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 (Honours)

Semester Structure: The course details with codes and titles assigned are as given below.

Duration: 6 Semesters (3 Years)

Semester –I

BOT (H) 101-Paper-I: Cytology

BOT (H) 102-Paper-II: Algae and Lichens

BOT (H) 103-Paper III: Plant Physiology I

BOT (H) 104 -Paper IV: Ecology

BOT (H) P I-Practical: Based on Theory Papers

Semester –II

BOT (H) 201-Paper-I: Genetics and Plant Breeding

BOT (H) 202-Paper-II: Mycology

BOT (H) 203-Paper III: Plant Physiology II and Biochemistry

BOT (H) 204 -Paper IV: Bryophyta

BOT (H) P II-Practical: Based on Theory Papers

Semester-III

BOT (H) 301-Paper-I: Molecular Biology

BOT (H) 302-Paper-II: Pteridophyta

BOT (H) 303-Paper III: Morphology of Angiosperms

BOT (H) 304 -Paper IV: Microbiology

BOT (H) P III-Practical: Based on Theory Papers

Semester –IV

BOT (H) 401-Paper-I: Biotechniques and Biostatistics

BOT (H) 402-Paper-II: Gymnosperms and Paleobotany

BOT (H) 403-Paper III: Anatomy of Angiosperms

BOT (H) 404-Paper IV: Plant Pathology

BOT (H) P IV-Practical: Based on Theory Papers

Semester –V

BOT (H) 501-Paper-I: Plant Biotechnology

BOT (H) 502-Paper-II: Systematics of Angiosperms

BOT (H) 503-Paper III: Economic Botany

BOT (H) 504-Paper IV: Embryology of Angiosperms

BOT (H) P V-Practical: Based on Theory Papers

Semester –VI

BOT (H) 601-Paper-I: Genetic Engineering

BOT (H) 602-Paper-II: Ethnobotany

BOT (H) 603-Paper III: Biodiversity Conservation & Human Welfare

BOT (H) 604 -Paper- IV: Seed Science

BOT (H) P VI-Practical: Based on Theory Papers

B. Sc. (H) I Semester
Max. Marks (Theory): 300
(Practical):150
Grand total: 450

Nomenclature			**EoSE**	**CIA**	**Total Max. Marks**	**Total Min. Marks**
BOT (H) 101	Paper-I	Cytology	54	21	75	30
BOT (H) 102	Paper-II	Algae and Lichens	54	21	75	30
BOT (H) 103	Paper-III	Plant Physiology I	54	21	75	30
BOT (H) 104	Paper-IV	Ecology	54	21	75	30
BOT (H) P I – Practical			External	Internal	Total Max.	
			90	60	150	

B. Sc. (H) II Semester
Max. Marks (Theory): 300
(Practical):150
Grand total: 450

Nomenclature			**EoSE**	**CIA**	**Total Max. Marks**	**Total Min. Marks**
BOT (H) 201	Paper-I	Genetics and Plant Breeding	54	21	75	30
BOT (H) 202	Paper-II	Mycology	54	21	75	30
BOT (H) 203	Paper-III	Plant Physiology II & Biochemistry	54	21	75	30
BOT (H) 204	Paper-IV	Bryophyta	54	21	75	30
BOT (H) P II - Practical			External	Internal	Total Max.	
			90	60	150	

B. Sc. (H) III Semester
Max. Marks (Theory): 300
(Practical):150
Grand total: 450

Nomenclature			EoSE	CIA	Total Max Marks	Total Min. Marks
BOT (H) 301	Paper-I	Molecular Biology	54	21	75	30
BOT (H) 302	Paper-II	Pteridophyta	54	21	75	30
BOT (H) 303	Paper-III	Morphology of Angiosperms	54	21	75	30
BOT (H) 304	Paper-IV	Microbiology	54	21	75	30
BOT (H) PIII - Practical			External	Internal	Total Max.	
			90	60	150	

B. Sc. (H) IV Semester
Max. Marks (Theory): 300
(Practical):150
Grand total: 450

Nomenclature			EoSE	CIA	Total Max Marks	Total Min. Marks
BOT (H) 401	Paper-I	Biotechniques and Biostatistics	54	21	75	30
BOT (H) 402	Paper-II	Gymnosperms and Palaeobotany	54	21	75	30
BOT (H) 403	Paper-III	Anatomy of Angiosperms	54	21	75	30
BOT (H) 404	Paper-IV	Plant Pathology	54	21	75	30
BOT (H) P IV - Practical			External	Internal	Total Max.	
			90	60	150	

B. Sc. (H) V Semester
Max. Marks (Theory): 300
(Practical):150
Grand total: 450

Nomenclature			**EoSE**	**CIA**	**Total Max Marks**	**Total Min. Marks**
BOT (H) 501	Paper-I	Plant Biotechnology	54	21	75	30
BOT (H) 502	Paper-II	Systematics of Angiosperms	54	21	75	30
BOT (H) 503	Paper-III	Economic Botany	54	21	75	30
BOT (H) 504	Paper-IV	Embryology of Angiosperms	54	21	75	30
BOT (H) P V - Practical			External	Internal	Total Max.	
			90	60	150	

B. Sc. (H) VI Semester
Max. Marks (Theory): 300
(Practical):150
Grand total: 450

Nomenclature			**EoSE**	**CIA**	**Total Max Marks**	**Total Min. Marks**
BOT (H) 601	Paper-I	Genetic Engineering	54	21	75	30
BOT (H) 602	Paper-II	Ethnobotany	54	21	75	30
BOT (H) 603	Paper-III	Biodiversity Conservation and Human Welfare	54	21	75	30
BOT (H) 604	Paper-IV	Seed Science	54	21	75	30
BOT (H) P VI – Practical			External	Internal	Total Max.	
			90	60	150	

SEMESTER I

PAPER I - CYTOLOGY

Course Code: BOT (H) -101

Max. Marks: 75

45 Hrs.

Scheme of Examination

There will be two parts in the 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 the 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:

Types and significance of chemical bonds: pH and buffers

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. Origin of eukaryotic cell (Endosymbiotic theory)

Cell wall and Plasma Membrane: Origin, ultrastructure, chemistry, and functions of the cell wall; models of cell membrane organization; fluid mosaic model; chemical composition of membranes; Membrane transport – passive, active and facilitated transport, endocytosis, exocytosis. **11 hrs**

UNIT-II:

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

Mitochondria and Chloroplast: Origin of organelles, variation in size, shape and number; organelles structure and biogenesis; organelle membranes and organization of macromolecular complexes, organelle genome organization. Semiautonomous nature of mitochondria and chloroplast. **12 hrs**

UNIT – III:

Endomembrane System: – Structure, and function of, Golgi complex and Endoplasmic reticulum

Structure and Function of Other Sub Cellular Structures: Ribosome; Vacuoles, Microbodies-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**.** **11 hrs**

UNIT-IV:

Cell division and its Regulation: Mitosis and meiosis-historical perspective and significance; various stages of cell division progression; cytokinesis; the role of centromere, kinetochore, and spindle apparatus; plant cell cycle.

