

**S.S.JAIN SUBODH P.G. (Autonomous) COLLEGE, JAIPUR
(Affiliated to University of Rajasthan)**



SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

**Bachelor of Science
Subject: Botany**

Semester Structure: The details of the courses with code, title assign are as given below.

Duration: 6 Semesters (3 Years)

Semester –I

- BOT 101-Paper-I: Cell biology
- BOT 102-Paper-II: Microbiology
- BOT 103-Paper III: Algae and Lichens

BOT P I-Practical: Based on Theory Papers

Semester –II

- BOT 201-Paper-I: Genetics and Plant breeding
- BOT 202-Paper-II: Mycology and Plant Pathology
- BOT 203-Paper III: Bryophyta

BOT P II-Practical: Based on Theory Papers

Semester-III

- BOT 301-Paper-I: Molecular Biology
- BOT 302-Paper-II: Biotechnology
- BOT 303-Paper III: Plant Physiology I

BOT P III Practical: Based on Theory Papers

Semester –IV

- BOT 401-Paper-I: Pteridophytes
- BOT 402-Paper-II: Gymnosperms and Paleobotany
- BOT 403-Paper III: Plant Physiology II and Biochemistry

BOT P IV-Practical: Based on Theory Papers

Semester –V

- BOT 501-Paper-I: Morphology of Angiosperms
- BOT 502-Paper-II: Anatomy of Flowering Plants
- BOT 503-Paper III: Plant Systematics

BOT P V-Practical: Based on Theory Papers

Semester –VI

- BOT 601-Paper-I: Reproductive Biology of Angiosperms
- BOT 602-Paper-II Economic Botany and Ethanobotany
- BOT 603-Paper III Ecology

BOT P VI-Practical: Based on Theory Papers

B. Sc. I Semester

Max. Marks (Theory): 150

(Practical):75

Nomenclature			<i>EoSE</i>	CIA	Total Max. Marks	Total Mini. Marks
BOT 101	Paper I	Cell Biology	35	15	50	20
BOT 102	Paper II	Microbiology	35	15	50	20
BOT 103	Paper III	Algae and Lichen	35	15	50	20
					150	60
BOT P I Practical: Max. Marks 75			External	Internal	Total Max.	
			45	30	75	

B. Sc. II Semester

Max. Marks (Theory): 150

(Practical):75

Nomenclature			EoSE	CIA	Total Max. Marks	Total Mini. Marks
BOT 201	Paper I	Genetics and Plant Breeding	35	15	50	20
BOT 202	Paper II	Mycology and Plant Pathology	35	15	50	20
BOT 203	Paper III	Bryophyta	35	15	50	20
					150	60
BOT P II Practical: Max. Marks 75			External	Internal	Total Max.	
			45	30	75	

B. Sc. III Semester
Max. Marks (Theory): 150
(Practical):75

Nomenclature			EoSE	CIA	Total Max. Marks	Total Mini. Marks
BOT 301	Paper I	Molecular Biology	35	15	50	20
BOT 302	Paper II	Biotechnology	35	15	50	20
BOT 303	Paper III	Plant Physiology I	35	15	50	20
					150	60
BOT P III Practical: Max. Marks 75			External	Internal	Total Max.	
			45	30	75	

B. Sc. IV Semester
Max. Marks (Theory): 150
(Practical):75

Nomenclature			EoSE	CIA	Total Max. Marks	Total Mini. Marks
BOT 401	Paper I	Pteridophytes	35	15	50	20
BOT 402	Paper II	Gymnosperm and Paleobotany	35	15	50	20
BOT 403	Paper III	Plant physiology II and Biochemistry	35	15	50	20
					150	60
BOT P IV Practical: Max. Marks 75			External	Internal	Total Max.	
			45	30	75	

B. Sc. V Semester**Max. Marks (Theory): 150****(Practical):75**

Nomenclature			EoSE	CIA	Total Max. Marks	Total Mini. Marks
BOT 501	Paper I	Morphology of Angiosperms	35	15	50	20
BOT 502	Paper II	Anatomy of flowering plants	35	15	50	20
BOT 503	Paper III	Plant Systematic	35	15	50	20
					150	60
BOT P V Practical: Max. Marks 75			External	Internal	Total Max.	
			45	30	75	

B. Sc. VI Semester**Max. Marks (Theory): 150****(Practical):75**

Nomenclature			EoSE	CIA	Total Max. Marks	Total Mini. Marks
BOT 601	Paper I	Reproductive Biology of Angiosperms	35	15	50	20
BOT 602	Paper II	Economic Botany and Ethnobotany	35	15	50	20
BOT 603	Paper III	Ecology	35	15	50	20
					150	60
BOT P VI Practical: Max. Marks 75			External	Internal	Total Max.	
			45	30	75	

* EoSE- End of Semester Examination

* CIA - Cumulative Internal Assessment

SEMESTER I
Paper I: CELL BIOLOGY
Course Code: BOT-101

Max. Marks: 35
30Hrs.

