory question paper will consist of **two** parts **A & B**.

PART-A: 14 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of 2 marks each. Candidate have to attempt seven questions.

PART-B: 56 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5.

There will be one question from each unit with internal choice. Each question will carry 14 marks.

Unit-I

Microbiology: Introduction to microbial world : History and Development in the field of microbiology, Systematic position of Micro-organisms (R.H. Whittaker's five kingdom concept, Carl Woese's Domain System), Origin of Life, contribution of Louis Pasteur and Robert Koch, Germ theory of disease.

Virus: Discovery, General account, structure with special reference to TMV, Pox virus, Bacteriophage; Replication of T4 phage (Lytic and Lysogenic).

Mycoplasma: General Characteristics, Morphology and Reproduction.

15 Hrs.

Unit-II

Bacteria: General Characteristics, Classification, Cell structure, endospore formation, Reproduction- asexual and recombination (Conjugation, Transformation and Transduction).

Applied Microbiology Economic importance of viruses, Economic importance of Bacteria with reference to their role in agriculture and food industry, Bio-films .

15 Hrs

Unit-III

Phyto pathology: Terminology and basic concepts (Primary and Secondary inoculum; infection, Pathogenicity, Pathogenesis, Disease Cycle); Biotic and abiotic diseases, General symptoms caused by Viruses, Bacteria, Fungi, Mycoplasma, Nematodes, Insects (smut, rust, mildews, canker, mosaic, vein clearing, spots, lesion, knot, galls).

Diseases: Viral, Mycoplasmal and Bacterial diseases: Brief account, Symptomology and control of the following plant diseases:-Tobacco Mosaic, Little leaf of Brinjal, Citrus canker and Angular Leaf spot of Cotton. 15 Hrs

Unit-IV

Fungal Diseases: Symptomology, disease cycle and control of the following plant diseases with special reference to Rajasthan: White rust of crucifers, Downy mildew/green ear disease of Bajra, Black/stem rust of Wheat, Loose and covered smut of Barley, Early blight of Potato **Diseases: Disease caused by insects and nematodes:** General account of diseases caused by insects and nematodes, Brief account and Histopathology of root knot of vegetables, leaf gall of *Pongamia* 15 Hrs

Suggested Books and References

1. Pelczar, M.J. (2001) Microbiology, 5th edition. New Delhi, Delhi: Tata Mc-Graw- Hill Co.
2. Prescott, L.M., Harley J.P., Klein D.A. (2005). Microbiology, 6th edition: McGraw Hill, New Delhi.
3. Agrios G.N. (2004) Plant Pathology, 5th Edition, Academic Press
4. Pandey B.P. (2001) Plant Pathology (Pathogen and Plant Disease), S. Chand Publishing
5. Mehrotra RS and Aggarwal A. (2003) Plant Pathology, 2nd Edition. Delhi: Tata Mc-Graw- Hill Co.
6. Sharma P.D. (2013). *Plant pathology*. Deep and Deep Publications.

Suggested E-resources:

1. <https://archive.nptel.ac.in/courses/102/103/102103015/>
2. https://onlinecourses.swayam2.ac.in/cec21_bt16/preview
3. <https://www.pdfdrive.com/plant-pathology-concepts-and-laboratory-exercises-e179105354.html>

**B.Sc. Semester– III (2026-27) BOT-P- Botany
Practical-III**

- I** Microscopic techniques- handling of light microscope, general idea of SEM and TEM.
Write major contribution of leading scientists of Microbiology.
Study of TMV, Bacteriophage and Poxvirus, Mycorrhiza (Photographs/3D Models).
- II** Study of Bacteria by Gram Staining and Negative staining Preparation of Liquid and solid media for culturing microbes Pure culture techniques- pour plate, spread plate, streaking
- III** Study of symptoms of plant diseases(specimen/permanent slide)- Downy mildew/ green ear disease of Bajra, Tobacco Mosaic, Citrus canker, Little leaf of Brinjal, Study of spores of *Alternaria* from Early blight of Potato.
- IV** Study and identification of spores from temporary slide preparation from infected plant material:-white rust of crucifers (conidia stage), Black/ stem rust of Wheat (all stages).
Study of histopathology using temporary slide preparation of infected part of root knot of tomato, Leaf gall of *Pongamia*.