11 hrs

Suggested Readings:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.

2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4. Berg, J, M., Tymoczko, J.L. and Stryer L (2011) Biochemistry, W.H.Freeman and Company

5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H.Freeman and Company.

6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.

7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Beckers World of the Cell, Pearson Education Inc. U.S.A. 8th edition.

8. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

9. 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.

SEMESTER I

PAPER-II: ALGAE AND LICHENS

Course Code: BOT (H) -102

Max. Marks: 75

45 Hrs

Scheme of Examination

There will be two parts in the 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 the 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:

Algae: History, occurrence, and distribution, general characters, classification of algae, range of thallus organization and evolutionary tendencies, the ultra structure of the algal cell, flagella, photosynthetic pigments, and reserve food material. Reproduction: vegetative, asexual, and sexual, types of life cycles.

11 hrs

UNIT II:

Cyanophyceae: General characteristics, thallus organization, cell structure, reproduction and life cycle of - *Nostoc*

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

Xanthophyceae - General characteristics, thallus organization, cell structure, reproduction and life cycle with reference to *Vaucheria and Oedogonium*. **12 hrs**

UNIT III:

Phaeophyceae: General characteristics, thallus organization, cell structure, reproduction, and life cycle of — *Ectocarpus.*

Rhodophyceae: General characteristics, thallus organization, cell structure, reproduction, and life cycle of — *Polysiphonia.* **11 hrs**

UNIT IV:

Economic importance and role of algae in the environment, agriculture, biotechnology and industry, toxic algae.

Lichens: General characters, types, structure, reproduction,
and economic importance, its importance as colonizers and indicators of the environment. Applied aspects of Algae **11 hrs**

Suggested Readings:

1. Bold, H. C. and Wayne, M. J. 1996. Introduction to Algae. 2nd Edition. Prentice Hall,

Inc. Englewood Cliffs, New Jersey.

2. Ghemawat, M. S., Kapoor, J. N. and Narayan, H. S. 1976. A Textbook of Algae. Ramesh

Book Depot., Jaipur.

3. Gilbart, M. S. 1985. Cryptogamic Botany. Vol. I and II second edition. Tata McGraw Hill

Publishing Co. Ltd., New Delhi.

4. Kumar, H. D. 1998. Introductory Phycology. Affiliated East-West Press Ltd., New York.

5.Sambamurthy, A.V.S.S. 2006. A Textbook of Algae. I. K. International Pvt. Ltd., New.

6. Singh.V., Pandey, P. C. and Jain, D. K. 2001. A Textbookof Botany. Rastogi Publication, Meerut.

7. Thakur, A. and Bassi, S., 2007. Diversity of microbes and Cryptogams. S. Chand and Co., New Delhi.

8. Van den Hoek, C., Mann, D.J. and Jahns, H.M. 1995. Algae: An introduction to

Phycology. Cambridge Univ. Press., England.

9.vashitha, B. R. 2002. Botany for degree students (Algae and Bryophytes). S. Chand and Co. Ltd., New Delhi

10. O.P. Sharma. 2011. Diversity of microbes and cryptogams. ALGAE. McGraw Hill Education (India) Private Limited.New Delhi.

SEMESTER- I

PAPER –III: PLANT PHYSIOLOGY I

Course Code: BOT (H) - 103

Max. Marks: 75

45 Hrs

Scheme of Examination

There will be two parts in the 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 the 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:

Structure and properties of water, osmosis, water potential, and its components, absorption of water, root pressure, the 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.

11 hrs.

UNIT II:

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

11 Hrs.

UNIT III:

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

12 Hrs.

UNIT IV:

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

11 Hrs.

Suggested readings:

1. Hopkins, W.G. and Huner, P. A. 2008. Introduction to Plant Physiology**.** John Wiley and Sons, USA.
2. Jain, V.K. 2013. Fundamental of Plant Physiology. S. Chand and Company Ltd., New Delhi.
3. Malik, C. P. and Srivastava A.K. 1982. Text book of Plant Physiology. Kalyani publication, New Delhi.

4. Mukherjee S., Ghosh A. K. 2006. Plant Physiology. New Central Book Agency, Calcutta.
5. Parashar, A. N. and Bhatia, K. N. 1985. Plant Physiology. Trueman Book Company, New Delhi.
6. Sinha, R. K. 2007. Modern Plant Physiology. 2nd Edition Tata McGraw, New Delhi.
7. Taiz, L. and Zeiger, E. 2006. Plant Physiology**.** 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
8. Verma, S. K. and Verma, M. 2000. A Text book of Plant Physiology, Biochemistry and Biotechnology. S. Chand and co. Ltd., New Delhi.
9. Verma, V. 2007. Text Book of Plant Physiology. ANE Books, India.

SEMESTER - I

PAPER: IV ECOLOGY

Course Code: BOT (H) -104

Max. Marks: 75

45 Hrs.

Scheme of Examination

There will be two parts to the 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 the 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

Plants and Environment: Atmosphere (stratosphere, troposphere, mesosphere and thermosphere), Adaptations (morphological, anatomical and physiological) in Hydrophytes, Xerophytes and Halophytes. Light (global radiation, photosynthetically active radiation, zonation in water body: littoral, limnetic and profundal zones; (heliophytes and sciophytes) Temperature (Raunkier's classification of plants: megatherm, mesotherm, microtherm, hekistotherm; thermoperiodicity) Soil (soil profile, development, weathering, and maturation) Soil texture, soil types, the role of pH, organic matter, soil water, soil nutrients. Interactions among organisms (neutralism, amensalism, allelopathy), competition, predation, parasitism, protocooperation, mutualism**.**

12 Hrs

UNIT-II

Ecosystem-Concept, structure and function of ecosystem; energy flow models and principles trophic levels; Food chain and food webs; Productivity; Ecological Pyramids; Ecological efficiency; biogeochemical cycles-C, N and P; Ecosystem Diversity-Aquatic (freshwater) and Terrestrial (forests), ecosystem services.