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.

UNIT I: 7 Hrs.

History of cell and cell theory, microscopy, elementary idea on micrometry and cell fractionation, characteristics of prokaryotic and eukaryotic cell, chemistry, structure and function of cell wall and plasma membrane.

UNIT II: 8 Hrs.

Ultra structure and function of Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, Peroxisome, Glyoxysome, Ribosome, Vacuoles.

UNIT III: 7Hrs.

Detailed structure and function of Nucleus, nuclear envelope, nuclear pore complex and nucleolus. Chromatin Structure, morphology and organization of chromosomes. Special types of chromosomes - Sex chromosomes, polytene and lampbrush chromosomes.

UNIT IV: 8 Hrs.

Cell cycle and Cell division: Amitosis, Mitosis: different stages, mitotic spindle and chromosome movement in detail, Meiosis I and II: different stages and its significance, cytokinesis, General account of chiasmata formation, crossing over, linkage and synaptonemal complex.

Suggested Readings:

- 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.

SEMESTER- I
Paper –II: MICROBIOLOGY
Course Code: BOT-102

Max. Marks: 35

30 Hrs

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.

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, microbial nutrition and scope of microbiology

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, Cyanobacteria: Cell structure, reproduction and life history of *Nostoc*.

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, Mycoplasma: Occurrence, morphology, reproduction and importance.

UNIT IV: 7 Hrs.

Economic importance of bacteria with special reference to their role in agriculture, industry, waste management and biocontrol. Economic importance of viruses with special reference to vaccine production, role in research and medicine. Probiotics. Basic concept of food spoilage and food preservation.

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.

SEMESTER- I
Paper –III: ALGAE AND LICHENS
Course Code: BOT-103

Max. Marks: 35
30 Hrs

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.

UNIT I: 8 Hrs.

General characters, classification of algae (Fritsch, Smith), diversity in habitat, range of vegetative thallus organization, cell structure photosynthetic pigments and reserve food material, Reproduction: vegetative, asexual and sexual, evolution of sex in algae, types of life cycles.

UNIT II: 8 Hrs.

Chlorophyceae: General characteristics, thallus organization, cell structure, reproduction and life cycle of *Chlamydomonas*, *Volvox*, *Chara*.

Xanthophyceae: General characteristics, *Vaucheria*: Thallus organization, cell structure, reproduction and life cycle.

UNIT III: 7 Hrs.

Phaeophyceae: General characteristics, *Ectocarpus*: Thallus organisation, cell structure, reproduction and life cycle.

Rhodophyceae: General characteristics, *Polysiphonia*: Thallus organisation, cell structure, reproduction and life cycle.

UNIT IV: 7 Hrs.

Economic importance of algae, isolation and culture of algae. Lichens: General characters, types, structure, multiplication, reproduction and economic importance, its importance as colonizers and indicators of environment.

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 McGraw 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.

- Singh.V., Pandey, P. C. and Jain, D. K. 2001. A Text book of Botany. Rastogi Publication, Meerut.
- Thakur, A. and Bassi, S., 2007. Diversity of microbes and Cryptogams. S. Chand and Co., New Delhi.
- Van den Hoek, C., Mann, D.J. and Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press., England.
- Vashitha, B. R. 2002. Botany for degree students (Algae and Bryophytes). S. Chand and Co. Ltd., New Delhi.

BOTANY PRACTICAL I

Maximum practical Marks	=	75 marks
Internal marks	=	30 Marks
External marks	=	45 Marks
		60 HOURS

1. Introduction of handling and maintenance of laboratory equipments.
2. The components, use and care of the bright field compound microscope and dissecting microscope.
3. Calibration of an ocular micrometer for different objectives (Low power & high power).
4. Measurement of cell size (length and breadth) by using ocular and stage micrometer.
5. Demonstration of the phenomenon of protoplasmic streaming in leaf.
- 6 To study chloroplast, chromoplast and leucoplast in plant material.
- 7 Isolation of mitochondria from cauliflower.
- 8 Study of Mitosis in root tip and Meiosis in flower bud from temporary and permanent slides.
- 9 Study the prokaryotic, eukaryotic cell and cell organelles by electron micro photographs.
- 10 To study the effect of organic solvent on membrane permeability.
- 11 Study of the types of bacteria from temporary/permanent slides.
- 12 Introduction of techniques of slide preparation, stain preparation and staining.
- 13 Gram's staining of bacteria from curd.
- 14 To study sterilization techniques.
- 15 Preparation of microbiological culture media (potato dextrose agar, nutrient agar).
- 16 Isolation of bacteria from soil.
- 17 Measurement of number of microbial cells by the use of haemocytometer.
- 18 Study of vegetative and reproductive structures of: *Nostoc*, *Chlamydomonas* *Volvox*, *Chara*, *Voucheria*, *Ectocapus*, *Polysiphonia*.
- 19 Study of different types of lichens.