Course Learning Outcomes: Upon completion of course, students will be able to:

- 1. Understand about morphology and function diverse microbes.
- 2. Understand about diagnosing plant diseases, understanding their causes, and implementing management strategies to control or prevent them.
- 3. Understand and perform different laboratory exercise to further understand about microorganisms.
- 4. Acquire knowledge about different types of microbes with structure, function and their economic importance, Host pathogen interaction and its effects on plants.
- 5. Apply control and management strategies for plant diseases caused by fungi, bacteria, nematodes, insects etc.
- 6. Acquire proficiency in various laboratory techniques, such as culturing microorganisms, gram staining, microscopy, and biochemical assays.
- 7. Develop interest among students in agricultural research, crop protection and pest management to improve crop yield and quality.
- 8. Work in disease prevention and control, focusing on plant diseases that impact food safety and public health

B.Sc. Semester- III (Bio Group)
Botany Practical-III Scheme of Practical

Distribution of marks

Duration: 3Hrs

Maximum Marks-30

S.No.	Exercise	Regular
1.	Perform exercise of Microbiology Gram ⁺ /negative staining of bacteria or Identification of virus/ mycoplasma	3
2.	Perform the exercise based on the microbiology Media preparation/ any pure culture technique	3
3.	Study the material “A” carefully, prepare a suitable stained preparation, and identify the casual organism associated with the disease giving reasons (Fungal disease)	5
4.	Identify the material “B” carefully, prepare a suitable stained preparation, and identify the casual organism associated with the disease giving reasons (Insect/Nematode disease)	4
5.	Spotting(5spots)	10
6.	Viva-voce	5
	TOTAL	30

Examination Scheme for EoSE for Semester IV

CIA–Continuous Internal Assessment

EoSE –End of Semester Examination

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-T-401 –Plant Taxonomy and Economic Botany	CIA	1Hrs	CIA	30Marks	CIA	Marks
		EoSE	3Hrs	EoSE	70Marks	EoSE	Marks
Practical	BOT –Practical IV	CIA	1Hrs	CIA	20Marks	CIA	Marks
		EoSE	3Hrs	EoSE	30Marks	EoSE	Marks
Semester	Code of the Course	Title of the Course/ Paper				NHEQF Level	Credits
IV	BOT-401	Plant Taxonomy and Economic Botany				6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Intermediate	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic presentations and informative assessments during Lecture hours	
Prerequisites		Botany course of Foundation/Introductory level					
Objectives of the Course:		➤ To gain in-depth knowledge about plant taxonomy and economic botany. ➤ To learn about the various aspects of taxonomy like nomenclature, classification and identification ➤ To understand the benefits of plants with their products in various field. ➤ To learn about plant collection and preservation of plants in lab (herbarium).					

Syllabus

BOTANY

Plant Taxonomy and Economic Botany IV Semester- B.Sc. (Bio Group)

Botany

COURSE OUTCOMES

On completion of the course the student would be able to develop the following:

Understanding	• To Understand the historical development and modern approaches to plant classification systems, including the principles and criteria used for categorizing plants • Understand the evolutionary relationships among different plant groups and how phylogenetic trees represent these relationships. • Understand the key morphological features that are used to identify and classify plants at various taxonomic levels (family, genus, species).
Memorizing	• Memorize the hierarchical classification of plants, including ranks such as domain, kingdom, phylum, class, order, family, genus, and species. • Memorize the characteristics and representative species of major plant families, including their economic and ecological significance.
Applying	• Apply knowledge to identify plant species in the field using keys, guides, and floras, demonstrating proficiency in using diagnostic features. • Apply techniques for collecting, preserving, and preparing plant specimens for herbarium collections, ensuring accurate labeling and documentation. • Conduct independent or group research projects involving the collection, identification, and classification of local plant species, integrating field and laboratory work.

The theory question paper will consist of **two** parts **A & B**.

