

S.S. JAIN SUBODH P.G.(Autonomous) COLLEGE, JAIPUR

(Affiliated to University of Rajasthan)



SYLLABUS

Three Year Under graduate programme in Science

I & II Semester Examination 2023-24

III & IV Semester Examination 2024-25

V & VI Semester Examination 2025-26

**Bachelor of
Science**

DEPARTMENT OF BOTANY

(Syllabus as per NEP 2020 and Choice based Credit system)

Medium of programme: Hindi/English

w.e.f Academic Session 2023-24

Content

- 1. Eligibility**
- 2. Scheme of Examination**
- 3. Scheme for CBCS**
- 4. Semester Structure**
- 5. Contact Hours**
- 6. Course Outcomes**
- 7. Course Details**

1. ELIGIBILITY:

10+2 with 48% from Rajasthan Board / CBSE from Rajasthan state and 60% for CBSE or any other equivalent recognized Board from other state in Science Stream with Physics, Chemistry and Biology.

2. SCHEME OF EXAMINATION

Sr. No.	Paper	ESE	CIA	Total
1.	Theory	70%	30%	100
2.	Practical	60%	40%	100

Each theory paper syllabus is divided into four units. Each theory paper 3 hours duration.

Each Practical /Lab work 4 hours duration

The number of papers and the maximum marks for each paper/ practical shall be shown in the syllabus for the paper concerned. It will be necessary for a candidate to pass in theory part as well as practical part of a subject separately.

Note: Maximum marks for a theory paper is 50 marks which include 35 marks for ESE and 15marks for internal assessment.

Examination Question Paper Pattern for all semester Exams.

Attempt all questions

I. 10 Questions (very short answer questions) 7x 1 Mark = 7

II. 4 Questions (1 question from each unit with internal choice) 4x7 Marks = 28

Total of End Sem. Exam - 35

Internal Assessment – 15

Maximum Marks - 50

Minimum Marks – 20

3. Scheme for CBCS

B. Sc. Three year degree / (Subsidiary) Botany

Scheme for CBCS Curriculum

Semester	Subject 1/ Discipline 1 (DSC / DSE) (credits)	Subject 2 / Discipline 2 (DSC/DSE) (credits)	Subject 2 / Discipline 2 (DSC/ DSE) (credits)	Generic Elective (GE) (credits)	Ability Enhancement Course (AEC C) (credits)	Skill enhancement course (SEC) (credits)	Internship/ Apprentice- ship/ Project/ Community	Value addition course (VAC) (credits)	Total Credits
I	DSC-1(2)	DSC-3(2)	DSC-5 (2)		English (2)			Choose one from a pool of courses (0)	20 credits
	DSC-2(2)	DSC-4(2)	DSC-6 (2)						
	DSCP(2)	DSCP(2)	DSCP(2)						
II	DSC-7(2)	DSC-9(2)	DSC-11(2)		Hindi (2)			Choose one from a pool of courses (0)	20 credits
	DSC-8(2)	DSC-10(2)	DSC-12(2)						
	DSCP(2)	DSCP(2)	DSCP(2)						
<i>Students on exit shall be awarded Undergraduate Certificate in Science after securing the requisite 40 credits in Semesters I and II</i>									40+4
III	DSC-13 (2)	DSC-15 (2)	DSC-17(2)	Choose one from pool of courses, GE -1 (2)**		Computer Science(2)		Choose one from a pool of courses (0)	22 credits
	DSC-14 (2)	DSC-16 (2)	DSC-18 (2)						
	DSCP(2)	DSCP(2)	DSCP(2)						
IV	DSC-19 (2)	DSC-21 (2)	DSC-23(2)	Choose one from pool of courses GE - 2 (2)**		Env.Sc.and Sustainable Dev. (2)		Choose one from a pool of courses (0)	22 credits
	DSC-20 (2)	DSC-22 (2)	DSC-24 (2)						
	DSCP(2)	DSCP(2)	DSCP(2)						
<i>Students on exit shall be awarded Undergraduate Diploma in Science after securing the requisite 84 credits on completion of Semester IV</i>									84+4
V	Choose two from pool of courses, DSE – 1 (2)	Choose two from pool of courses, DSE – 3 (2)	Choose two from pool of courses, DSE – 5 (2)			Mental ability & reasoning (2)		Choose one from a pool of courses(0)	20 Credits

	DSE-2(2)	DSE-4(2)	DSE-6(2)						
	DSEP (2)	DSEP (2)	DSEP (2)						
VI	Choosetwo from pool of courses, DSE-7(2)	Choosetwo from pool of courses, DSE-9(2)	Choosetwo from pool of courses, DSE-11(2)			Anandam-Joy of giving (2) or NCC/ NSS / Rovers and Rangers/ Red Ribbon Club / Sports/ Extra-curricular and co-curricular activities(2)		Choose one from a pool of courses (0)	20 credits
	DSE-8(2)	DSE-10(2)	DSE-12(2)						
	DSEP (2)	DSEP (2)	DSEP (2)						
<i>Students on exit shall be awarded Bachelor of Science (3 years) after securing the requisite 124 credits on completion of Semester VI</i>									124+4

4. SEMESTER STRUCTURE

The details of the course with code, title and the credits assign are as given below.
Abbreviations Used

Course structure with Nomenclature B.Sc. (BOTANY)

Semesters	Code	Name of Paper	Credits	Total credits
Semester-I				
Paper I-	DSC-1 BOT-101	Microbiology	2	6
Paper II-	DSC-2 BOT-102	Algae, Bryophyte and Lichens	2	
Practical	DSCP BOT P I	Practical: Based on theory papers	2	
Semester-II				
Paper I-	DSC-3 BOT-201	Mycology and Plant Pathology	2	6
Paper II-	DSC-4 BOT-202	Cell biology, Genetics and Plant Breeding	2	
Practical	DSCP BOT P II	Practical: Based on theory papers	2	
Semester-III				
Paper I-	DSC-5 BOT-301	Molecular Biology	2	6
Paper II-	DSC-6 BOT-302	Biotechnology	2	
Practical	DSCP BOT P III	Practical: Based on theory Papers	2	
Semester-IV				
Paper I-	DSC-7 BOT-401	Pteridophyta, Gymnosperms and Palaeobotany	2	6

Paper II-	DSC-8 BOT-402	Plant Physiology and Biochemistry	2	0
Practical	DSCP BOT P IV	Practical: Based on theory Papers	2	
Semester-V		Choose any two		
Elective I-	DSE-1 BOT-501	Plant Anatomy and Embryology	2	6
Elective II-A	DSE-2 BOT-502-A	Plant Systematics	2	
Elective II-B	DSE-2 BOT-502-B	Natural Resource Management	2	
Practical	DSEP BOT P V	Practical: Based on theory Papers	2	
Semester-VI		Choose any two		
Elective I-	DSE-3 BOT-601	Ecology	2	6
Elective II-A	DSE-4 BOT-602-A	Biostatistics	2	
Elective II-B	DSE-4 BOT-602-B	Economic Botany	2	
Practical	DSEP BOT P VI	Practical: Based on theory Papers	2	

Course Category

DSC: Discipline Specific Core

DSCP: Discipline Specific Core Practical

DSE: Discipline Specific Elective

DSEP: Discipline Specific Elective Practical

GE : General Elective

AEC: Ability Enhancement Course

AECC: Ability Enhancement Compulsory Course

SEC: Skill Enhancement Course

SEM: Seminar

PRJ: Project Work

RP: Research Publication

5.Contact Hours

L: Lecture

T: Tutorial
P: Practical or Other
S: Self Study

Semester-I

The medium of instruction and examination shall be Hindi/English.

The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic.