SEMESTER- II
Paper –I: GENETICS AND PLANT BREEDING
Course Code: BOT-201

Max. Marks: 35

30 hrs.

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.

UNIT I:

7 Hrs.

Mendel's laws of inheritance- Dominancy, law of segregation, law of independent assortment, deviations from Mendel's laws; interaction of genes, incomplete dominance, codominance, lethal alleles, epistasis, pleiotropy, polygenic inheritance (grain color in wheat, corolla length in *Nicotiana tabacum*) and multiple allelism: ABO blood groups in human.

UNIT II:

8 Hrs.

Linkage, crossing over and chromosome mapping- interrelationships and importance. Linkage maps, chromosome theory of inheritance, sex determination and sex linked inheritance. Chromosomal aberrations: deletion, duplication, inversion, translocation, aneuploidy and polyploidy. Extra nuclear genome: mitochondrial and chloroplast.

UNIT III:

8 Hrs.

Concept of gene: *Neurospora* genetics- one gene one enzyme hypothesis. Brief account on fine structure of gene in eukaryotes and prokaryotes. Mutations- types of mutations, point mutation- transition, transversion and frame shift mutation. Physical and chemical mutagens.

Cytoplasmic inheritance: Maternal influence, shell coiling in snail, Kappa particles in *Paramecium*.

UNIT IV:

7 Hrs.

Plant breeding: Introduction and objectives of plant breeding , general methods of breeding - self-pollinated, cross pollinated and vegetative propagated crop plants : Introduction and acclimatization, selections and hybridizations, hybrid vigour and inbreeding depression, green revolution, Role of mutation and polyploidy in plant breeding, national and international agriculture research institute, famous plant breeders and their contribution (Indian and international), Plant breeding work done on wheat and rice in India.

Suggested Readings:

- 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.

SEMESTER- II
Paper –II: Mycology and Plant Pathology
Course Code: BOT-202

Max. Marks: 35
30 Hrs

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

UNIT I:

7 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 account of class chytridiomycetes, 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* (Downey mildew/Green ear disease) and *Pilobolus*.

UNIT III:

8 Hrs.

General characteristics, structure and life history/disease cycle of class Ascomycetes Basidiomycetes and Deuteromycetes with special reference to the genera: *Aspergillus*, *Saccharomyces*, *Claviceps* (ergot disease), *Peziza*, *Puccinia* (rust disease) and *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), *Cercospora* and *Colletotrichum*. 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 of 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. 3rd edition, Cambridge University Press, Cambridge.

SEMESTER- II
Paper –III: BRYOPHYTA
Course Code: BOT-302

Max. Marks: 35
30 Hrs

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.

UNIT I: **8 Hrs.**
Bryophytes: General characteristic, origin, evolution, classification (Eichler and Proskauer), habitat range, thallus structure, reproduction, alternation of generation and economic importance.

UNIT II: **7 Hrs.**
Habitat, structure, reproduction and life cycle of the following: Hepaticopsida; *Riccia* and *Marchantia*.

UNIT III: **7 Hrs.**
Habitat, structure, reproduction and life cycle of the following: Anthoceropsida; *Anthoceros*. Phylogenetic relationship with hepaticopsida and Bryopsida.

UNIT IV: **8 Hrs.**
Bryopsida: Habitat, structure, reproduction and life cycle of *Funaria* and *Sphagnum*. Sterilisation of sporogenous tissues in Bryophytes.