PART-A: 14 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 56Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 14marks

BOT-401: Plant Taxonomy and Economic Botany

UNIT-I

Classification: Artificial (Linnaeus), Natural (Bentham & Hooker) and Phylogenetic (Engler and Prantle's) System. **Nomenclature:** Angiosperm Phylogeny Group (APG). International Code of Botanical Nomenclature. Introduction, principles, rules (Name of Taxon, Priority & publication) and Recommendations. Introduction to International Code of Nomenclature for algae, fungi and plants (ICNAPF), **Herbarium:** Equipments, herbarium sheet preparation & preservation and Significance. Introduction to Botanical Survey of India (BSI). 15 Hrs

UNIT-II

Taxonomic literature Floras, Monographs, Icons. **Modern Trends:** Cytotaxonomy, Chemotaxonomy, Palynology, Embryology, Anatomy and Numerical taxonomy. Study of Families: Diagnostic characters and economic importance of Ranunculaceae, Brassicaceae, Malvaceae, Fabaceae, Apiaceae, Rubiaceae and Asteraceae. 15 hrs

UNIT-III

Study of Families: Diagnostic characters and economic importance of Apocyanaceae, Asclepiadiaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae and Poaceae. **Economic Botany:** Vavilov's concept of centre of origin. Primary and secondary centres. **Cereals** (General account): Rice, Wheat, Maize. **Millets** (General account): Ragi (finger millet), Jowar (Sorghum), Sama (Little millet), Bajra (pearl millet), Variga (Poro millet). 15 Hrs.

UNIT-IV

Economic Botany of Vegetable oil : Ground nut and Mustard Spices: General account of turmeric, asafoetida, Cumin, Coriander & Red Chilli. **Beverages:** Tea and Coffee.

Medicinal plants: General account (Tulsi, Isabgol, Ashwagandha, Neem and Ephedra).

Fibres: Cotton & Jute. Processing of Rubber & Sugarcane

15 Hrs.

Suggested Books and References

- Principles of Angiosperm Taxonomy by Davis & Heywood. Publisher: Oliver & Boyd
- Taxonomy of Vascular Plants by Lawrence HM George. Publisher: Scientific Publishers
- Plant Systematics: An Integrated Approach. By Gurcharan Singh. Publisher: CRC Press
- Plant Taxonomy by O.P. Sharma. Publisher: McGraw Hill Education
- Taxonomy of Angiosperms by A.V.S.S. Sambamurthy. Publisher: Dream tech Press
- Modern Plant Taxonomy by N.S. Subrahmanyam. Publisher: S Chand
- Economic Botany by B.P. Pandey. Publisher: S Chand & Company
- Economic botany: a comprehensive study by S.L. Kochhar. Publisher: Cambridge University Press
- Economic Botany by Singh, Pandey & Jain. Publisher: S. Chand Publishing

Suggested E-resources:

1. https://www.google.co.in/books/edition/The_Flowering_Plants_Handbook/yoLaBAAQBAJ?hl=en&gbpv=1&dq=james+byng+taxonomy&printsec=frontcover
2. <https://www.pdfdrive.com>

B.Sc. Semester – IV

BOT-P-Botany

Practical-IV

Exercises based on Plant Taxonomy:-

- Plant description and identification of following families: Ranunculaceae, Brassicaceae, Malvaceae, Fabaceae, Apiaceae, Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae and Poaceae
- Exercise based on using taxonomic modern tools
- Preparation of Herbarium sheets
- Campus Flora writing/Excursion/ Field study
- Herbarium tools

Exercises based on Plant Taxonomy

- Biochemical test for Starch, Protein, Oil, Cellulose, lignin and tannin
- Medicinal plant-identification and collection
- Study of specimens with reference to economic use of Cereals, millets, Pulses, Oil, Fibres, Spices, and Beverages (common name, Botanical name, Family, Parts used, Economic uses)
- Collection of specimens of locally available medicinal /wild plants
- Any other exercise based on theory syllabus.