Semester -I

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	BOT - 101	Microbiology	DSC	2	3	-	-	3	-
2.	BOT - 102	Algae, Bryophyte and Lichens	DSC	2	3	-	-	3	-
3.	BOT - P	Practical	DSCP	2	-	-	4	-	4

Semester -II

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	BOT - 201	Mycology and Plant Pathology	DSC	2	3	-	-	3	-
2.	BOT - 202	Cell Biology, Genetics and Plant Breeding	DSC	2	3	-	-	3	-
3.	BOT- P	Practical	DSCP	2	-	-	4	-	4

Semester III

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	BOT - 301	Molecular Biology	DSC	2	3	-	-	3	-
2.	BOT - 302	Biotechnology	DSC	2	3	-	-	3	-
3.	BOT - P	Practical	DSCP	2	-	-	4	-	4

Semester -IV

S.No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	BOT - 401	Pteridophyta Gymnosperms and	DSC	2	3	-	-	3	-
2.	BOT - 402	Plant physiology and	DSC	2	3	-	-	3	-
3.	BOT - P	Practical	DSCP	2	-	-	4	-	4

Semester V

In Fifth Semester and Sixth Semester, students can choose any two electives. Departments will offer two theory elective courses for the semester based on options submitted by students and availability of Faculty to teach the course.

S.No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	BOT - 501	Plant Anatomy	DSE	2	3	-	-	3	-
2.	BOT - 502 A	Plant Systematics	DSE	2	3	-	-	3	-
3.	BOT - 502 B	Natural resource Management	DSE	2	3	-	-	3	-
4.	BOT - P	Practical	DSEP	2	-	-	4	-	4

Semester VI

S.No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	BOT - 601	Ecology	DSE	2	3	-	-	3	-
2.	BOT - 602	Biostatistics	DSE	2	3	-	-	3	-
3.	BOT - 602 B	Economic Botany	DSE	2	3	-	-	3	-
4.	BOT - P	Practical	DSEP	2	-	-	4	-	4

Programme Learning Outcomes-

Analytical reasoning-The student would develop a skill to analyze the awareness of the subject and think in a multidirectional way to solve the problem and to gain benefit in a sustainable manner. They would be able to think about the use of plants as industrial resources or as human source of revenue support system and is well versed with the use of transgenic technologies for basic and applied research in plants. The students will be able to demonstrate the knowledge in understanding research and addressing practical problems.

Reflective thinking -The structure and content of the course enables students to reflect on the learnings from different courses and integrate the same for a problem solving approach. They would be capable of correlating various concepts applicable to diverse situations and phenomenon. Multicultural competence

Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.

Lifelong learning -The subject of botany the applied theoretically and practically applied in day today life.

The successful students will be able to learn the basic concepts, principles and processes in plant biology. They have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, medicinal, ecological and agricultural applications.

The programme also has a strong interdisciplinary constituent. Emphasis is on experiential knowledge through hands-on laboratory exercises, field trips and assignments.

Current thrust areas of teaching provide students with substantial exposure and skills in plant biology.

Communication Skills -The students will develop a confidence on gaining the knowledge and skill after this course and they will be able to effectively communicate their views, present their work and impress the audience.

Graduates are expected to be well-versed in speaking and communicating their idea/ finding/concepts to a wider audience.

Research-related skills This course provides wide interdisciplinary knowledge and stimulates the students to think beyond the course knowledge, apply this knowledge for solving the environmental problems, efficient use of resources by designing novel and innovative experiments.

Students are expected to design a scientific experiment through statistical hypothesis testing and reasoning. Cooperation/Team work

The students would learn the use of the new technologies used in learning biology, digital platforms for fast transfer of information. Students will attain digital skills and integrate the fundamental concepts with modern tools.

Moral and ethical awareness/reasoning -Besides the theoretical knowledge, the student is familiar with moral and ethical duties, an awareness towards the conservation of nature and natural resources. Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

Learners are expected to be responsible citizen and be aware of moral and ethical duties. They are expected to define their core ethical virtues good enough to differentiate what construes as illegal and criminal under Indian constitution.

Learners should know academic and research ethics, Benefit Sharing, Plagiarism, Scientific Misconduct etc. Leadership readiness/qualities

The vast and deep knowledge of the subject, analytical and scientific reasoning, effective communication and problem solving task develop special qualities in a person to attract and influence the audience, which would be gained after the completion of this course.

Students are expected to be familiar with decision making process and basic managerial skills to become a better leader. Skills may include defining objective vision and mission, how to become responsible citizens and charismatic inspiring leader.

Programme Specific Outcomes (PSO's) -

PSO1. Students identify and get relevant information about the plants, so as to recognize their position in the classification systems and at phylogenetic level.

PSO2. Students will be able to understand the basics of Botany and different branches.

PSO3. Students will be able to compare and contrast the characteristics of the different groups of plants such as algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.

PSO4. Students will be able to understand comparative botany to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth.

PSO5. Students will be able to explain modern techniques used to study plants at molecular level

PSO6. Students will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.

PSO7. Students will be able to conceive the idea of artificial propagation of plants via vegetative methods and to find a livelihood via establishing miniature plant nursery.

PSO8 - Students will be able to know the economic importance and medicinal use of plants.

Objectives-

The B.Sc. - Botany programme is formed to gain knowledge and technical skills to study plants in a holistic manner. Students would get training in various disciplines of plant sciences using a combination of core and elective papers with significant inter-disciplinary components.

Botany is natural science give aesthetic value to human beings, main aims of this course is for understanding of plant Diversity and its importance in the maintenance of ecological balance. Students learn to carry out practical work, in the field and in the laboratory, interpreting plant morphology and anatomy, Plant identification, Vegetation analysis techniques. They can apply the knowledge of basic science, life sciences and fundamental process of plants in day today life. Modern techniques and instruments for Biochemical estimation, Molecular Biology, Biotechnology, Plant Tissue culture experiments, cellular and physiological studies of plants help in uncover the hidden aspect of botany. Although we are familiar to so many flora still there is need of research and exploration in the field of identification and their importance.

8. COURSE DETAIL

SEMESTER- I
Paper –I: MICROBIOLOGY
Course Code: BOT-101

Scheme of Examination

Max. Marks-35
30 hrs-Credits-2

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7

Course Outcomes-

CO-1 Microbiology

Students understand the diversity of microbes, structure, reproduction with their applications. Contribution of various microbiologist.

UNIT I

8 Hrs.

History and development of Microbiology; contribution of eminent scientists (Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Paul Ehrlich, Alexander Flemming, Selman A. Waksman, Edward Jenner), spontaneous generation, biogenesis, germ theory of disease, vaccination and discovery of antibiotics, concept of quorum sensing and biofilms.

UNIT II

8 Hrs.

General characteristics, occurrence, classification, ultra structure of Bacterial cell: morphology (Structure and shapes), flagella, capsule, nutritional types, chromatin material. Reproduction- Vegetative, asexual and sexual (transformation, conjugation and transduction), Comparison of Archaeobacteria and Eubacteria, Gram positive and Gram negative Bacteria.

UNIT III

7 Hrs.

Discovery, classification and structural component of Viruses, replication, lytic and lysogenic cycle, Bacteriophages, Structure and reproductive cycle of TMV and Pox virus, Transmission of viruses. Economic importance of viruses.

UNIT IV

7 Hrs.

Mycoplasma: Occurrence, morphology, reproduction and importance.

Economic and biological importance of bacteria with special reference to their role in agriculture, industry, medicine and sanitation.