11 Hrs

UNIT-III

Population Ecology: Characteristic (Density, Dispersion, Natality, Mortality, Survivorship curves, Age Structure); Diversity and pattern; Population growth, Carrying capacity, Population regulation: r and k selection.

Community concept of ecological niche, ecological amplitude, ecotone and edge effect; Succession types, climax concept, species diversity (α, β).

11 Hrs

UNIT-IV

Natural Resource Management: Renewable and nonrenewable resource, management and conservation; Endangered conventional and non-conventional energy sources; Conservation of biodiversity, hot spots, IUCN categories of threatened species.

Impact of Human Activities-Pollution of Air, Water, and soil and their prevention and control, Environmental Protection Act (EPA) and Global Warming, Environment Impact Assessment (EIA). **11 Hrs**

Suggested readings:

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

BOTANY PRACTICAL I

Maximum practical Marks **=150 marks**

Internal Marks **= 60 Marks**

External Marks **= 90 Marks**

60 HOURS

Suggested laboratory exercises:

1. Study of Bacteria with permanent slides (*Bacillus, Coccus, Streptococcus, Spirillum*)
2. Comparative study of cell structure in *Allium*, *Hydrilla* and *Spirogyra* cells.
3. Study of cyclosis in *Tradescantia* staminal hairs and *Hydrilla* leaf.
4. Bacterial staining (Gram's staining).
5. Study of plastids in *Cassia, Lycopersicon, Capsicum*.
6. Study of different stages of mitosis in onion root tip and meiosis in onion flower bud using aceto carmine method.
7. Measurement of cell size by the technique of micrometry.
8. Counting the cells per unit volume with the help of a hemocytometer. (Yeast/pollen grains).
9. Study of cells and its organelles with the help of electron micrographs.
10. Study the phenomenon of plasmolysis and deplasmolysis.
11. Laboratory culture of algae.
12. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas, Volvox, Chara, Voucheria, Oedogonium, Ectocarpus, Polysiphonia.*
13. Study of different types of lichens.
14. To determine the water potential of given plant material.
15. Demonstration of the phenomenon of osmosis using potato osmoscope.
16. Demonstration of the phenomenon of plasmolysis.
17. To determine the osmotic potential of vacuolar sap by the plasmolytic method.
18. To study the permeability of plasma membrane using different concentrations of organic solvents.
19. To study the effect of temperature on the permeability of plasma membrane.
20. To demonstrate root pressure.
21. Study of the effect of temperature on the rate of transpiration.
22. Study of transpiration rate in dorsiventral and isobilateral leaves by use of potometer.
23. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophyte.
24. Study of the mechanism of stomatal opening and closing.
25. To study the rate of photosynthesis under varying HCO_3concentrations using Wilmott and Bubbler.
26. Demonstration of O_2 evolution during photosynthesis by inverted funnel method.
27. To study that light is necessary for photosynthesis by using a Ganong's screen.
28. To demonstrate anaerobic and aerobic respiration.
29. To study that CO_2, light, and chlorophyll are essential for photosynthesis (Moll's half experiment).
30. Study of C_3 and C_4 plants.
31. To study the R.Q. of the different substrates by Ganong's respirometer.
32. Demonstration of O_2 evolution during aerobic respiration
33. Determination of pH of various soil and water samples by pH meter and pH paper.
34. Analysis of chlorides and dissolved oxygen in water samples by titration method.

35. Determination of bulk density, soil porosity, and water holding capacity in soil samples
36. Determination of species-area curve by minimal quadrat size to study the herbaceous vegetation.
37. Quantitative analysis of frequency, density, and abundance of herbaceous vegetation using the quadrat method.
38. Estimation of biomass of aerial and underground part of herbaceous plants (fresh and dry weight)
39. Study the adaptation of following

    Hydrophytes: - *Hydrilla* stem, *Typha* leaf and *Nymphaea /Eichhornia* petiole.
    Xerophytes- *Calotropis, Capparis* and *Casuarina* stem and *Nerium* leaf

SEMESTER- II

Paper –I: GENETICS AND PLANT BREEDING

Course Code: BOT (H) -201

Max. Marks: 75

45 hrs.

Scheme of Examination

There will be two parts in the 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 the 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

Mendelian Genetics and its Extension: History; Principles of inheritance, chromosome theory of inheritance, Auotosomes and sex chromosomes.

Allelic and Non-allelic Interaction: Back cross and test cross, gene interaction: codominance and incomplete dominance, complementary, supplementary, duplicate, and epistatic factors, Multiple allelism, polygenic inheritance. Pleiotropy.

Linkage, Crossing Over and Chromosome Mapping: Coupling and repulsion phases; recombination frequency, two and three-point test crosses, interference and coincidence, linkage map. **11 hrs**

UNIT - II

Maternal Influence on Inheritance: Shell coiling in snails and *Kappa* particles in *Paramecium,* cytoplasmic inheritance in yeast (mitochondria) and *Mirabilis jalapa* (plastid)

Sex Determination: Mechanism of sex determination; sex-linked, sex-limited, and sex-influenced characters**.**

12 hrs

UNIT - III

Genetic Alterations: Types of mutations, the molecular basis of mutations, transitions, transversions, and frame-shift mutations. Mutagens - Physical and Chemical mutagens (Base analogs, deaminating, alkylating, and intercalating agents), the role of transposons in mutation.

Chromosomal Alterations: Origin, Types, and effects of duplications, deletions, inversions, and translocations.

Origin, occurrence, production meiosis of haploids, aneuploids and euploids, origin and production of autopolyploids, allopolyploids types, the evolution of major crop plants (Evolution of allotetraploid *Gossypium*, *Nicotiana,* and allopolyploid *Triticum*). **11 hrs**

UNIT – IV

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

Methods of Plant improvement: Pureline and mass 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). **11 hrs**

Suggested Readings:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics. John Wiley & sons, India. 8th edition.

2. 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.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cum-mings, U.S.A. 10th edition.

4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc.,India. 5th edition.

5. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.

6. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2ndedition. 52

7. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

SEMESTER- II

PAPER-II: MYCOLOGY

Course Code: BOT (H) -202

Max. Marks: 75

45 hrs.

Scheme of Examination

There will be two parts in the 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 the 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

Fungi: History, occurrence and distribution, general characters, classifications, Ultrastructure of the fungal cell, nutrition, reproduction, homothallism, heterothallism, heterokaryosis, Parasexual cycle.