Botany Practical-IV Scheme of Practical Examination and Distribution of Marks

Maximum Marks-30

Duration: 3Hrs

B.Sc. Semester- IV (Bio Group)

S. No.	Exercises	Regular
1.	Identify the family of the given flower and describe floral characters in semi-technical language. Draw a floral diagram and write the floral formula.	5
2.	Identify and describe the given herbarium tool	3
3.	Perform the biochemical test on the given material.	3
4.	Identify the given material (economic botany), write botanical characters and economic importance	4
5.	Spotting(5)	10
6.	Viva-voce	5
7.	TOTAL	30

Course Learning Outcomes:

On completion of the course the student will be able to:

- Learn the types of classifications- artificial, natural, and phylogenetic.
- Gain knowledge about Botanical Survey of India (BSI).
- Briefly study herbarium techniques.
- Learn the taxonomic evidences from molecular, numerical and chemicals.
- Brief study the economic products with special reference to the Botanical name, family, morphology of useful part and the uses
- Learn diverse uses of plants and plant products for humans.
- Apply the knowledge gained in seeking employment to reputed institutions and organizations known in the field of plant taxonomy, diversity, conservation, agro- industry, pharmaceuticals etc.
- Memorize the various classification with the botanical names, distinctions, distribution, habit, characteristics and affinities of various taxon.
- Learn the perspective of origin, history and role of important plants and plant products for the development of human culture.
- Acknowledge the economic uses of plants in modern society.
 - Acquire an increased awareness and appreciation of plants & plant products encountered in everyday life.
 - Develop scientific insights into the development of many plant products that have shaped our society.
 - Appreciate the diversity of plants and the plant products in human use.

Examination Scheme for EoSE for Semester V

CIA—Continuous Internal Assessment

EoSE —End of Semester Examination

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-T-501 Plant Biochemistry and Physiology	CIA	1 Hrs.	CIA	30 Marks	CIA	Marks
		EoSE	3Hrs	EoSE	70 Marks	EoSE	Marks
Practical	BOT-Practical-V	CIA	1 Hrs.	CIA	20 Marks	CIA	Marks
		EoSE	3Hrs	EoSE	30 Marks	EoSE	Marks
Semester	Code of the Course	Title of the Course/ Paper		NHEQF Level		Credits	
V	BOT-501	Plant Biochemistry and Physiology		6		4	
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Intermediate	Major/Minor	4	2	6	Yes	60 Lectures with diagrammatic presentation and informative assessments during lecture Hours	
Prerequisites	Botany course of Foundation/Introductory level						
Objectives of the Course		➤ Understand the classification, structure, and function of major biomolecules (proteins, carbohydrates, lipids, nucleic acids). ➤ Explain the nature and types of biological bonds such as glycosidic, peptide, and phosphodiester bonds. ➤ Describe enzyme classification, structure, and factors affecting their activity. ➤ Illustrate mechanisms of water and nutrient transport in plants, including osmosis, transpiration, and pressure flow. ➤ Identify essential macro- and micronutrients in plants and symptoms of their deficiencies. ➤ Analyse key processes of photosynthesis and respiration, including electron transport and energy pathways. ➤ Interpret plant growth and development stages, hormonal regulation, and responses to environmental cues like photoperiodism and vernalisation.					

Syllabus
BOTANY
Plant Biochemistry and Physiology
V Semester- B.Sc. (Bio Group)
Botany

COURSE OUTCOMES

On completion of the course, the student would be able to develop the following:

Understanding	• To understand the structure, classification and functions of major biomolecules such as carbohydrates, proteins, lipids, and nucleic acids, • To understand the nature and significance of biochemical bonds (glycosidic, peptide, phosphodiester) and key metabolic processes like alpha and beta oxidation. • To understand the mechanisms of water and nutrient transport in plants and relate them to physiological processes like osmosis, transpiration, and root pressure.
Memorizing	• To memorise the processes of nitrogen metabolism and biological nitrogen fixation. • To memorise the light and dark reactions of photosynthesis, cyclic and non-cyclic photophosphorylation, including factors affecting the process. • To memorise the pathways of respiration (aerobic and anaerobic), glycolysis, TCA cycle, ETS, and pentose phosphate pathway, and assess their role in energy Production • Memorising of enzymes, including their classification, structure, mechanism of action, and the factors influencing their activity.
Applying	• Apply the macro- and micronutrients in plant growth and diagnose common nutrient deficiency symptoms • Apply the concepts of photoperiodism and vernalization in understanding flowering responses and seasonal adaptations in plants.