Suggested Readings:

- > Agrawal, K. and Sharma, J. 2014. A Text book of Mycology, Microbiology and Plant Pathology. CBH publisher, Jaipur.
- > Aneja, K. R. 2003. Experiment in Microbiology, Plant Pathology and Biotechnology. New age international (P) Ltd. Publishers, New Delhi.
- > Biswas, S. B. and Biswas, A. 2000. An introduction of Viruses. Vikas publications, New Delhi.
- > Dubey, R. C. and Maheshwari, D. K., 2002. A Text Book of Microbiology. S. Chand and Co., New Delhi.
- > Kumar, H. D. and Kumar, S. 1998. Modern Concepts of Microbiology. Vikas publishing house Pvt. Ltd., New Delhi.
- > Madahar, C. L. 2001. Introduction of Bacteria. Mc Graw Hill Edu. Pvt. Ltd., London. Mckane, L. and Judy, K. 1996. Microbiology: Essentials and Applications. McGraw Hill, New York.
- > Pandey, S. N. and Trivedi, P. C. 2005. A text book of Fungi, Bacteria and Virus. Vikas Publishing House, New Delhi.
- > Pelczar, M.J. Microbiology. *5th edition*, Tata Mc Graw-Hill Co., New Delhi.
- > Prescott, L., Harley, J. and Klein, D. 2005. Microbiology. 6th edition, Tata Mc Graw-Hill Co., New Delhi.
- > Purohit, S. S. 2002. Microbiology. Agro. Bot. Publication, Jodhpur.
- > Sharma, P. D. 2003. Microbiology and Pathology. Rastogi Publication, Meerut. Singh, V. and Srivastava, V. 1998. Introduction of Bacteria. Vikas Publication, New Delhi.
- > Singh, R. P. 2010. Microbiology. Kalyani Publishers, New Delhi.

B.Sc. SEMESTER- I
Paper –II: Algae, Bryophyte and Lichens
Course Code: BOT-102

Max. Marks-35

30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO- 2 Algae ,Bryophytes and Lichen

Students understand the diversity of lower plant and their distinct features.

They understand the algal diversity and its industrial application.

They know about distinct classes of Lichen and their utilisation

They know about character, life cycle pattern,classification and economic importance of of Bryophyte.

UNIT I

8Hrs.

Algae: General characteristics,classification (Smith), diversity in habitat, range of thallus organization,types of flagella, photosynthetic pigments and reserve food material. Reproduction (vegetative, asexual and sexual), types of life cycles and Economic importance.

UNIT II

7Hrs.

General characteristics, thallus organization, cell structure, reproduction and life cycle of the following

-
Cynophyceae - *Nostoc*.

Chlorophyceae - *Volvox*, *Chara*.

Xanthophyceae- *Vaucheria*.

Phaeophyceae- *Ectocarpus*.

Rhodophyceae - *Polysiphonia*.

UNIT III

7 Hrs.

Bryophyta - General characteristic, classification, habitat range, thallus structure, reproduction, alternation of generation and Economic importance.

Habitat, structure, reproduction and life cycle of the following:

Hepaticopsida – *Riccia*, *Marchantia*.

UNIT IV

8 Hrs.

Habitat, structure, reproduction and life cycle of the following-

Anthoceropsida - *Anthoceros*.

Bryopsida - *Funaria*

Lichens: General characters, habitat, types, structure, reproduction, economic and ecological importance (as colonizers).

Suggested Readings

- > Bold, H. C. and Wayne, M. J. 1996. Introduction to Algae. 2nd Edition. Prentice Hall, Inc. Englewood Cliffs, New Jersey.
- > Ghemawat, M. S., Kapoor, J. N. and Narayan, H. S. 1976. A Text book of Algae. Ramesh Book Depot., Jaipur. Gilbert, M. S. 1985. Cryptogamic Botany. Vol. I and II second edition. Tata McGra Hill Publishing Co. Ltd., New Delhi.
- > Kumar, H. D. 1998. Introductory Phycology. Affiliated East-West Press Ltd., New York.
- > Lee, R.E. 2008. Phycology. Fourth Edition, Cambridge University Press, USA. Sambamurthy, A.V.S.S. 2006. A Textbook of Algae. I. K. International Pvt. Ltd., New Delhi.
- > Chopra, R.N. and Kumar, P.K. 1988. Biology of Bryophytes. Wiley Eastern Ltd. New Delhi.
- > Pandey, S.N., Mishra, S.P. and Trivedi, P.S. 1981. A text book of Botany vol. II, Vikas publishing House Pvt. Ltd, New Delhi.
- > Parihar, N.S. 1965. An Introduction to Bryophyta. Central Book Depot, Allhabad.

BOTANY PRACTICAL I

Maximum practical Marks	=	50 marks
Internal marks	=	20 Marks
External marks	=	30 Marks
		Credit-2

Study of the types of bacteria from temporary/permanent slides.

3. Introduction of techniques of slide preparation, stain preparation and staining.
4. Gram's staining of bacteria from curd.
5. To study sterilization techniques.
6. Preparation of microbiological culture media (potato dextrose agar, nutrient agar).
7. Isolation of bacteria from soil.
8. Measurement of number of microbial cells by the use of haemocytometer.
9. Study of vegetative and reproductive structures of: *Nostoc*, *Volvox*, *Chara*, *Voucheria*, *Ectocapus*, *Polysiphonia*.
10. Study of different types of lichens.
11. Study of habit, habitat, vegetative thallus organization and structure, reproductive structures of the following taxa through temporary mounts and permanent slides:
12. *Riccia*, *Marchantia*, *Anthoceros*, *Funaria*,

B.Sc. SEMESTER- II
Paper –I: Mycology and Plant Pathology

Course Code: BOT-201

Scheme of Examination

Max. Marks-35
30 hrs-Credits-2

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will consist four questions from each unit with internal choice. Each question will carry 7 marks

CO –3 Mycology and Plant Pathology

Students understand fungal diversity with their morphology, life cycles, disease caused by them etiology, symptoms and control measures and their application in various industries.

UNIT I

8 Hrs.

General characteristics, classification (Alexopoulos and Ainsworth's), thallus, cell structure, nutrition, asexual, sexual reproduction, homothallism, heterothallism and heterokaryosis.

Plant disease: Biotic and abiotic diseases, important symptoms caused by fungi, bacteria, virus and MLOs (Blight, mildew, Downy mildew and green ear, rust, smut, canker, mosaic, little leaf, gall) etc.

UNIT II

7 Hrs.

General characteristics, structure and life cycles/disease cycles of members of oomycetes and zygomycetes with special reference to the genera: *Albugo* (white rust disease), *Sclerospora* (Downy mildew/Green ear disease) and *Mucor*.

UNIT III

7 Hrs.

General characteristics, structure, reproduction, various types of fruiting bodies, life history/disease cycle of class Ascomycetes Basidiomycetes with special reference to the genera: *Aspergillus*, *Peziza*, *Puccinia* (Rust disease), *Agaricus*.

UNIT IV

8 Hrs.

General characteristics and structure and life cycle of class Deuteromycetes with special references to *Alternaria* (early blight of potato disease). Parasexual cycle, Sex degeneration in fungi and economic importance of fungi.

Suggested Readings:

- Alexopoulos, C.J. and Mims, C.V. 1988. Introductory Mycology. John Wiley and Sons, New York.
- Dubey, H.C. 1989. Fungi. Rastogi publication, Meerut.
- Pandey, S. N. and Trivedi, P. S. 1994. A text book of Fungi, Bacteria and Virus. Vikas Publishing House, New Delhi.
- Sarabhai, R.C. and Saxena, R.C. 1990. A textbook Botany, Rastogi publication, Meerut
- Vashishta, B. R. 2001. Botany for degree student's Fungi. S. Chand and company, New Delhi.
- Webster, J. and Weber R. 2007. Introduction to Fungi. 3 Press, Cambridge.

B.Sc. SEMESTER- II
Paper –II: CELL BIOLOGY, GENETICS, AND PLANT BREEDING
Course Code: BOT-202

Max. Marks-35
30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO4 - Cell Biology, Genetics and Plant Breeding

Students Understand the structure of cell organelles, their functions and cell cycle in detail

With this they understand types of cell division.