Suggested readings

- 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.
- Puri, P. 1985. Bryophytes. Atmaram and Sons, Delhi.
- Smith, G.M. 1938. Cryptogramic Botany Vol. II. Bryophytes and Pteridophytes. Mc Graw Hill Book Company, London.
- Sporne, K.R. 1967. The Morphology of Bryophytes. Hutchinson University Library, London.
- Tyagi, A. and Saxena, M. 2014. Algae, Lichens and Bryophyta, CBH, Jaipur
- Vashishta, B. R., Sinha, A. K. and Kumar, A. 2011. Botany for degree students, Bryophyta. S. Chand and Co. New Delhi.
- Watson E.V. 1971. The structure and life of Bryophytes. Hutchinson University Library, London.
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BOTANY PRACTICAL II

Maximum practical Marks	=	70 marks
Internal marks	=	30 marks
External Practical Exam (duration 3 hrs.)	=	45 marks
		60 HOURS

1. Genetic problems on monohybrid, dihybrid cross, test cross and back cross.
2. Genetic problems on allelic and non allelic gene interactions, multiple alleles, blood group etc
3. Karyotype preparation.
4. Identification of chromosomes on the basis of their size and centomere position.
5. Pedigree analysis for dormant and recessive autosomal and sex linked traits.
6. Study of Barr body in epithelial cells of females.
7. Nuclear staining of filamentous fungi.
8. Preparation of slides and study of following genera through temporary mounts and permanent slides:
Albugo, Pilobolus, Aspergillus, Claviceps, Peziza, Puccinia, Ustilago, Agaricus Alternaria .
9. Study of plant diseased specimens caused by fungi, viruses, bacteria, mycoplasma and nematodes.
10. Measurement of fungal extracellular enzymes.
11. Survey of structure for defense mechanisms- cuticle, wax, lignin, bark, thron, prickle, trichome.
12. Collection, identification and submission of minimum 3 diseased specimens.
13. Study of habit, habitat, vegetative thallus organization and structure, reproductive structures of the following taxa through temporary mounts and permanent slides:
Riccia, Marchantia, Anthoceros, Porella, Funaria, Sphagnum.

SEMESTER- III
Paper –I: MOLECULAR BIOLOGY
Course Code: BOT-301

Max. Marks: 35
30 Hrs

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.

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. 6th 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 edition, Academic Press, USA.
- Upadhyaya, A. and Upadhyaya, K. 2005. Basic Molecular Biology. Himalaya Publishers. New Delhi.

SEMESTER- III
PAPER: II : BIOTECHNOLOGY
Course Code: BOT-302

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, interferon's, 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. 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. 6th 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 edition, Academic Press, USA.
- Upadhyaya, A. and Upadhyaya, K. 2005. Basic Molecular Biology. Himalaya Publishers. New Delhi.

SEMESTER- III
Paper –III: PLANT PHYSIOLOGY I
Course Code: BOT-303

Max. Marks: 35
30 Hrs

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.

UNIT I: 8 hrs.

Structure and properties of water, osmosis, water potential and its components, absorption of water, root pressure, pathway of water movement; concepts of symplast and apoplast. Ascent of sap, mechanism of stomatal movements, factor affecting transpiration, its theories, mechanism and significance, antitranspirants and guttation.

UNIT II: 8 Hrs.

Transport of ions across cell, mechanism of active and passive transport, translocation of, macro and micro nutrients; role of essential nutrients in plant metabolism and their deficiency symptoms. Outline of Nitrogen and phosphorus cycle. Transamination and deamination.

UNIT III: 7 Hrs.

Photosynthesis, discovery and structure of pigments (chlorophyll and accessory pigment), light harvesting units, law of limiting factors. Light reaction- photophosphorylation- (cyclic and non cyclic), dark Reaction- Calvin and Benson cycle, Hatch and Slack pathway, Crassulacean acid metabolism and photorespiration.

UNIT IV: 7 Hrs.

Respiration: Aerobic and anaerobic, glycolysis, tricarboxylic acid cycle, oxidative phosphorylation, and factors affecting oxidative processes, pentose phosphate pathway, fermentation, Cyanide-resistant respiration.

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.

BOTANY PRACTICAL III

Maximum practical Marks	=	70 marks
Internal marks	=	30 marks
External Practical Exam (duration 3 hrs.)	=	45 marks
		60 HOURS

1. Preparation of Murashige and Skoog (MS) media.
2. Preparation of artificial seeds.
3. Estimation of soluble protein from a selected plant and separation by SDS-PAGE.
4. Isolation of plasmid DNA together from *E. coli*.
5. Demonstration of gel electrophoresis.
6. To determine the water potential of given plant material.
7. Demonstration of phenomenon of osmosis using potato osmoscope.
8. Demonstration of phenomenon of plasmolysis.
9. To determine the osmotic potential of vacuolar sap by plasmolytic method.
10. To study the permeability of plasma membrane using different concentration of organic solvents.
11. To study the effect of temperature on permeability of plasma membrane.
12. To demonstrate root pressure.
13. Study of effect of temperature on rate of transpiration.
14. Study of transpiration rate in dorsiventral and isobilateral leaves by use of potometer.
15. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophyte.
16. Study of the mechanism of stomatal opening and closing.
17. Rate of photosynthesis under varying HCO_3^- concentration in an aquatic plant using bicarbonate (Wilmott and Bubbler).
18. Demonstration of O_2 evolution during photosynthesis by inverted funnel method.
19. To study that light is necessary for photosynthesis by using ganong screen.
20. To demonstrate of anaerobic and aerobic respiration.
21. To study that CO_2 , light and chlorophyll is essential for photosynthesis (Moll's half experiment).
22. Study C_3 and C_4 plant with the kranz anatomy.
23. To study the R.Q. of different substrate by Ganong's respirometer.