The theory question paper will consist of two parts

A & B. PART-A: 14 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each. PART-B: 56Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 14marks

BOT-501 - Plant Biochemistry and Physiology

UNIT – I

Biomolecules: Nomenclature, classification, importance, molecular structure and function of Proteins (primary, secondary, tertiary, conjugated), Carbohydrates (monosaccharides, disaccharides, polysaccharides), Lipids (saturated and unsaturated), General account of Secondary Metabolites in plants. Nature of Bond: Glycosidic linkage, Peptide bond, Phosphodiester bonds, Alpha and Beta oxidation. Enzymes: Nomenclature, classification, Structure, mechanism of action, factors affecting enzyme activity . **15 Hrs.**

UNIT –II

Transport in Plants: Facilitated diffusion, active absorption, Passive and Active Transport (uniport, co-transport, symport, antiport), Concept and Mechanism of Water Potential, Osmosis, Plasmolysis, Ascent of Sap, Root Pressure, Guttation, Transpiration (Pressure Flow Hypothesis. Mineral Nutrition and translocation: Macro- and Micro nutrients in Plants and deficiency symptoms, Translocation of Solutes, Phloem transport, Source-sink relationship, Factors affecting translocation of nutrients, Nitrogen Metabolism, Biological Nitrogen Fixation, Nodule formation.

15 Hrs.

UNIT –III

Photosynthesis: Pigments, Photosynthetic apparatus, Light reaction, PSI, PSII, Cyclic and Non-cyclic Photophosphorylation, Calvin cycle, C4 and CAM Pathway, Photorespiration, Factors affecting Photosynthesis. Respiration: Aerobic and Anaerobic respiration, Glycolysis, Tricarboxylic Acid Cycle, Electron Transport System (ETS) and Oxidative Phosphorylation, Pentose Phosphate Pathway, Respiratory Quotient (RQ).

15 Hrs.

UNIT-IV

Growth and Development: Phases of Growth, Differentiation, Dedifferentiation and Redifferentiation, Characteristics, discovery and Physiological effects of Plant Growth Regulators: Auxins, Gibberellins, Cytokinins, Ethylene, Absciscic Acid. Concept, Physiology and Mechanism of Photoperiodism and Vernalisation. Florigen concept, Seed Dormancy.

15 Hrs.

Suggested Books and References –

1. Cox, M.M. and Nelson DL (2004) Lehninger Principles of Biochemistry (Third Edition) MacMillan Worth Publishers.
2. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons.U.S.A. 4th edition.
3. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
4. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
5. Srivastava, L. M. 2002. Plant Growth and Development: Hormones and Environment (1st edition). Academic Press, USA.
6. Verma, S. K., Textbook of Plant Physiology, S. Chand & Company.

Suggested E-resources:

1. https://docs.google.com/file/d/0B_FBtJyzk2ZNLVNuZFp6S3E2YU0/edit?resourcekey=0-NxnSCZjwDIn3VDCh0rfgSQ
2. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
3. <https://archive.org/details/plant-physiology-and-bio-chemistry/page/18/mode/2up>

B.Sc. Semester- V
Bot-P- Botany Practical-V

Exercises Based on Plant Biochemistry and Physiology: -

1. To study the effect of temperature on the permeability of the plasma membrane
2. To determine the osmotic potential of Vascular Sap using the Plasmolytic method.
3. To study the effect of two environmental factors (light and wind) on transpiration by an excised twig.
4. To separate chlorophyll pigments using paper chromatography.
5. To separate chlorophyll pigments using the solvent method.
6. Separation of amino acids by paper chromatography.
7. To demonstrate enzyme activity- Catalase, amylase.
8. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
9. Mohl's Half-Leaf experiment.
10. To study the effect of light intensity and bicarbonate on O₂ evolution in photosynthesis.
11. Calculate the Respiration Quotient (RQ) of different substrates by Ganong's Respirometer.
12. To study the phenomenon of seed germination (effect of light).
13. Demonstration of Potato Osmoscope
14. Demonstration of Aerobic and Anaerobic respiration
15. To measure the rate of Transpiration
16. To measure plant growth using an Arc Auxanometer.