Basic concept of Genetics and Plant breeding

UNIT -I

8Hrs.

The Cell: History of cell and cell theory, elementary idea on micrometry and cell fractionation, cell size and cell structure of Prokaryotic and Eukaryotic cells.

Cell wall and Plasma Membrane: Ultrastructure and functions of the cell wall; models of cell membrane organization; fluid mosaic model; chemical composition and functions of plasma membranes

Cytoskeleton: Role and structure of microtubules, microfilaments, and intermediary filament.

UNIT-II

8Hrs.

Structure, and function of Mitochondria and chloroplast, Golgi complex and Endoplasmic reticulum, Ribosome, Vacuoles, Peroxisomes, and Glyoxysomes.

Nuclear Organization: Ultra-structure; nuclear envelope and nuclear pore complex; nuclear lamina, nuclear matrix, and nucleoplasm; molecular organization of chromatin: DNA and histones; nucleosome and higher levels of the organization.

Cell Division: Mitosis and Meiosis and their importance

UNIT-III

7Hrs.

Mendelian Genetics: Mendel's Laws of Inheritance, Back cross and test cross,

Allelic and Non-allelic Interaction: Codominance and incomplete dominance and epistasis, Multiple allelism.

Linkage, Crossing Over, and Chromosome Mapping: Coupling and repulsion phases; recombination frequency, linkage map.

Preliminary study of Maternal Influence: *Kappa* particles in *Paramecium*,

Mutation: Types, transitions, transversions, and frame-shift mutations. Mutagens - Physical and Chemical mutagens, Structural Aberrations: **Chromosomal Alterations:** Duplications, deletions, inversions, and translocations. Brief account on numerical changes in chromosomes.

Plant Breeding: Introduction, objectives of plant breeding. Types of plant reproduction: vegetative, sexual, green revolution.

Methods of Plant improvement: Pure line, mass and clonal selection; hybridization in self and cross-pollinated crops; introduction and acclimatization; hybrid vigor and inbreeding depression, National and International agriculture research institute, Famous plant breeders and their contribution (Indian and International).

Suggested Readings:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics. John Wiley & sons, India. 8th edition.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
- Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
- Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition. 52
- Acquah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing
- Alberts, B., Johnson, A., Lewis, J., Roff, M., Roberts, K. and Walter, P., 2008. Molecular Biology of the Cell. Garland Publishers, New York.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Gupta, P.K. 2009. Cytology, Genetics, Evolution and Plant breeding, Rastogi publication, Meerut.
- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley and Sons. Inc. New Jersey, USA.
- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M., Scott, P.M., Zipursky, L. and Darnell, J. 2008. Molecular Cell Biology. W. H. Freeman and company, Macmillan publishers, London.
- Roy, S.C. and De, K.K. 1999. Cell biology. New central Book Agency (P) Ltd., Calcutta.
- Verma, P.S. and Agrawal, V.K. 2012. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Co. Ltd., New Delhi.
- Brooker, R. J. 1999. Genetics: Analysis and Principles. Addison-Wesley, Boston.
- Choudhary, H. K. 1989. Elementary Principle of Plant Breeding. Oxford and IBM Publishing Co., New Delhi.
- De Robertis, E. D. P. and De Robertis, E. M. F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Dnyansagar, V. R. 1986. Cytology and Genetics, Tata Mc Graw - Hill Pub Co. Ltd., New Delhi.
- Gardner, E. J., Simmons, M. J. and Snustad, D. P. 2008. Principles of Genetics. 8th Edition, Wiley India.
- Gupta, P. K. 2009. Cytology, Genetics, Evolution and Plant Breeding, Rastogi Publication, Meerut.
- Miglani, G. S. 2000. Advanced genetics. Narosa Publishing House, New Delhi.

- Shukla, R. S. and Chandel, P. S. 2000. Cytogenetics, Evolution and Plant Breeding, S. Chand and Co. Ltd., New Delhi.
- Singh, R. B. 1999. Text Book of Plant Breeding. Kalyani publishers, Ludhiana.
- Snustad, D. P., Simmons, M. J. 2011. Principles of Genetics. V Edition. John Wiley and Sons Inc. New Jersey USA.

BOTANY PRACTICAL II

Maximum practical Marks	=	50 marks
Internal marks	=	20 marks
External Practical Exam (duration 4 hrs.)	=	30 marks
		Credits-2

1. Preparation of slides and study of following genera through temporary mounts and permanent slides: *Albugo*, *Aspergillus*, *Peziza*, *Puccinia*, *Agaricus*, *Alternaria*.
2. Study of plant diseased specimens caused by fungi, viruses, bacteria, mycoplasma and nematodes.
3. Measurement of fungal extracellular enzymes.
4. Collection, identification and submission of minimum 3 diseased specimens.
5. Introduction of handling and maintenance of laboratory equipments.
6. The components, use and care of the bright field compound microscope and dissecting microscope.
7. Calibration of an ocular micrometer for different objectives (Low power & high power).
8. Measurement of cell size (length and breadth) by using ocular and stage micrometer.
9. Demonstration of the phenomenon of protoplasmic streaming in leaf.
10. To study chloroplast, chromoplast and leucoplast in plant material.
11. Isolation of mitochondria from cauliflower.
12. Study of Mitosis in root tip and Meiosis in flower bud from temporary and permanent slides.
13. Study the prokaryotic, eukaryotic cell and cell organelles by electron micro photographs.
14. To study the effect of organic solvent on membrane permeability.
15. Genetic problems on monohybrid, dihybrid cross, test cross and back cross.
16. Genetic problems on allelic and non allelic gene interactions, multiple alleles, blood group etc
17. Karyotype preparation.
18. Identification of chromosomes on the basis of their size and centomere position.
19. Pedigree analysis for dormant and recessive autosomal and sex linked traits.
20. Study of Barr body in epithelial cells of females.

B.Sc. SEMESTER-III

Paper –I: MOLECULAR BIOLOGY

Course Code: BOT-301

Max. Marks-35
30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO5 -Molecular Biology

Course explain the scope and importance of molecular biology.

They understand the structure of DNA, Packing of DNA and types of DNA, RNA.

DNA replication process, enzymes involved in that process.

UNIT I

7 Hrs

Salient features and structure of DNA and RNA, chemistry of DNA synthesis (Korenberg's discovery). DNA Replication (prokaryotes and eukaryotes) Synthesis of leading and lagging strands, Okazaki fragments, DNA Polymerases, DNA damage and molecular mechanism of repair.

UNIT –II

7 Hrs

Transcription in prokaryotes and eukaryotes (Initiation, Elongation and Termination), Promoter, RNA Polymerases, Transcriptional factors and Inhibitors, attenuation and antitermination, RNA Splicing and processing (concept of introns and exons, removal of Introns).

UNIT-III

8 Hrs

Translation (Initiation, Elongation and Termination) in Prokaryotes and Eukaryotes, Genetic code, Translational factors and inhibitors, Operon concept, regulation of gene expression in prokaryotes and eukaryotes. Extra nuclear genome: mitochondria and chloroplast.

UNIT-IV

8 Hrs

Southern, Northern and Western blotting, DNA fingerprinting, polymerase chain reaction, DNA sequencing methods (Sanger's & Maxam Gilbert Methods), DNA microarrays, Electrophoresis.