11 Hrs

UNIT-II

General characters, structure, life cycle of Mastigomycotina- *Pythium, Phytophthora*;
Zygomycotina- *Mucor* **11 Hrs**

UNIT-III

General characters, structure , reproduction and life cycle of Ascomycotina- *Saccharomyces, Eurotium, Chaetomium, Peziza*

12 Hrs

UNIT-IV

General characters, structure,reproduction and life cycle of-
Basidiomycotina- *Puccinia, Agaricus*
Deuteromycotina- *Cercospora, Colletotrichum*
Economic importance of fungi, Evolutionary trends in fungi **11 Hrs**

Suggested reading Books

1. Alexopoulos C. J, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition.
2. Alexopoulos, C.J. and Mims, C.V. 1988. Introductory Mycology. John Wiley and Sons, New York.
3. Dubey HC 1990 An introduction of fungi, Vikas Publication House Pvt Ltd Delhi
4. Sharma, P. D. 2003. Microbiology and Pathology. Rastogi Publication, Meerut.
5. Dubey, H.C. 1989. Fungi. Rastogi Publication, Meerut.

6. Pandey, S. N., and Trivedi, P. S. 1994. A textbook of Fungi, Bacteria, and Virus. Vikas Publishing House, New Delhi.
7. Vashishta, B. R. 2001. Botany for degree student's Fungi. S. Chand and company, New Delhi.
8. Webster, J. and Weber, R. 2007. Introduction to Fungi. 3 Press, Cambridge. 14
9. Agrawal, K. and Sharma, J. 2014. A Textbook of Mycology, Microbiology and Plant Pathology. CBH publisher, Jaipur.

SEMESTER- II

PAPER –III: PLANT PHYSIOLOGY II AND BIOCHEMISTRY

Course Code: BOT (H) -203

Max. Marks: 75

45 Hrs

Scheme of Examination

There will be two parts in the 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 the 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:

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. **11 Hrs.**

UNIT II:

Structure, biosynthesis, and physiological role of Cytokinine 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.

11 Hrs

UNIT III:

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, triacylglycerols, phospholipids and sphingolipids, fatty acids biosynthesis, oxidation of fatty acids. **12 Hrs**

UNIT IV:

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

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

11 Hrs

Suggested Readings:

1. Berg, J.M., Tymoczko, J.L., Stryer, L. 2006. Biochemistry. 6th Edition, W.H. Freeman and Company, New York.

2. Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.
3. Conn, E.E., Stumpf, P.K. and Bruening, G. 2006. Outlines of Biochemistry. 4th Edition**,** John Wiley and Sons Inc. New Jersey, USA.
4. Elliot, W.H. and Elliot, D.C. 2009. Biochemistry and Molecular Biology. Oxford Publishers, India.
5. Hopkins, W.G. and Huner, P.A. 2008. Introduction to Plant Physiology**.** John Wiley and Sons, USA.
6. Mukherjee, S., Ghosh, A.K. 2006. Plant Physiology. New Central Book Agency, Calcutta.
7. Nelson, D.L. and Cox, M.M. 2004. Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
8. Ranjit, K. 2008. Research methodology: A step-by-step guide for beginners. Pearson, India.
9. Sinha R. K., 2007. Modern Plant Physiology. 2nd Edition Tata McGraw, New Delhi.
10. Taiz, L. and Zeiger, E. 2006. Plant Physiology**.** 4th Edition Sinauer Associates Inc. Publishers, Massachusetts, USA.
11. Voet, D. and Voet, J.G. 2000. Biochemistry, John Wiley, New York.
12. Wilson, K. and Walker, J. 2008. Principlesand techniques of Biochemistry and Molecular Biology**,** Cambridge University Press.

SEMESTER-II

PAPER-IV: BRYOPHYTA

Course Code: BOT (H) -204

Max. Marks: 75

45 hrs.

Scheme of Examination

There will be two parts in the 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 the 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:

Bryophyta: History, occurrence, distribution, general characteristics, classification, the study of comparative morphology, anatomy and reproduction among bryophytes, alternation of generation, ecological and economic importance. **11 hrs**

UNIT II

Habitat, structure, reproduction, and life cycle of Hepaticopsida: *Riccia* and *Marchantia***.** **11 hrs**

UNIT III

Habitat, structure, reproduction, and life cycle of Anthocerotopsida: *Anthoceros* **11 hrs**

UNIT-IV

Habitat, structure, reproduction, and life cycle of Bryopsida: *Funaria, Sphagnum.* Evolution of sporophyte and gametophyte in Bryophytes.

12 hrs

Suggested Readings:

1. Chopra, R.N. and Kumar, P.K. 1988. Biology of Bryophytes. Wiley Eastern Ltd. New Delhi.

1. Pandey, S.N., Mishra, S.P. and Trivedi, P.S. 1981. A textbook of Botany vol. II, Vikas Publishing House Pvt. Ltd, New Delhi.
2. Parihar, N.S. 1965. An Introduction to Bryophyta. Central Book Depot, Allahabad.
3. Puri, P. 1985. Bryophytes. Atmaram and Sons, Delhi.
4. Smith, G.M. 1938. Crytogramic Botany Vol. II. Bryophytes and Pteridophytes. Mc Graw Hill Book Company, London.
5. Sporne, K.R. 1967. The Morphology of Bryophytes. Hutchinson University Library, London.
6. Tyagi, A.and Saxena, M. 2014. Algae, Lichens and Bryophyta, CBH, Jaipur

7. Vashishta, B. R., Sinha, A. K. and Kumar, A. 2011. Botany for degree students, Bryophyta. S. Chand and Co. New Delhi.
8. Watson E.V. 1971. The structure and life of Bryophytes. Hutchinson University Library, London.