B.Sc. Semester- V (Bio Group)
Botany Practical-V Scheme of Practical
Examination and Distribution of marks

Duration: 3Hrs

Maximum Marks-30

S.No.	Exercises	Marks
1	Major Exercise in Plant Physiology	7
2	Minor Exercise in Plant Biochemistry	8
3	Spotting	10
4	Viva	5
5.	Total	30

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Identify and classify major biomolecules such as carbohydrates, proteins, lipids, and nucleic acids, and explain their structure and function in biological systems.
2. Explain the nature and significance of biochemical bonds (glycosidic, peptide, phosphodiester) and key metabolic processes like alpha and beta oxidation.
3. Demonstrate an understanding of enzymes, including their classification, structure, mechanism of action, and the factors influencing their activity.
4. Describe the mechanisms of water and nutrient transport in plants and relate them to physiological processes like osmosis, transpiration, and root pressure.
5. Interpret the role of macro- and micronutrients in plant growth and diagnose common nutrient deficiency symptoms.
6. Explain the processes of nitrogen metabolism and biological nitrogen fixation, and evaluate their importance in plant productivity and sustainable agriculture.
7. Illustrate the light and dark reactions of photosynthesis and compare cyclic and non-cyclic photophosphorylation, including factors affecting the process.
8. Describe the pathways of respiration (aerobic and anaerobic), glycolysis, TCA cycle, ETS, and pentose phosphate pathway, and assess their role in energy production.
9. Apply the concepts of photoperiodism and vernalization in understanding flowering responses and seasonal adaptations in plants.

Examination Scheme for EoSE for Semester VI

CIA—Continuous Internal Assessment

EoSE —End of Semester Examination

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-T-601 Plant Morphology, Anatomy and Embryology	CIA	1 Hrs.	CIA	30 Marks	CIA	Marks
		EoSE	3Hrs	EoSE	70 Marks	EoSE	Marks
Practical	BOT-Practical-VI	CIA	1 Hrs.	CIA	20 Marks	CIA	Marks
		EoSE	3Hrs	EoSE	30 Marks	EoSE	Marks
Semester	Code of the Course	Title of the Course/ Paper		NHEQF Level		Credits	
VI	BOT-601	Plant Morphology, Anatomy and Embryology		6		4	
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Intermediate	Major/Minor	4	2	6	Yes	60 Lectures with diagrammatic presentation and informative assessments during lecture Hours	
Prerequisites	Botany course of Foundation/Introductory level						
Objectives of the Course		This course will enable the students: ➤ To understand the morphology and anatomy of flowering plants and their practical and experimental aspects. ➤ To understand the modifications of the root, stem, leaves and their significance in plant life. ➤ To make the students learn about the concepts of secondary growth, abnormal secondary growth and wood formation. ➤ To provide knowledge of the internal structure and functional organisation of higher plants ➤ To provide basic knowledge of male and female plant reproductive structures ➤ To provide a detailed understanding of plant embryology and seed structure					

B.Sc. Sem. VI
BOT--601-Plant Morphology, Anatomy and Embryology

COURSE OUTCOMES

On completion of the course, the student would be able to develop the following

Understanding	• To understand the morphological features of roots, stems, and leaves with abnormal features, according to adaptations. • To understand the meristems of different types based on position and ontogeny. • To understand tissue and tissue systems. • To understand the primary structure of root, stem, and leaves with secondary growth and abnormality. • To understand the reproductive structures of angiospermic flower. • To understand structure of microsporangium, megasporangium with gametogenesis • To understand structure of monocot and dicot embryo. • To understand different types of endosperms. • To memorise modifications of root, stem and leaf with the examples
Memorizing	• To memorise special features/exceptional features in the anatomy of root/stem/leaf. • To memorise causes of abnormality at primary and secondary level. • To memorise the mode of pollination found in angiosperms. • To memorize types of fruits. • To apply the concept of fertilization in self-incompatibility.
Applying	• To apply the concept of parthenocarpy and apomixis. • To apply the concept of breaking dormancy.

The theory question paper will consist of two parts A & B.

PART-A: 14 Marks

Part A will be compulsory, having 10 very short answer-type questions (with a limit of 20 words) of 2 marks each. Candidates have to attempt seven questions.

PART-B: 56 Marks

Part B of the question paper shall be divided into four units, comprising questions 2-5. There will be one question from each unit with internal choice. Each question will carry 14 marks.