Suggested Readings:

- Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Brown, T. A. 2010. Gene cloning and DNA analysis: An Introduction. Blackwell Publication, USA.
- Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists., USA.
- Chrispeel, M.J. and Sadava, D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers, USA.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington, D.C. Sinauer Associates, MA.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Glick, B.R. and Pasternak, J.J. 2003. Molecular Biotechnology: Principles and Applications of recombinant DNA. ASM Press, Washington.
- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6 th edition. John Wiley and Sons. Inc. New jersey, USA.
- Mascarenhas, A.F. 1988. Hand book of Plant tissue culture. Publication and information. Div., ICAR, New Delhi.
- Purohit, S.S. and Mathur, S.K. 1996. Biotechnology Fundamental and Application. Agro Botanical Publisher, Bikaner.
- Razdan, M.K., 1993. An introduction to Plant tissue culture. Publication and Information Div., ICAR, New Delhi.
- Rana, S.V.S. 2012. Biotechnology theory and practice. (Third Ed.) Rastogi Publication, Meerut.
- Rastogi, V.B. 2008. Fundamentals of Molecular Biology. Ane Books, Meerut, India.
- Smith, R. H. 2000. Plant Tissue Culture: Techniques and Experiments. 2nd Academic Press, USA. edition,
- Upadhyaya, A. and Upadhyaya, K. 2005. Basic Molecular Biology. Himalaya Publishers. New Delhi.

E-Books

1. Advanced molecular biology, R.M. Twyman, Garland Science
2. Molecular biology of the cell, B. Alberts, Garland Science
3. Molecular biology, Clark and Pazdernik, Elsevier and academic press
4. Molecular biology of the gene- 7 th ed, James Watson
5. Pearson education, Molecular cell biology, Lodish Darnell -5 th ed, W H freeman

B. Sc. SEMESTER- III
PAPER: II: BIOTECHNOLOGY
Course Code: BOT-302

Max. Marks-35
30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO 6-Biotechnology

Course explain about the terminologies related to plant biotechnology.

Basic concept of Biotechnology, techniques of sterilisation, method of Tissue culture, various types of cultures, protoplasm isolation, fusion techniques and their applications

UNIT I

7Hrs.

Biotechnology: Functional definition. Basic aspects of Plant tissue culture, Basal medium, Media preparation and aseptic culture technique. Concept of cellular totipotency, Differentiation and morphogenesis. Micropropagation and synthetic seeds.

UNIT II

7Hrs.

Protoplast isolation, culture and Somatic cell hybridization, Androgenesis and its importance, Gynogenesis, Somaclonal variation, Somatic embryogenesis, Clonal propagation, Applications of Plant tissue culture,

UNIT III

8Hrs.

Recombinant DNA technology: Techniques used in rDNA technology. Restriction enzymes. Vectors for gene transfer. Plasmids and Cosmids. Genomic and c-DNA library, RFLP, RAPD, AFLP, Transgenic plants, Application of transgenic plants: Bt cotton, Golden rice, Selectable markers and reporter genes, method of gene delivery, Agrobacterium mediated gene transfer,

UNIT IV

8 Hrs.

Medical Biotechnology: Disease diagnosis - Infectious diseases and genetic diseases; Therapeutics- Antisense oligonucleotides, RNAi as therapeutics; Endogenous therapeutics - insulin, somatostatin, interferons, vaccines, gene therapy, stem cells and their relevance, Industrial Biotechnology: Large scale production of alcohol and antibiotics.

Suggested Readings:

- Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Brown, T. A. 2010. Gene cloning and DNA analysis: An Introduction. Blackwell Publication, USA.
- Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists., USA.
- Chrispeel, M.J. and Sadava, D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers, USA.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5 ASM Press and Sunderland, Washington, D.C. Sinauer Associates, MA. th edition.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Glick, B.R. and Pasternak, J.J. 2003. Molecular Biotechnology: Principles and Applications of recombinant DNA. ASM Press, Washington.
- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6 th edition. John Wiley and Sons. Inc. New jersey, USA. 20

BOTANY PRACTICAL III

Maximum practical Marks	=	50 marks
Internal marks	=	20 marks
External Practical Exam (duration 4 hrs.)	=	30 marks
		Credits-2

1. Preparation of medium and sterilization methods.
2. Preparation of Murashige and Skoog (MS) media.
3. Preparation of artificial seeds.
4. Estimation of soluble protein from a selected plant and separation by SDS-PAGE.
5. Isolation of DNA from plant material.
6. Isolation of plasmid DNA together from *E. coli*.
7. Demonstration of gel electrophoresis.
8. Demonstration of Anther culture Technique.
9. Demonstration of callus culture Technique.

B. Sc. SEMESTER- IV
Paper-1 Pteridophyta, Gymnosperms and Paleobotany
Course Code-401

Scheme of Examination

Max. Marks-35
30 hrs-Credits-2

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO-7Pteridophytes,Gymnosperms and Paleobotany

Students understand morphology, anatomy life cycles pattern of Pteridophytes and Gymnosperms with special reference to Genera.course provide information about types of fossils,theory of fossilisation and detail of some specific form - Genera.

UNIT- I

8 Hrs.

Pteridophytes - General characteristics, Distribution, classifications, Types of stele, development of sporangia (eusporangiate and leptosporangiate) life cycle patterns and economic importance .

UNIT –II

7 Hrs.

Heterospory and seed habit, Apospory and Apogamy.

Morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum* and *Marsilea*.

UNIT-III

8 Hrs.

Gymnosperm: General characteristics, distribution, classification and economic importance. Affinities of Gymnosperms with Pteridophytes and Angiosperms.

Morphology, anatomy, reproduction and life cycle of *Cycas* and *Pinus*.

UNIT-IV

7 Hrs.

Morphology, anatomy, reproduction and life cycle of *Ephedra*.

Paleobotany: Geological time scale, fossil types and theories of fossilization, technique of study of fossils. Fossil pteridophyte - *Rhynia*, *Lepidodendron* , Fossil gymnosperm-*Williamsonia*.

Suggested Readings:

- > Bierhorst, D.W. 1971. Morphology of Vascular Plants. MacMillan Co., N.Y. and Collier-MacMillan Ltd., London.
- > Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
- > Singh, V., Pandey, P. C. and Jain, D. K .2013. A text book of Botany. IV edition, Rastogi publication, Meerut.
- > Sharma, O. P. 1990. Textbook of Pteridophyta, MacMillan India Ltd., Delhi.

- Vashishta, P.C. 1997. Botany for Degree Students- Pteridophyta. S. Chand and Company, New Delhi.
- Wilson, N. S. and Rothewall, G. W. 1993. Paleobotany and Evolution of Plants. (2nd Edition), Cambridge University Press, U. K.
- Bhatnagar, S. P. and Moitra, A. 1997. Gymnosperms. New Age International (P) Ltd., Publisher, New Delhi.
- Clark, D. L. 1976. Fossils, Palaeobotany and Evolution. W.M.C. Brown Company, New York.
- Meyen, S. V. 1978. Fundamentals of Palaeobotany. Chapman and Hall, London.
- Sharma, O. P. 1997. Gymnosperms. Pragati Prakashan, Meerut, India.
- Sporne, K. R. 2002. The Morphology of Gymnosperms. B. I. Pub. Pvt. Ltd. Mumbai, Kolkata, Delhi.
- Thomas, B. A. and Spice, R. A. 1986. The Evolution and Palaeobotany of land Plants. Publ. Crom. Helm London and Sydney.
- Vasishta P.C. 1980. Gymnosperms. S. Chand and Co. Ltd., New Delhi.

B.Sc. Semester IV

Paper-II: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Course Code: BOT-402

Scheme of Examination

Max. Marks-35
30 hrs-Credits-2

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO -8 Plant Physiology and Biochemistry

Course help in understanding, definition of various process related to water:

Osmosis, diffusion, Imbibition etc. Student understand processes of mineral nutrition, absorption of water, ascent of sap, Transpiration, mechanisms of water loss from plants. Photosynthesis and respiration in Plants. This course help in understanding various types of biomolecules and their metabolism, Plant growth regulators and their role in growth.

Unit-I

7Hrs

Water: Structure, physiochemical properties, importance to plant life, concept of water potential, Absorption and Transport of water, Ascent of sap, Transpiration, Stomatal movement, Factors affecting transpiration, Guttation.