24. Demonstration of O₂ evolution during aerobic respiration.

SEMESTER- IV
Paper –I: PTERIDOPHYTES
Course Code: BOT-401

Max. Marks: 35
30 Hrs

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.

UNIT I: 8 Hrs.

Pteridophytes: General account of Pteridophytes, origin, telome theory, classification (G.M. Smith), evolution of stele, development of sporangia (eusporangiate and leptosporangiate) and life cycle patterns of homosporus and heterosporus pteridophytes.

UNIT –II: 7 Hrs.

Heterospory and seed habit, Apospory and Apogamy. Evolutionary relationship of Pteridophytes. General characteristics of Psilotophyta: Morphology, anatomy and reproduction of *Psilotum*

UNIT-III: 8 Hrs.

General characteristic of Lycophyta and Sphenophyta: Morphology, anatomy and reproduction of *Seleginella* and *Equisetum*

UNIT-IV: 7 Hrs.

General characteristics of Filicophyta: Morphology, anatomy and reproduction of *Pteridium* and *Marsilea*. Economic importance of Pteridophytes.

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.

SEMESTER- IV
Paper II: GYMNOSPERMS AND PALEOBOTANY
Course Code: BOT-402

Max. Marks: 35
30 Hrs

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.

UNIT I: 7Hrs.

Gymnosperm: General characteristics, distribution, classification (K. R. Sporne, 1965) and economic importance. Brief account of Progymnosperm, affinities of Gymnosperms with Pteridophytes and Angiosperms.

UNIT: II 8Hrs

General characteristics of Cycadales, Coniferales: Morphology, anatomy, reproduction and life cycle with special reference to the genera *Cycas* and *Pinus*.

UNIT: III 8Hrs.

General characteristics of Ephedrales: Morphology, anatomy, reproduction and life cycle of *Ephedra*. Palaeobotany: Geological time scale, fossil types and their formation, technique of study of fossils.

UNIT IV: 7 Hrs.

General account of dominant fossils flora of different ages, palaeobotany in relation to exploration of fossil fuels. Primitive land plant: *Rhynia*, Fossil pteridophytes: reconstructed plant-*Lepidodendron* and *Calamites*, Fossil gymnosperm-*Williamsonia*.

Suggested Readings:

- 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.

SEMESTER- IV
Paper –III: PLANT PHYSIOLOGY II AND BIOCHEMISTRY
Course Code: BOT-403

Max. Marks: 35
30 Hrs

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.

UNIT I: 7 Hrs.

Seed dormancy and germination, phases of growth and development; plant movement and biological clock and their regulatory factor.

Growth hormones: Structure, biosynthesis, and physiological role of auxins, gibberellins.

UNIT II: 7 Hrs.

Structure, biosynthesis and physiological role of Cytokinin and Ethylene. Growth inhibitors: Abscisic acid, Brassinosteroids and jasmonic acid.

Physiology of Flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization. Discovery, chemical nature and role of phytochrome in photomorphogenesis and senescence.

UNIT III: 8 Hrs

Carbohydrates: Structure and classification into monosaccharides, oligosaccharides and polysaccharides. Glycoprotein and Glycolipids, Biosynthesis and degradation of sucrose and starch.

Lipids–Structure and classification of lipids, fatty acids- saturated and unsaturated, triacyl glycerols, phospholipids and sphingolipids, fatty acids biosynthesis, oxidation of fatty acids.

UNIT IV: 8 Hrs

Proteins- Amino acids as basic units, structure and classification of proteins (primary, secondary, tertiary and quaternary), conformation and denaturation.

Nomenclature and classification of enzyme feature of active sites substrate specificity, mechanism of action, Michaelis-Menten equation, enzyme inhibition and factor affecting enzyme activity.