UNIT - I

Morphology and the Tissue System Basic body plan of a typical dicot and a monocot plant; diversity of plants based on habit, habitat, longevity, and body forms. Types and structural modification of roots, stem and leaves for storage, physiological and mechanical adaptations. Tissues: Structure and function- Meristematic Tissues, Permanent Tissues: Simple Tissues and Complex Tissues; Tissue systems: Epidermal Tissue System, Ground Tissue System and Vascular Tissue System. Organizational theories of Shoot apical meristem (SAM) and Root apical meristem (RAM)

15 Hrs.

UNIT - II

Growth in plants: Anatomy of primary structures of root, stem and leaf of dicot and monocot plants. Secondary Growth: Structure and function of vascular cambium, secondary growth in stem and roots; Annual Rings: Spring wood and autumn wood, Heartwood and sapwood, tyloses, Porous and non-porous wood. Structure and function of cork cambium. Periderm. Anomalous growth in *Nyctanthes*, *Boerhavia*, *Bignonia*, *Salvadora*, *Dracaena* and *Leptadenia*.

15 Hrs.

UNIT - III

Embryology I: Angiosperm flower, Structure of anther, microsporogenesis, development of male gametophyte, Structure of pistil, structure of ovule and its types, megasporogenesis, development and types of female gametophyte

15 Hrs.

UNIT - IV

Embryology II: Pollination and double fertilization. Endosperm: structure and types, embryo development in dicotyledons and monocotyledons, Seed structure (monocot and dicot), specialized structures related to seed, seed dispersal mechanisms. Polyembryony, apomixis .

15 Hrs.

Suggested Books and References –

1. Cutter E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II Organs. Edward Arnold, London.
2. Esau K. 1977. Anatomy of seed plants, 2nd edition, John Wiley and Sons New York.
3. Fahn, A. 1974. Plant anatomy 2nd edition. Pergamon press. Oxford.
4. Crang, R. et al, 2018. Plant anatomy: a concept-based approach to the structure of seed plants.
5. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
7. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
8. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
9. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands. 10. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands

Suggested E-resources: 1. <https://nptel.ac.in/courses/102107075>

B.Sc. Semester- VI Bot-P- Botany Practical-VI

1. Study of Tissue organization in root and shoot apices using permanent slides.
2. To study types and structural modification of roots , stem and leaves for storage, physiological and mechanical adaptations
3. Study of Anatomy of Dicot and Monocot Roots.
4. Study of the Anatomy of dicot and monocot stem.
5. Study of Anatomy of Dicot and Monocot Leaves.
6. Study of Anomalous secondary growth in stems of *Nyctanthes*, *Boerhaavia*, *Bignonia*, *Salvadora*, *Dracaena*, and *Leptadenia*.
7. Study of the ovule using temporary/ permanent slides/photographs.
8. Study of T. S. of anther, to study the wall layers and pollen sac with pollen grains.
9. Study of pollen germination and pollen viability.
10. Measurement of pollen size using micrometry.
11. Study of types of placentation in angiosperms.
12. Study of the structure of endosperm (nuclear and cellular) using permanent slides / Photographs.
13. Study of developmental stages of dicot and monocot embryos using permanent slides/photographs.
14. Study of seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
15. Any other exercise related to the syllabus.

B.Sc. Semester- VI (Bio Group)
Botany Practical-VI Scheme of Practical
Examination and Distribution of Marks

Duration: 3Hrs

Maximum Marks-30

S.No.	Exercises	Marks
1.	Make a suitable preparation of material 'A'. comments on the anatomy of primary structure/secondary structure/abnormal structure of root/ stem/leaf, identify it by giving reasons, draw an outline or cellular diagram with suitable labelling.	8
2.	Make a suitable preparation of material 'B'. comments on T. S. of anther/pollen structure/ viability/ pollen tube germination/ Structure of embryo. Draw a suitable diagram with labelling.	7
3	Spotting	5
4	Viva-voce	5
	TOTAL	30

Course Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Apply knowledge of plant anatomy to identify plant samples and interpret their adaptive significance
2. Understanding of the organization of tissues and tissue systems in plants.
3. Analyse and compare vascular bundles and secondary growth in monocot and dicot plants. Identify and analyse anomalous patterns of secondary growth in various plants.
4. Understand, evaluate and analyse the wood anatomy and climate studies .
5. Identify and compare the different reproductive organs of angiosperms and analyse the diversity of their structures.
6. Understand the process of double fertilization and its significance in flowering plants
7. Illustrate and interpret various aspects of embryology.