Mineral nutrition: Essential micro and macro nutrients, their uptake, hydroponics and nutrient requirement deficiency and toxicity symptoms.

Transport of organic substances: Mechanism of Phloem transport, factors regulating the translocations of nutrients.

Unit-II

8Hrs

Photosynthesis: Photosynthetic apparatus, Pigments, light reaction: Photo system I and II, Photophosphorylation, C₃ & C₄ Cycle and CAM Pathway, Photorespiration, Factors affecting the photosynthesis.

Respiration: Aerobic and anaerobic respiration, RQ (Respiration Quotient), Glycolysis, Krebs cycle, Oxidative phosphorylation and factors affecting the respiration, Fermentation.

Unit-III

8Hrs

Enzymes: Structure, nomenclature and classification of enzyme, Characteristic of enzymes, mechanism of action, Carbohydrate, protein and lipid: Structure, classification and function.

Unit-IV

7Hrs

Phases of growth and development, seed germination, and mobilization of food reserves, Seed dormancy . Plant growth regulators: Structure, discovery biosynthesis, mode of action and Physiological effects of Auxins, Gibberellins, Cytokinins, Ethylene and ABA. Jasmonic acid and Brassinosteroids.

Plant movements, Biological clock, Photoperiodism, Vernalization and Physiology of flowering.

Suggested readings:

- Hopkins, W.G. and Huner, P. A. 2008. Introduction to Plant Physiology. John Wiley and Sons, USA.
- Jain, V.K. 2013. Fundamental of Plant Physiology. S. Chand and Company Ltd., New Delhi.
- Malik, C. P. and Srivastava A.K. 1982. Text book of Plant Physiology. Kalyani publication, New Delhi.
- Mukherjee S., Ghosh A. K. 2006. Plant Physiology. New Central Book Agency, Calcutta.
- Parashar, A. N. and Bhatia, K. N. 1985. Plant Physiology. Trueman Book Company, New Delhi.
- Sinha, R. K. 2007. Modern Plant Physiology. 2nd Edition Tata McGraw, New Delhi.
- Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
- Verma, S. K. and Verma, M. 2000. A Text book of Plant Physiology, Biochemistry and Biotechnology. S. Chand and co. Ltd., New Delhi.
- Verma, V. 2007. Text Book of Plant Physiology. ANE Books, India.
- Berg, J.M., Tymoczko, J.L., Stryer, L. 2006. Biochemistry. 6th Edition, W.H. Freeman and Company, New York.
- Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.
- Conn, E.E., Stumpf, P.K. and Bruening, G. 2006. Outlines of Biochemistry. 4th Edition, John Wiley and Sons Inc. New Jersey, USA.
- Elliot, W.H. and Elliot, D.C. 2009. Biochemistry and Molecular Biology. Oxford Publishers, India.
- Hopkins, W.G. and Huner, P.A. 2008. Introduction to Plant Physiology. John Wiley and Sons, USA.
- Mukherjee, S., Ghosh, A.K. 2006. Plant Physiology. New Central Book Agency, Calcutta.
- Nelson, D.L. and Cox, M.M. 2004. Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
- Ranjit, K. 2008. Research methodology: A step by step guide for beginners. Pearson, India.
- Sinha R. K., 2007. Modern Plant Physiology. 2nd Edition Tata McGraw, New Delhi.
- Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition Sinauer Associates Inc. Publishers, Massachusetts, USA.
- Voet, D. and Voet, J.G. 2000. Biochemistry, John Wiley, New York.
- Wilson, K. and Walker, J. 2008. Principles and techniques of Biochemistry and Molecular Biology, Cambridge University Press

BOTANY PRACTICAL IV

Maximum practical Marks	=	50 marks
Internal marks	=	20 marks
External Practical Exam (duration 3 hrs.)	=	30 marks

Credits-2

1. Double staining technique and technique for preparation of permanent slides.
2. Study of following with the temporary slide preparation and specimens:
3. **Pteridophytes:** *Psilotum*, *Selaginella*, *Equisetum* and *Marselia* (Vegetative and reproductive).
4. **Gymnosperm:** *Cycas* (coralloid root, T.S. of coralloid root, T.S. of leaflet, petiole, male cone and L.S. of male cone, microsporophyll, megasporophyll, T.S. of microsporophyll, ovule, L.S. of ovule and seed).
5. *Pinus* (T.S. of stem and needle, male cone and female cone, L.S. of male cone and female cone, seed).
6. *Ephedra* (Stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed).
7. To determine the water potential of given plant material.
8. Demonstration of phenomenon of osmosis using potato osmoscope.
9. Demonstration of phenomenon of plasmolysis.
10. To determine the osmotic potential of vacuolar sap by plasmolytic method.
11. To study the permeability of plasma membrane using different concentration of organic solvents.
12. To study the effect of temperature on permeability of plasma membrane.
13. To demonstrate root pressure.
14. Study of effect of temperature on rate of transpiration.
15. Study of transpiration rate in dorsiventral and isobilateral leaves by use of potometer.
16. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophyte.
17. Study of the mechanism of stomatal opening and closing.
18. Rate of photosynthesis under varying HCO_3^- concentration in an aquatic plant using bicarbonate (Wilmott and Bubbler).
19. Demonstration of O_2 evolution during photosynthesis by inverted funnel method.
20. To study that light is necessary for photosynthesis by using ganong screen.

21. To demonstrate of anaerobic and aerobic respiration.
22. To study that CO_2 , light and chlorophyll is essential for photosynthesis (Moll's half experiment).
23. Study C_3 and C_4 plant with the kranz anatomy.
24. To study the R.Q. of different substrate by Ganong's respirometer.
25. Demonstration of O_2 evolution during aerobic respiration.
26. Preparation and applications of Phosphate buffers in biological studies.
27. Principle, working and use of colorimeter and spectrophotometer.
28. Principle, types and application of centrifuges.
29. Principle and types of Chromatography.
30. Separation of amino acids by paper chromatography and thin layer chromatography.
31. Microchemical tests for carbohydrates (Fehling's test, Benedicts test) and proteins (Ninhydrin test, Xanthoproteic test).
32. Separation of chlorophyll and carotenoid pigments by solvent method
33. Separation of chlorophyll and carotenoid pigments by paper chromatography.
34. Preparation of standard curve of protein for estimation of soluble proteins in plant materials by Lawry's method.
35. To study the activity of peroxidase, catalase and amylase enzyme.
36. Estimate chlorophyll and carotenoid content in C_3 and C_4 plant.
37. To test the presence of ascorbic acid in different plant juices.
38. Bioassay of plant growth hormone(auxin,gibberellins and cytokinin).
39. Measurement of growth using auxanometer.

B.Sc. Semester V
Paper I- Plant Anatomy and Embryology
Course Code-501

Scheme of Examination

Max. Marks-35
30 hrs-Credits-2

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

B.Sc. SEM IV Course:

CO- 9Plant Anatomy and Embryology

Students understand the importance of plant morphology in allied branches of botany

Students study the anatomical features of angiosperms root, stem and leaf.

Student know about the different tissues systems present in plant, their structure and role.

They understand the differences in internal organization of two distinct plant group dicot and Monocot. Students understand Secondary growth process in root and stem

Student know the different abnormalities in root and stem anatomy

Students understand the types and development of microspore, Megaspore. The Structure and development process of male and female gametophyte

Types of embryo Sac, Placentation types, structure of ovules, Dicot, Monocot embryo, seed and endosperm. This is to study the process of pollination and fertilisation.

Unit I

7 Hrs.

Meristematic and permanent tissues Root and shoot apical meristems; Simple and complex tissues Organs-Primary structure of dicot and monocot root stem and leaf.