Suggested Readings:

- 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	=	70 marks
Internal marks	=	30 marks
External Practical Exam (duration 3 hrs.)	=	45 marks

60 HOURS

1. Double staining technique and technique for preparation of permanent slides.
2. Study of following with the temporary slide preparation and specimens:
Pteridophytes: *Psilotum*, *Selaginella*, *Equisetum*, *Pteridium* and *Marselia* (Vegetative and reproductive).
3. **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).
4. *Pinus* (T.S. of stem and needle, male cone and female cone, L.S. of male cone and female cone, seed).
5. *Ephedra* (Stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed).
6. Study of fossil specimens.
7. Preparation and applications of Phosphate buffers in biological studies.
8. Principle, working and use of colorimeter and spectrophotometer.
9. Principle, types and application of centrifuges.
10. Principle and types of Chromatography.
11. Separation of amino acids by paper chromatography and thin layer chromatography.
12. Microchemical tests for carbohydrates (Fehling's test, Benedicts test) and proteins (Ninhydrin test, Xanthoproteic test).
13. Separation of chlorophyll and carotenoid pigments by solvent method
14. Separation of chlorophyll and carotenoid pigments by paper chromatography .
15. Preparation of standard curve of protein for estimation of soluble proteins in plant materials by Lawry's method.
16. To study the activity of peroxidase , catalase and amylase enzyme.
17. Estimate chlorophyll and carotenoid content in C3 and C4 plant.
18. To test the presence of ascorbic acid in different plant juices.
19. Bioassay of plant growth hormone(auxin,gibberellins and cytokinin).
20. Measurement of growth using auxanometer.

SEMESTER- V
Paper –I: MORPHOLOGY OF ANGIOSPERMS
Course Code: BOT-501

Max. Marks: 35
30 Hrs

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.

UNIT 1: 7 Hrs

Plant habit, the basic plan of flowering plants, modular types of growth, diversity of plant form in annuals, biennials and perennials, evolution of tree habit in gymnosperm, monocotyledons and dicotyledons, trees largest and longest lived plants. .

UNIT II: 8 Hrs.

Root: Structure of root, types and structural modification for storage, physiological and mechanical, interaction of root with other microorganisms.

Stem: Structure, types and modification (storage and mechanical), branching pattern, monopodial and sympodial growth, canopy architecture.

UNIT III: 7 Hrs.

Leaves: Origin, development, types, phyllotaxy, venation, lamina parts, shapes, size and modifications, leaf surface features and appendages, leaf surface area, stomata and trichome structure.

UNIT IV: 8 Hrs.

Flower: Flower as a modified shoot, detailed structure of flower, types of inflorescence and specialized inflorescence, fruit Structure, types and classification, detail structure of seed and seed coat (monocot and dicot), significance of seed, suspended animation, ecological adaptation, dispersal strategies.

Suggested readings:

- Eames, A. J. 1981. Morphology of Angiosperms .McGraw Hill, New York.
- Gifford, E.M. and Foster, A.S. 1989. Morphology and Evolution of Vascular Plants. W.H. Freeman, New York.
- Sporne, K.R. 1974. Morphology of Angiosperms. Hutchinson University Press, London.
- Singh, V.P., Pandey, P.C. and Jain, D.K. 2011. A Text book of Botany- Angiosperms. Rastogi Publication, Merrut.
- Trivedi, P.C., Sharma, N. and Dhankad, R. S. 2009. Plant Morphology and Anatomy. Ramesh Book Depot. Jaipur.

SEMESTER- V
Paper –II: ANATOMY OF FLOWERING PLANTS
Course Code: BOT-502

Max. Marks: 35
30 Hrs

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.

UNIT I: 8 Hrs.

Classification and structure of tissues; Simple tissue: Structure occurrence and function (parenchyma, collenchyma, sclerenchyma), Complex tissues: Structure, origin and function (xylem and phloem), tissue systems, Secretory tissues: Glands, glandular hairs, nectaries, hydathodes, schizogenous and lysigenous ducts, resin ducts, mucilage ducts and laticifers. Vascular bundle: Types (conjoint, collateral, bi-collateral, open closed, radial, concentric: amphicribal and amphivasal).

UNIT II: 7 Hrs.

Meristem definition, classification, types and function, Shoot apical meristem theories: Apical cell theory, histogen theory, tunica-carpus theory, continuing meristematic residue, cytohistological zonation. Root apical meristem theories: Apical cell theories, histogen theory, korper-kappe theory, quiescent cell theory,

UNIT III: 7 Hrs.

Stem: Primary structure in dicotyledonous and monocotyledonous, primary anomalous structures. Root: Primary structure in dicotyledonous and monocotyledonous, development of lateral roots and adventitious root. Root- stem transition. Leaf- Internal structure of dorsiventral, isobilateral and centric leaves.

UNIT IV: 8 Hrs.