BOTANY PRACTICAL II

Maximum practical Marks **= 150 marks**

Internal Marks **= 60 Marks**

External Marks **= 90 Marks**

60 HOURS

Suggested laboratory exercises:

1. Study various stages of meiosis in flower buds of onion.
2. Solve exercises related to:
    - Mendelian law (Monohybrid and Dihybrid ratios)
    - Incomplete dominance
    - Gene interactions (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4)
    - ABO blood groups & Rh factor
5. Study of sex chromosomes
6. Study of Barr body through *Giemsa* staining.
7. Preparation of chromosome maps – gene mapping with a three-point cross
8. Exercise on Emasculation, bagging, and tagging.
9. Preparation of slides and study of following genera through temporary mounts and permanent slides:
    - *Pythium,*
    - *Phytophthora*
    - *Agaricus*
    - *Saccharomyces*
    - *Peziza*
    - *Colletotrichum*
    - *Cercospora*
10. Preparation of Potato Dextrose Agar medium.
11. Preparation and applications of Phosphate buffers in biological studies.
12. Principle, working, and use of colorimeter and spectrophotometer.
13. Principle, types, and application of centrifuges.
14. Principle and types of Chromatography.
15. Separation of amino acids by paper chromatography and thin-layer chromatography.
16. Histochemical tests for carbohydrates, proteins, and lipids.
17. Separation of chlorophyll and carotenoid pigments by solvent method
18. Separation of chlorophyll and carotenoid pigments by paper chromatography.
19. Preparation of standard curve of protein and estimation of soluble proteins in an unknown sample of plant material by Lowry's method.
20. To study the activity of peroxidase, catalase, and amylase enzyme.
21. Estimate chlorophyll and carotenoid content in C_3 and C_4 plants.
22. To test the presence of ascorbic acid in different plant juices.
23. Bioassay of plant growth hormone (auxin, gibberellins, and cytokinin).
24. Measurement of growth using an auxanometer.

25. Study of external morphology, the internal structure of vegetative and reproductive parts of the following genera through the specimen and temporary slide preparation:

- *Riccia,*
- *Marchantia,*
- *Anthoceros,*
- *Funaria,*
- *Sphagnum.*

SEMESTER-III

PAPER-I: MOLECULAR BIOLOGY

Course Code: BOT (H) -301

Max. Marks: 75

45 hrs.

Scheme of Examination: There will be two parts in the 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 the 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

Miesher to Watson and Crick- Historic perspective, DNA structure, Salient features of double helical.Types of DNA Types of genetic material , denaturation and renaturation, cot curve., Organelle DNA- mitochondria and chloroplast DNA. Structure of RNA,types of RNA (t RNA, m RNA, Ribosomes, mi RNA, si RNA), and their functions.

DNA replication, damage, and repair

Replicons – linear, circular, and D-loops, Initiation DNA polymerases, helicases, primase and other enzymes and proteins used in replication, coordinating synthesis of the leading and lagging strands, Okazaki fragments, Elongation, and Termination. Causes of DNA damage and molecular mechanisms of repair-Excision repair system in bacteria and eukaryotes, Base excision, Nucleotideexcision, mismatch repair system**.** **12 hrs**

UNIT-II

Transcription

Prokaryotic and eukaryotic RNA Polymerases, promoter sequences, Start point for RNA polymerase, transcription initiation. Promoter clearance and elongation, termination.

RNA modifications

Capping and Polyadenylation, Split genes, the concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, Alternative splicing. **11 hrs**

UNIT-III

Translation

Genetic code. Protein synthesis in Prokaryotes and Eukaryotes. Translation- aminoacyl tRNA synthetase, Initiation, elongation, and termination in prokaryotes and eukaryotes, translational inhibitors. Co and post-translational modification of proteins. **11 hrs**

UNIT-IV

Gene regulation

Prokaryotic transcription regulation: Lac and Trp Operons, cis and trans-acting elements, Eukaryotic transcription regulation, Protein-protein interactions, DNA binding domains, Histone acetylation, Promoter activation, and turning ON/OFF the gene. **11 hrs**

Suggested Readings:

1. 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.

2. Brown, T. A. 2010. Gene cloning and DNA analysis: An Introduction. Blackwell Publication, USA.

3. Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists., USA.

4. Chrispeel, M.J. and Sadava, D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers, USA.

5. 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. 18

6. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology 8th edition. Lippincott Williams and Wilkins, Philadelphia.

7. Glick, B.R. and Pasternak, J.J. 2003. Molecular Biotechnology: Principles and Applications of recombinant DNA. ASM Press, Washington.

8. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6 th edition. John Wiley and Sons. Inc. New jersey, USA.

9. Mascarenhas, A.F. 1988. Hand book of Plant tissue culture. Publication and information. Div., ICAR, New Delhi.

10. Purohit, S.S. and Mathur, S.K. 1996. Biotechnology Fundamental and Application. Agro Botanical Publisher, Bikaner.

11. Razdan, M.K., 1993. An introduction to Plant tissue culture. Publication and Information Div., ICAR, New Delhi.

12. Rana, S.V.S. 2012. Biotechnology theory and practice. (Third Ed.)

13. Rastogi Publication, Meerut. Rastogi, V.B. 2008. Fundamentals of Molecular Biology. Ane Books, Meerut, India.

14. Smith, R. H. 2000. Plant Tissue Culture: Techniques and Experiments. 2nd edition, Academic Press, USA.

15. Upadhyaya, A. and Upadhayaya, K. 2005. Basic Molecular Biology. Himalaya Publishers. New Delhi.

SEMESTER-III

PAPER-II: PTERIDOPHYTA

Course Code: BOT (H) -302

Max. Marks: 75

45 hrs.

Scheme of Examination: There will be two parts in the 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 the 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:

Pteridophyta: History, occurrence and distribution, general characters, classification, detailed account of the stellar system, Telome theory, and life cycle pattern of homosporous and heterosporous pteridophyte.

11 hrs

UNIT- II:

Heterospory and seed habit, Apogamy and Apospory.

General characteristics, morphology, anatomy, and reproduction in *Psilotum*. **11 hrs**

UNIT-III

General characteristics of Lycophyta and Sphenophyta: morphology, anatomy, and reproduction: *Lycopodium, Selaginella, Equisetum.* **12 hrs**

UNIT-IV:

General characteristics of Filicophyta: Morphology, anatomy, and reproduction .Comparative study of *Pteris* and *Marsilea.* Economic importance of pteridophyta. **11 hrs**

Suggested Readings*:*

1.Sharma O. P. Pteridophytes.2000. Todayand Tomorrow Publication.

2. Sarabhai R.C. and Saxena R.C. 1990. A textbookof Botany. Rastogi Publications Merrut.

3. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

4.
Singh, V., Pandey, P. C. and Jain, D. K .2013. A textbook of Botany. IV edition, Rastogi Public ation, Meerut.

5.Vashishta, P.C. 1997. Botanyfor Degree Students-Pteridophyta.
S. Chand and Company, New Delhi.

6.Wilson, N. S., and Rothewall, G. W. 1993. Paleobotany and Evolution of Plants. (2

Edition), Cambridge University Press, U. K.

SEMESTER-III

PAPER-III: MORPHOLOGY OF ANGIOSPERMS

Course Code: BOT (H) -303

Max. Marks: 75

45 hrs.