Unit II

7 Hrs.

Secondary Growth: Cambium – structure and functions, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). Primary and secondary abnormalities with suitable examples. Adaptive and protective systems Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit III

8 Hrs.

Structural organization of flower, Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultra structure of mature embryo sac. Pollination and fertilization

Unit IV

8 Hrs.

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. Embryo and endosperm: Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm Relationship.

Suggested readings:

- Cuttler, E.G. 1971. Plant Anatomy. Part III Organs, Edward Arnold Ltd., London.
- Cuttler, E.G. 1969. Plant Anatomy. Part I Cells and Tissue. Edward Arnold Ltd., London.
- Eames, A.J. and MacDaniels, L.H. 1987. An Introduction to Plant Anatomy. Tata MacGraw-Hill Publishing Company Ltd., New Delhi.
- Esau, k. 1985. Plant Anatomy. 2nd Edition Wiley Eastern, New Delhi.
- Fahn, A. 1997. Plant Anatomy. Aditya Books (P) Ltd., New Delhi.
- Fahn, A. 2000. Plant Anatomy. Permagon Press.
- Gifford, E.M. And Foster, A.S. 1989. Morphology and Evolution of Vascular Plants. W.H. Freeman, New York.
- Pandey, S.N. and Chadha, A. 2014. A text book of Botany- Plant anatomy and Economic Botany. Vikas publishing house Pvt. Ltd, New Delhi.
- Vashishta, P.C. 1974. Plant Anatomy. Pradeep Publication, Jalandhar.
- Singh, V.P., Pandey, P.C. and Jain, D.K. 2011. A Text book of Botany- plant Morphology and anatomy. Rastogi Publication, Merrut.
- Trivedi, P.C., Sharma, N. and Dhankad, R. S. 2009. Plant Morphology and Anatomy. Ramesh Book Depot. Jaipur.
- Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication Ltd. New Delhi.
- Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

B.Sc. Semester V

Paper –II: PLANT SYSTEMATICS

Course Code: BOT- 502(A)

Scheme of Examination

**Max. Marks-35
30 hrs-Credits-2**

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO-10 Plant Systematics

Course provide knowledge of terminology of Taxonomy and distinguish features of different families. Students learn Plant collection, preservation techniques and can identify plant in field.

UNIT I

7 Hrs.

Scope and importance of taxonomy, history and classification of angiosperm (Linneaus, Bentham and Hooker and Engler and Prantl), brief reference of angiosperm phylogeny group (APG III) classification, concept of species, genus and family. Taxonomic tools: Herbarium, E- Flora, botanical garden, monograph, journals, key and icons.

UNIT II

7 Hrs.

Principle and rules of botanical nomenclature: Ranks, names, type method, author citation, valid publication, principle of priority and its limitations.

Taxonomic studies of the following families (Bentham and Hooker): Ranunculaceae, Brassicaceae, Malvaceae, Myrtaceae

UNIT III

8Hrs.

Taxonomic evidences from morphology, anatomy, palynology, cytology, phytochemistry, embryology, genome analysis and nucleic acid hybridization and taximetrics. Taxonomic studies of the following families (Bentham and Hooker),Dicots: Fabaceae, Asteraceae, Apocyanaceae and Asclepiadaceae.

UNIT IV

8 Hrs.

Taxonomic studies of the following families (Bentham and Hooker): Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Arecaceae, Liliaceae and Poaceae.

Suggested readings:

Suggested readings:

- > Naik, V.N.2011. Taxonomy of Angiosperms. TATA McGraw Hill, New Delhi.
- > Pandey, S.N. and Misra, S.P. 2008. Taxonomy of Angiosperms. Ane Books India, New Delhi.

- Saxena, N.B. and Saxena, S. 2011. Plant Taxonomy. Pragati Prakashan, New Delhi.
- Sharma, B.D. 1984. Flora of India vol. I. Botanical Survey of India, Calcutta.
- Sharma, O.P. 1996. Plant Taxonomy. TATA McGraw Hill, New Delhi
- Simpson, M.C. 2006. Plant Systematics. Elsevier, Amsterdam.
- Singh, G. 2001. Plant systematics. Oxford and IBH, New Delhi.
- Sivarajan, V.V. 1991. Introduction to Principles of Plant Taxonomy. Oxford and IBH, New Delhi

B.Sc. Semester V
Paper-II Natural Resources management

Course Code: BOT-502-B

Max. Marks-35

30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO -11 Natural Resource Management

This paper help in understanding the various types of natural resources (renewable and Non renewable),uses and their conservation strategies.

Unit I **8 Hrs**

Classification of Natural Resources: Renewable and non- renewable resources, Classes of earth resources, resource regions. Definition and criteria: Resource degradation, Depletion of Natural resources

Unit II **8 Hrs**

Non mineral resources: Land, Land use classification, Planning, land degradation. Soil: Soil formation and Profile. Water: Classification and characteristics of water resources. Bioresources: Plants, animals and microorganisms. Forest resources: Timber and non- timber resources, Agricultural resources.

Unit III **7Hrs**

Mineral resources: Ores, reserves and formation and classification of mineral deposits. Fuel resources: Fossil fuel. Coal, petroleum and natural gas. Marine resources.

Unit IV **7Hrs**

Natural resource Management: Preservation, conservation and restoration. Sustainable management of resources, mine reclamation practices, Water conservation methods.

Suggested Readings:

- Energy and Environment, V K Ahluwalia The Energy and Resources Institute(TERI)
- Energy, the Environment, and Sustainability, Efstathios E. Michaelides, CRC Press
- Sustainable Energy and Environment: An Earth System Approach, Sandeep Narayan Kundu, Muhammad Nawaz, CRC Press

- Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, 1996
- Raven, P.H., Hassenzehl, D.M., Hager, M.C., Gift, N.Y. and Berg, L.R. (2015). Environment, 9 th Edition. Wiley Publishing, USA.
- Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
- Kaushik, Anubha and Kaushik, C.P. (2018) Perspectives in Environmental Studies
- Bharucha, Erach Textbook of Environmental Studies for Undergraduate Courses (2018)
- Sharma, P.D. Fundamentals of Ecology. Rastogi Publications.

BOTANY PRACTICAL V

Maximum practical Marks	=	50 marks
Internal marks	=	20 marks
External Practical Exam (duration 3 hrs.)	=	30 marks
		Credits-2

Laboratories Exercises

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, phloem (Permanent slides, photographs).
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultra structure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).

12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.
14. Study of fossil specimens.
15. Study of vegetative and floral characters of species of the families studied in theory.
16. Identification of selected taxa up to genus using taxonomic keys.
17. Herbarium technique.
18. Familiarity with local flora and preparation of herbarium sheet.
19. Practical Exercise related to natural resource management and conservation policies.

B.Sc. Semester VI
Paper-I Ecology
Course Code: BOT-601

Max. Marks-35

30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO -12 Ecology

This paper will acquaint the students about the concept and basic principles of ecology, the diversity at biological levels, concept of Population and community, environmental factors (biotic and Abiotic) population interactions, Structure and function of ecosystem, biogeochemical cycles.

Student understand various environmental policies and act for protection and conservation.

Students will know how the vegetation pattern change in different ecosystem.

Students will learn the techniques of vegetation studies and its application.

UNIT I

8 Hrs.

Environment and plant: Ecological factors; Atmosphere (four distinct zone), light (photosynthetically active radiation, zonation in water bodies, photoperiodism, heliophytes and sciophytes), temperature (Raunkier's classification of plant: megatherms, mesotherms, microtherms, heikistotherms, thermos periodicity and vernalisation), soil (development, soil profile, properties).

UNIT II

7Hrs.

Population ecology: Characteristics, growth curve, ecotypes, ecads. Population interaction among organisms. Community characteristics, frequency, density, biological spectrum, ecological succession (Hydrosere, Psammosere and xerosere), concept of climax.