Secondary growth in dicot and monocot stem. Secondary structures: Wood structure, types and formation of wood, annual rings, tyloses, dendrochronology, periderm, bark and lenticels. Anomalous secondary growth in dicot stem: *Boerhavia*, *Mirabilis*, *Bignonia*, *Leptadaenia*, *Salvadora*, *Bougainvillea*, *Amaranthus*, in monocot stem: *Dracaena* and in dicot roots: *Beta vulgaris* and *Ipomea batatas*.

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.

SEMESTER- V
Paper –III: PLANT SYSTEMATICS
Course Code: BOT-503

Max. Marks: 35
30 Hrs

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.

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 (APGIII) classification, concept of species, genus and family. Taxonomic tools: Herbarium, E-Flora, botanical garden, monograph, library index, 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 evidences from cytology, phytochemistry, embryology and taximetric. Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly and polyphyly)

UNIT III: 8Hrs.

Taxonomic studies of the following families (Bentham and Hooker), Dicots: Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Myrtaceae, Fabaceae, Apiaceae, Asteraceae, Apocynaceae and Asclepidaceae.

UNIT IV: 8 Hrs.

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

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.

BOTANY PRACTICAL V

Maximum practical Marks	=	70 marks
Internal marks	=	30 marks
External Practical Exam (duration 3 hrs.)	=	45 marks

1. Study of different modifications of root, stem, leaf by using specimens.
2. Study of different epidermal appendages (trichome etc.) by making slides.
3. Study of floral apex.
4. Survey and study of dispersal mechanism of seeds.
5. Microscopic studies on types and anatomy of stomata (monocotyledons and dicotyledons).
6. Study of apical and lateral meristem using plant material and slides
7. Anatomical study of root, stem and leaf (dicotyledons and monocotyledons) by making double stained temporary and permanent slides.
8. Anatomical studies of anomalous secondary structure in stem of *Mirabilis*, *Bignonia*, *Borhavia*, *Nyctanthus*, *Salvodora*, *Leptadenia*, *Dracena* by making temporary and permanent slides.
9. Anatomical study of dicot and monocot seed (Cicer, Maize and cotton)
10. Study of vegetative and floral characters of species of the families studied in theory.
11. Identification of selected taxa up to genus using taxonomic keys.
12. Herbarium technique.
13. Familiarity with local flora and preparation of herbarium sheet.

SEMESTER- VI
Paper –I: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS
Course Code: BOT-601

Max. Marks: 35
30 Hrs

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.

UNIT I: 7 Hrs.

Typical angiosperm flower, structure of anther, microsporogenesis, microgametogenesis, palynology and scope. Pollen wall protein; pollen viability and abnormal features; polyads, massulae, pollinia.

UNIT II: 8 Hrs.

Structure and types of ovule, special structures- aril, oburator etc., megasporogenesis, megagametogenesis (monosporic, bisporic and tetrasporic types), structure of typical embryo sac, (Polygonum, Allium and Adoxa type).

UNIT III: 7 Hrs.

Pollination types, significance adaptations; compatibility and incompatibility; basic concepts. Pollen tube entry, syngamy and triple fusion, double fertilization, development, type and function of endosperm.

UNIT IV: 8 Hrs.

Six types of Embryogeny; General pattern of development of dicot and monocot embryo; suspensor structure and function, embryo-endosperm relationship; nutrition of embryo, apomixis, polyembryony, fruit-development and maturation.

Suggested Readings

- Bhojwani, S.S. and Bhatnagar, S.P. 2004. The Embryology of Angiosperms. Vikas Publishing House, New Delhi.
- Davis, C.L. 1965. Systematic Embryology of Angiosperms. John Wiley, New York.
- Johri, B. D. 1984. Embryology of Angiosperms. Springer Verlag, Berlin.
- Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verlag, Netherlands.
- Maheswari, P. 1985. Introduction to Embryology of Angiosperms. Mac Graw Hill House (P) Ltd., New York.
- Raghavan, V. 2000. Developmental Biology of Flowering plants. Springer, Netherlands.
- Trivedi, P.C. Sharma, N. and Sharma, J. L. 2003. Structure, Development and reproduction in Flowering Plants. Ramesh Book Depot., Jaipur.

SEMESTER- VI
Paper –II: ECONOMIC BOTANY AND ETHNOBOTANY
Course Code: BOT-602

Max. Marks: 35
30 Hrs

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.

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. Identification and medicinal value of locally available medicinal plants (only five).

UNIT II: 8 Hrs.

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

UNIT III: 8 Hrs.

General account and identification of locally available fruits, vegetable and ornamental plant. History, cultivation, processing and economic use of sugar and rubber, fiber yielding plants (cotton and jute).

UNIT IV: 6 Hrs.

Ethnobotany and its concepts and relevance. Ethnobotanical areas of Rajasthan, ethnic groups in India and ethnobotanical study of any tribal area of Rajasthan. Ethical aspect of ethnobotany.