Scheme of Examination: There will be two parts in the 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 the 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:

Plant habit, the basic plan of flowering plants, modular types of growth, diversity of plant form in annuals, biennials, and perennials, the evolution of tree habit in gymnosperm, monocotyledons and dicotyledons, trees largest and longest-lived plants. **11 Hrs**

UNIT II:

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

Stem: Structure, types, and modification (storage and mechanical), branching pattern, monopodial and sympodial growth, canopy architecture. **11 Hrs.**

UNIT III:

Leaves: Origin, development, types, phyllotaxy, venation, lamina parts, shapes, size and modifications, leaf surface features and appendages, leaf surface area, stomata, and trichome structure. **12 Hrs.**

UNIT IV:

Flower: Flower as a modified shoot, detailed structure of flower, types of inflorescences 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. **11 Hrs.**

Suggested readings books:

1. Eames, A. J. 1981. Morphology of Angiosperms.McGraw Hill, New York.
2. Gifford, E.M. and Foster, A.S. 1989. Morphology and Evolution of Vascular Plants. W.H. Freeman, New York.
3. Sporne, K.R. 1974. Morphology of Angiosperms. Hutchinson University Press, London.

4. Singh, V.P., Pandey, P.C. and Jain, D.K**.** 2011.A Textbook of Botany- Angiosperms. Rastogi Publication, Merrut.
5. Trivedi, P.C., Sharma, N. and Dhankad, R. S. 2009. Plant Morphology and Anatomy. Ramesh Book Depot. Jaipur.

SEMESTER-III

PAPER-IV: MICROBIOLOGY

Course Code: BOT (H) -304

Max. Marks: 75

45 hrs.

Scheme of Examination: There will be two parts in the 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 the 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

Discovery of Microorganism: Systemic position of microorganism in biology world; classification of microorganisms and characteristic features of different groups.

Methods in Microbiology: Basic principles of microbiology, micrometry, staining, sterilizations, culture media, pure culture methods, methods for population estimation, growth determination**.** **11Hrs**

UNIT-II

Ultrastructure of Microorganism: Ultrastructure of the bacterial cell: morphology, flagella, nutritional types, chromatin material, reproduction-transformation, conjugation and transduction, comparison of archaebacteria and eubacteria, gram-positive and gram-negative bacteria. **11 Hrs**

UNIT-III

Virus: Discovery, structure, properties, and classification of Viruses, replication (lytic and lysogenic) characteristic feature of host-virus interaction; bacteriophage T4; tobacco mosaic virus, general account of mycoplasma: occurrence, morphology, reproduction, and importance**.** **12 Hrs**

UNIT-IV

Economic and biological importance of bacteria with particular reference to agriculture, industry, medicine, and sanitation. The basic concept of food spoilage and preservation, Economic importance of viruses.

11 Hrs

Suggested readings:

1. Aneja, K. R. 2003. Experiment in Microbiology, Plant Pathology, and Biotechnology. New age international (P) Ltd. Publishers, New Delhi.
2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
3. Biswas, S. B. and Biswas, A. 2000. An introduction of Viruses. Vikas publications, New Delhi.

4. Dubey, R. C., and Maheshwari, D. K., 2002. A Text-Book of Microbiology. S. Chand and Co., New Delhi.
5. Kumar, H. D. and Kumar, S. 1998. Modern Concepts of Microbiology. Vikas publishing house Pvt. Ltd., New Delhi.
6. 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.
7. Pandey, S. N., and Trivedi, P. C. 2005. A textbook of Fungi, Bacteria, and Virus. Vikas Publishing House, New Delhi. Pelczar, M.J. Microbiology. 5th edition, Tata Mc Graw-Hill Co., New Delhi.
8. Presscott, L., Harley, J. and Klein, D. 2005. Microbiology. 6th edition, Tata Mc Graw-Hill Co., New Delhi.
9. Purohit, S. S. 2002. Microbiology. Agro. Bot. Publication, Jodhpur.
10. Sharma, P. D. 2003. Microbiology and Pathology. Rastogi Publication, Meerut.
11. Singh, V. and Srivastava, V. 1998. Introduction of Bacteria. Vikas Publication, New Delhi.

BOTANY PRACTICAL III

Maximum practical Marks	**= 150 marks**
Internal Marks	**= 60 Marks**
External Marks	**= 90 Marks**
	60

HOURS

1. Preparation of culture medium
2. Demonstration of antibiotic resistance (Culture of *E. coli* containing plasmid (pUC 18/19) in LB medium with/without antibiotic pressure and interpretation of results.
3. Isolation and quantitative estimation of DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A 260 measurement).
4. To perform Ames test in *Salmonella*/*E.coli* to study mutagenicity.
5. To isolate plant DNA
6. Study of semi-conservative replication of DNA through micrographs/schematic representations.
7. Study of vegetative and reproductive parts of the following genera using temporary slides preparation and specimens
   - *Psilotum,*
   - *Lycopodium,*
   - *Selaginella,*
   - *Equisetum,*
   - *Marsilea,*
   - *Pteris*
8. Study of different modifications of the root, stem, leaf by using specimens.
9. Study of different epidermal appendages (trichomes etc.) by making slides.
10. Study of the floral apex.
11. Sterilization techniques for microorganisms.
12. Study of yeast, and lactobacilli.
13. Media preparation (nutrient agar)
14. Culture of microorganisms by streaking on agar plates.
15. Study of disease -Citrus canker, TMV, Little leaf of brinjal.
16. Study of Bacteriophage using electron micrograph.
17. Study of symptoms of virus-infected plants.

18. Study of Bacterial staining in milk and curd.
19. Flagella and endospore staining.

SEMESTER-IV
PAPER – I: BIOTECHNIQUES AND BIOSTATISTICS
Course Code: BOT (H) 401

Max. Marks: 75

45 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:

Principles of Microscopy: Light microscopy, Fluorescence microscopy, Confocal microscopy, Use of fluorochromes, Flow cytometry, FLUORESCENCE-ACTIVATED CELL SORTING

Transmission and Scanning electron microscopy – Principle and Instrumentation. **11 Hrs.**

UNIT II:

Centrifugation: Differential and density gradient centrifugation.

Electrophoresis: PAGE, SDS-PAGE; PCR: Principle, Procedure and application.

Chromatography: Principle, Paper chromatography, Column chromatography, TLC

Spectrophotometry: Principle and its application in biological research.