UNIT III

6 Hrs.

Ecosystem: Structure, components, food chain, food web, energy flow, trophic levels and ecological pyramids, primary and secondary productivity. Biogeochemical cycle of carbon, nitrogen and phosphorus.

UNIT IV

9 Hrs.

Pollution- air, water and soil. WWF, chipko movement, greenhouse effect, ozone depletion, loss of biodiversity and extinction of species, red data book. Efforts of Environment Management by Vienna Convention, Montreal Protocol, Earth summit, Kyoto Protocol, World Summit on sustainable development.

Suggested Readings:

- Banerjee, P.K. 2006. Introduction to Biostatistics. S. Chand and Co., New Delhi.
- Koromondy, E.J.1996. Concepts of Ecology. New Delhi. 4th Edition Prentice-Hall of India Pvt. Ltd.,
- Misra, K.C. 1988. Manuals of Plant Ecology. (3 rdEdition) Oxford and IBH Publishing Co., New Delhi.
- Odum, E.P. 1983. Basic Ecology. 5th Edition Thomson Business International Waldis Pvt. Ltd., Baricahd.
- Odum, E.P. 2008. Ecology. Oxford and IBH Publisher.
- Sharma, P.D. 2010. Ecology and Environment, (8th Edition) Rastogi Publications, Meerut.
- Singh, J.S., Singh, S.P. and Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi.

B. Sc. SEMESTER- VI
Paper –II : Biostatistics
Course Code: BOT-602- A

Max. Marks-35

30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO -13 Biostatistic

This paper impart the knowledge of statistics to solve the various mathematical problems. Also this course will help the students to understand the importance of statistical methods in the scientific research field further.

Unit I

8 Hrs

Introduction to Biostatistics, Definition, Statistical terms - Population, sample, primary and secondary data, qualitative and quantitative data, variables, discrete and continuous variables and statistical error. Sampling Techniques, Introduction, Methods of Sampling - Serial Random Sampling and Stratified Sampling.

Unit II

7Hrs

Diagrammatic and Graphic Representation of Data, Introduction, Diagrammatic representation of data - Bar diagram and Pie diagram, Measures of Central Tendency, Introduction, Calculation of arithmetic mean, median, and mode in an ungrouped data

Unit III

7 Hrs

Measures of Dispersion, Introduction, Methods of measuring dispersion A. Range - Characteristic of Range and coefficient of range B. Variance and Standard Deviation - Calculation of Standard Deviation and coefficient of Variation

Unit IV

8 Hrs

Test of Significance, Introduction, laying down of hypothesis - Null hypothesis, Alternative hypothesis and level of significance, Test based on normal distribution [Large sample test]. Testing one population mean. Testing equality of two population mean, Student's t-test [Small sample test]. Testing one population mean. Testing equality of two population mean. Paired t-test, Chi-Square test as a test of goodness of fit and its significance.

Suggested Readings:

- > Bisen, P. S. and ShrutiMathur, Life Science in Tools and Techniques.
- > Marimuthu, R., Microscopy and Microtechnique.
- > Sharma, V.K., Techniques in Microscopy and Cell Biology.
- > Prasad and Prasad, Outlines of Microtechnique.
- > Srivastava, Sharad and Singhal. Vineeta, Laboratory Methods in Microbiology.

- Annie and Arumugam, Biochemistry and Biophysics.
- Sass, John E., Botanical Microtechnique.
- Pranab Kumar Banerjee, Introduction to Biostatistics.
- Khan and Khanum, Fundamentals of Biostatistics.
- Mahajan, B. K., Methods in Biostatistics for medical students and research workers.
- Parikh, M. N. and Nithya Gogtay, ABC of Research Methodology and Applied Biostatistics.
- K. Viswesara Rao, Biostatistics in Brief.
- Wayne W. Daniel, Biostatistics - Basic Concepts and Methodology for the Health Sciences.
- Agarwal, B. L., Basic Statistics.
- B. Antonisamy, Solomon Chrostopher and P. Prasanna Samuel, Biostatistics - Principle and Practice.
- Sundar Rao, P.S.S. and Richards J, Introduction to Biostatistics and Research Methods. 17. Neil
- Weiss, Introductory Statistics.

B. Sc. SEMESTER- VI
Paper –II: Economic Botany
Course Code: BOT-602- B

Max. Marks-35
30 hrs-Credits-2

Scheme of Examination

There will be two parts in end semester theory paper.

Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks.

CO -14 Economic Botany

This help in understanding economic value of angiosperm in terms of cereal, pulse, spice and condiments, fodder, and medicinal use etc.

UNIT I

8 Hrs

Centre of origin of cultivated plants (Vavilov), secondary centre of origin. History, origin, distribution, botany, cultivation and processing of cereals: Wheat, maize, rice and bajra. General account of pulses: Chana and moong.

UNIT II

8 Hrs.

General account and identification of spices and condiments (any five) of Rajasthan. dyes (*Indigo* and *Lawsonia*), beverages (tea and coffee), fumigatories and masticatories. fat and oil yielding plants (*Brassica* and *Cocus*).

UNIT III

8 Hrs.

History, cultivation, processing and economic use of sugar and rubber, fibre yielding plants (cotton and jute). Fat and oil yielding plants (*Brassica* and *Cocus*).

UNIT IV

6 Hrs.

General account and identification of locally available fruits, vegetable and ornamental plants. Characteristics and uses of timber yielding plants teak and sal. Identification and medicinal value of locally available medicinal plants (only five).

Suggested Readings

- > Gupta, S.K. and Kaushik, M.P. 1973. An Introduction to Economic Botany. K. Nath and Co., Meerut.
- > Hill, A.W. 1952. Economic Botany. McGraw Hill Book Co., New York.
- > Jain, S.K. 1981. Glimpses of Indian Ethnobotany. Oxford and IBH, New Delhi.
- > Jain, S.K. 1987. A Manual on Ethnobotany. Scientific Publisher, Jodhpur.
- > Prakash, G., Sharma, S. K. 1975. Introductory Economic Botany. Jai Prakash Nath and Cosec, Meerut.
- > Sambamurthy, A.V.V.S. and Subrahmanyam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd., New Delhi.

- > Sen, S. 1992. Economic botany. New Central Book Agency, Calcutta.
- > Singh, V., Pandey, P.C. and Jain, D.K. 1998-99. Economic Botany. Rastogi Publications, Meerut.
- > Verma, V. 1974. A Text Book of Economic Botany. Emkay Publications, New Delhi.

BOTANY PRACTICAL VI

Maximum practical Marks	=	50 marks
Internal marks	=	20 marks
External Practical Exam (duration 3 hrs.)	=	30 marks
Credits-2		

1. Study of adaptive anatomical and morphological features of Hydrophytes, Epiphytes and Xerophytes using plant material.
2. Study of soil pH, soil moisture in relation to depth, bulk density, porosity and water holding capacity of different soil samples.
3. Determination of requisite size and number of quadrat for the study of plant community.
4. Study of structure of plant community by determining frequency, density and abundance of quadrat method.
5. Find out transparency of a water body by sacchi disc. Determine the dissolved oxygen content in polluted and unpolluted water samples.
6. To study different statistical methods: mean, median and mode, standard error, standard deviation.
7. Regression analysis and application of statistical tests in environmental problems.
8. Study following specimens with special reference to :
 1. Botany of the economically important part.
 2. Processing if any involved. Specimens of cereals, pulses, fibres, spices, beverage (tea, coffee), sugar, oil yielding plants and medicinal plants (mentioned in theory).
 3. Microchemical test for starch, sugar, oils, proteins, fat, carbohydrate, lignin using wheat, maize, soyabean. Chana, sweet potato, clove, ground nut, mustard and match sticks. Study of starch grains in potato and pea.
 4. Field trip to economically important place.