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.

SEMESTER- VI
Paper –III: ECOLOGY
Course Code: BOT-603

Max. Marks: 35
30 Hrs

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 question out of which four questions to be attempt with internal choice. Each question will carry 7 marks.

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: megatherm, mesotherm, microtherm, heikistotherm, thermoperiodicity and vernalisation), soil (development, soil profile, properties). Ecological adaptations of hydrophytes, xerophytes, epiphytes and halophytes. Population ecology: growth curve, ecotypes, ecads. Population interaction among organisms (neutralism, amensalism, alleliopathy), competition, predation, parasitism and mutulism.

UNIT II: 7Hrs.

Community characteristics, frequency, density, cover, life forms, biological spectrum, ecological succession. Ecosystem: Structure, components, food chain, food web, energy flow, trophic levels and ecological pyramids, primary and secondary productivity, biogeochemical cycle of carbon and phosphorus.

UNIT III: 7 Hrs.

Biogeographic regions of India, vegetation types of India; forest grassland with special reference to Rajasthan. Environmental pollution- air, water and soil, WWF, chipko movement, green house effect, ozone depletion loss of biodiversity and extinction of species, red data book.

UNIT IV: 8 Hrs.

Concept and principles of environmental management, principle of optimized use and sustainable development, threats to sustainable development, ecological footprint, National Environmental Policy, management of forest and degraded lands, concepts and principles of environmental management, efforts to control these effects (Vienna Convention, Montreal Protocol, Earth summit, Kyoto Protocol, World Summit on sustainable development, 2002 Carbon trade); IPCC.

Suggested Readings:

- Banerjee, P.K. 2006. Introduction to Biostatistics. S. Chand and Co., New Delhi.
- Koromondy, E.J.1996. Concepts of Ecology. 4th Edition Prentice-Hall of India Pvt. Ltd., New Delhi.
- Misra, K.C. 1988. Manuals of Plant Ecology. (3rd Edition) 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.

BOTANY PRACTICAL VI

Maximum practical Marks	=	70 marks
Internal marks	=	30 marks
External Practical Exam (duration 3 hrs.)	=	45 marks

1. Study different types of placentation, ovules and special structures of ovule through permanent slides, specimens or photographs.
2. Study of female gametophyte through permanent slides/ photographs: types and ultra structure of mature embryo sac.
3. Study of pollen grains: fresh and acetolyzed showing ornamentation and aperture, pseudomonads, pollinia (slides/photographs/ fresh materials).
4. Study of the different stages of anther development.
5. Study of pollen morphology of available plants.
6. Pollen germination test-
 - a. *In vitro* germination using sugar solution
 - b. Tetrazolium test
7. Study of monocotyledons and dicotyledons embryo of angiosperms through slides/photographs.
8. Dissect and display embryo at various developmental stages using mustard seeds.
9. Dissection of developing seeds for endosperm with free nuclear haustoria.
10. Submission of economically important plants and plant products (cereals, pulses, spices, fibers, condiments, fat and oils, tea, coffee, wood, dyes, tobacco).
11. Study following specimens with special reference to :
 1. Botany of the economically important part.
 2. Processing if any involved.
 3. Specimens of cereals, pulses, fibres, spices, beverage (tea, coffee), sugar, oil yielding plants and medicinal plants (mentioned in theory).
12. Microchemical test for starch, sugar, oils, proteins, fat, carbohydrate, lignin using wheat, maize, soyabean. Chana, sweet potato, clove, ground nut, mustard and match sticks.
13. Study of starch grains in potato and pea.
14. Field trip to economically important place.
15. Collection, description and submission of at least 5 plants of ethnobotanical importance.
16. Study of adaptive anatomical and morphological features of Hydrophytes, Epiphytes and Xerophytes using plant material.
17. Study of soil pH, soil moisture in relation to depth, bulk density, porosity and water holding capacity of different soil samples.
18. Determination of requisite size and number of quadrat for the study of plant community
19. Study of structure of plant community by determining frequency, density and abundance of quadrat method.
20. To study different statistical methods: mean, median and mode, standard error, standard deviation.
21. Regression analysis and application of statistical tests in environmental problems.
22. Find out transparency of a water body by secchi disc.
23. Determine the dissolved oxygen content in polluted and unpolluted water samples.

24. Field trip to a National Park/Biosphere reserve/Wild life Sanctuary (Student should submit a detailed project report based on the field trip. Evaluation of the project will be based on the detailed report and presentation).
25. Project work on a particular ecosystem/Polluted Site/ Level of Pollution in the City or Town/Land use site.