11 Hrs.

UNIT III:

Fixation of Biological Materials: Chemistry of Fixation, Fixative solutions, Freeze-drying, Cryopreservation.

Histological Methods: Fixation, dehydration, clearing, embedding, Microtomy, Staining: Classification of stains, Mechanism, and chemistry of staining.

11Hrs.

UNIT IV:

Biostatistics: Definition and Scope, Census and sampling methods, Collection and Tabular Presentation of Data, Tabulation of data; Frequency Distribution Table; Continuous and Discontinuous Series, Graphical Presentation of Data: Bar, Histogram, Line graph, Polygon, Pie Diagrams, Ogives.

Biostatistical Tools: Measures of Central tendency: mean, median, mode. Measures of Dispersion, Mean deviation & Standard deviation, Standard error. Probability.

12Hrs.

Suggested Readings:

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.

2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.

3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.

4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition

SEMESTER-IV
PAPER – II: GYMNOSPERMS AND PALEOBOTANY

Course Code: BOT (H) 402

Max. Marks: 75

45 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:

Gymnosperm: General characteristics, distribution, classification, Ecological and Economic importance of Gymnosperms. A brief account of Progymnosperm, affinities of Gymnosperms with Pteridophytes and Angiosperms. Evolutionary significance of gymnosperms.

11Hrs.

UNIT II:

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

12Hrs.

UNIT III:

General characteristics of Ephedrales: Morphology, anatomy, reproduction and life cycle with special reference to the genera *Ephedra*. **11 Hrs.**

UNIT IV:

Palaeobotany: Fossil formation, types of fossils, the technique of study of fossils.

Geological time scale: Sequence of plants in geological time.

Fossil pteridophytes:*Rhynia, Lepidodendron* and *Calamites,*

Fossil gymnosperm: *Williamsonia, Cordaites*, Contribution of Prof. Birbal Sahni.

Palaeobotany in relation to the exploration of fossil fuels. **11 Hrs.**

Suggested Readings:

1. Bhatnagar, S. P. and Moitra, A. 1997. Gymnosperms. New Age International (P) Ltd., Publisher, New Delhi.
2. Clark, D. L. 1976. Fossils, Palaeobotany and Evolution. W.M.C. Brown Company, New York.

3. Wilson N.S. and Rohwell,G.W.1993 Paleobotany and the evolution of plants (2nd edition) Cambridge University Press.UK.
4. Meyen, S. V. 1978. Fundamentals of Palaeobotany. Chapman and Hall, London.
5. S harma, O. P. 1 997. G ymnos perms. Pragati Prakashan, Meerut, India.
6. Sporne, K. R. 2002. The Morphology of Gymnosperms. B. I. Pub. Pvt. Ltd. Mumbai, Kolkata, Delhi.
7. Thomas, B. A. and Spice, R. A. 1986. The Evolution and Palaeobotnay of land Plants. Publ. Crom. Helm London and Sydney.
8. Vasishta P.C. 1980. Gymnosperms. S. Chand and Co. Ltd., New Delhi.

SEMESTER-IV
PAPER – III: ANATOMY OF ANGIOSPERMS
Course Code: BOT (H) 403

Max. Marks: 75

45Hrs.

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:
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, Secretary 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). **12 Hrs.**

UNIT II:
Meristem: definition, classification, types and function, shoot apical meristem theories: Apical cell theory, histogen theory, tunica-corpus theory, continuing meristematic residue, cytohistological zonation. Root apical meristem theories: Apical cell theories, histogen theory, korper-kappe theory, quiescent cell theory. **11 Hrs.**

UNIT III:
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. **11 Hrs.**

UNIT IV:
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, Leptadenia, Salvadora, Bougainvillea, Nyctanthes, Amaranthus,* Monocot stem: *Dracaena* and in dicot roots: *Beta vulgaris* and *Ipomea batatas.* **11 Hrs**

SEMESTER-IV
PAPER – IV: PLANT PATHOLOGY

Course Code: BOT (H) 404

Max. Marks: 75
45Hrs.

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

A General Account of Plant Pathogenesis: History and scope of plant pathology; a general account of disease caused by plant pathogens. Symptoms caused by a pathogen and environmental factors.
Pathogen attack and defense mechanisms: Modes of infection, Mechanism of penetration of pathogens. Protective and defense mechanism in plants – Morphological and biochemical. **11 Hrs.**

UNIT-II

Plant Disease by Fungi: Rust and Smut of wheat, downy mildew and green ear disease of bajra, white rust of crucifers, late blight of potato, powdery mildew of cucurbits and grapes, red rot of sugarcane.

Bacterial Disease: Bacterial blight of rice, Tundu disease of wheat. **12 Hrs.**

UNIT-III

Plant Disease Epidemiology: Transmission and spread of plant pathogens; disease cycles, epidemic modeling and disease forecasting.

Plant Disease Management: Chemical, biological, IPM, biopesticide. **11 Hrs.**

UNIT-IV

Genetic of resistant and susceptibility: Genes for virulence and virulence, their application of resistance and susceptibility; induced resistance (immunization).

Molecular plant pathology: Molecular diagnosis, identification of genes and specific molecules in disease development. **11 Hrs.**

Suggested Readings:

1. Agrios, G.N. 2005. Plant Pathology, 5th edition. Academic Press, New York, USA.

2. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc., New York, USA.

3. Khan, J.A. and J. Dijkstra. 2002. Plant Virus as Molecular Pathogens. The Haworth Press Inc. USA.

4. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology. 2nd Edition. TATA McGraw Hill. Pub. Company Ltd. New Delhi.

5. Singh, R.S. 1982. Plant Pathogens: The Fungi. Oxford and IBH Publishing Company, New Delhi, India.

6. Singh, RS. 1989. Plant Pathogens: The Prokaryotes. Oxford and IBH Publ. Company, New Delhi, India.

7. Trigiano, R.N., M.T. Windham and A.S. Windham. 2008. Plant Pathology: Concepts and Laboratory Exercises. 2nd edition. CRC Press.

8. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food product Press and Haworth Press INc. Binghamton, N

BOTANY PRACTICAL IV

Maximum practical Marks = 150 marks
Internal Marks = 60 Marks

External Marks = 90 Marks

60 HOURS

Suggested Laboratory exercises

1. Study of blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing.
2. Study the principle and procedure of PCR through photographs.
3. Demonstration of ELISA.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate proteins using PAGE.
7. Verification of Lambert and Beer's Law using spectrophotometer.
8. Preparation of permanent slides (double staining) of Vascular Plants.
9. Study of external morphology, anatomy, reproductive structure by slide preparation and Permanent slides of following genera:

- *Cycas*- Coralloid roots, Rachis, Leaflet, Cycas -Megasporophyll, Mature ovule and Male cone with Microsporophylls.
- *Pinus*- Stem (TLS and RLS), Needle (V.S.), Male and Female Cone, Mature Ovule.
- *Ephedra*- Stem (T.S.) Male and Female flowers, Mature ovule.
- *Rhynia, Lepidodendron, Calamites, Williamsonia, Cordaites* Chart specimen (fossil).

10. Anatomy of the primary structure of root and stem in monocots and dicots.
11. Secondary growth in Dicot and Monocot root and stem.
12. Anomalous secondary growth in stem: *Salvadora, Bignonia, Bougainvillea, Nyctanthes, Leptadenia, Dracaena.*
13. Study of internal structure of leaf: dorsiventral and isobilateral leaves.
14. Study of stomatal types.
15. Study of different plant diseases and their causal organisms.

- White rust of crucifer – *Albugo candida*
- Late blight of potato- *Phytophthora infestens*
- Early blight of potato- *Alternaria solani*
- Green ear disease of bajra- *Sclerospora graminicola*

- Powdery mildew – *Erysiphe Spp.*
- Tikka disease of groundnut- *Cercospora Spp.*
- Red rot of sugarcane. *Colletotrichum fulcatum*

16. Field study of plants in farms / Agricultural stations.
17. Exercise based on Biostatistics.

SEMESTER-V

PAPER-I: PLANT BIOTECHNOLOGY

Course Code: BOT (H) 501

Max. Marks: 75
45Hrs.

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:

Plant Tissue Culture: Historical perspective, the composition of media, nutrient and hormone requirement, methods of sterilization, totipotency, the concept of differentiation, dedifferentiation, and redifferentiation, physical-chemical conditions for propagation of plant cells and tissues, plant regeneration routes, micropropagation, organogenesis and somatic embryogenesis, anther culture, production of androgenic haploids, protoplast isolation, culture and fusion, somatic hybrids and cybrids. Application of plant tissue culture**.** **12 Hrs.**

UNIT II:

Recombinant DNA Technology: Introduction, Restriction endonucleases (history, types, and role); Restriction mapping (Linear and circular).

Vectors for Plant Transformation: Cloning Vectors: Prokaryotic (pBR 322, BAC); Lambda Phage, cosmid, shuttle vectors, Eukaryotic vector (YAC). Vectors for plant transformation: Basic features of vectors (Promoters, terminators, and sequences influencing gene expression), selectable markers & reporter genes, the origin of replication. Introduction of recombinant DNA into host cells, methods for identification of recombinants.

11 Hrs.

UNIT III:

Techniques in Biotechnology: Gel electrophoresis, PCR, DNA sequencing (Sanger's method and Maxam Gilbert's method); Southern, Northern, and Western Blotting. Gene constructs; construction of genomic and cDNA library to obtain gene of interest by different methods.

11 Hrs.

UNIT IV:

Plant Transformation Technology: Gene transfer methods; *Agrobacterium*-mediated transformation; Direct gene transfer methods –Electroporation, Microinjection, Gene-gun, Selection of transgenics – marker and reporter genes (Luciferase).

11Hrs.

Suggested readings:

1. Slater, A, Scott, N. W. & Fowler, M. R. 2008. Plant Biotechnology. The genetic manipulation of plants. Oxford University Press.
2. Bhojwani, S. S. and Razdan. 2004. Plant tissue Culture and Practice.
3. Crisped and Sadava, D. E. 1994. Plants, Genes, and Agriculture. Jones and Barlett Publisher.
4. J. Reinert & Y. P. S. Bajaj, 1997. Applied and fundamental aspects of Plant, Cell, Tissue and Organ Culture. Narosa Publishing House.
5. Smith, R. Plant tissue culture: Techniques and Experiments, 2nd edition, Academic.
6. Gardner, E. J., Simmonns, M. J. Snustad, D. P. 2008. 8th edition. Principles of Genetics. Wiley India.
7. Raven, P. H., Johnson, G. B., Losos, J. B. and Singer, S. R. 2005. Biology. Tata Mc Graw Hill.
8. Brown, T. A. Gene cloning and DNA analysis: An introduction. Blackwell Publication.
9. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition).

SEMESTER- V

PAPER –II: SYSTEMATIC OF ANGIOSPERMS

Course Code: BOT (H)-502

Max. Marks: 75
45 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:

Taxonomy: Introduction, definition, components, Taxonomic hierarchy-Taxonomic categories, concept of species,genus and family. Herbarium: specimen Preparation, Methods and importance. Important herbaria: National, International and digital Herbaria. Taxonomoic Literature-Botanical, garden, Monograph, Icones, Manuals Journals and Library. Key construction with their types for Plant Identification. **11 Hrs.**

UNIT II:

ICBN: Principle and rules of nomenclature, nomenclature of hybrids and cultivars. Types of classification -Linneaus, Bentham and Hooker and Engler and Prantl, Takhtajan and angiosperm phylogeny group (APGIII) classification. Taxonomic Evidences: Anatomy, Embryology, Palynology, ecology, cytology and chemotaxonomy. Numerical Taxonomy- Concept characters, OTU's coding, cluster analysis and cladistics. **11 Hrs.**

UNIT III:

Phylogeny of Angiosperm: Time and place of origin and evolution of angiosperms, primitive living angiosperms. Taxonomic studies of the following families (Bentham and Hooker): Ranunculaceae, Brassicaceae, Papaveraceae, Malvaceae, Fabaceae,Caryophyllaceae, Apiaceae, Rubiaceae, Asteraceae.

12 Hrs.

UNIT IV:

Taxonomic Studies of the Following Families (Bentham and Hooker): Apocynaceae and Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Arecaceae, Liliaceae and Poaceae. **11 Hrs.**

Suggested readings:

1. Naik, V.N.2011. Taxonomy of Angiosperms. TATA McGraw Hill, New Delhi.
2. Pandey, S.N. and Misra, S.P. 2008. Taxonomy of Angiosperms. Ane Books India, New Delhi.
3. Saxena, N.B. and Saxena, S. 2011. Plant Taxonomy. Pragati Prakashan, New Delhi.
4. Sharma, B.D. 1984. Flora of India vol. I. Botanical Survey of India, Calcutta.
5. Sharma, O.P. 1996. Plant Taxonomy. TATA McGraw Hill, New Delhi

6. Simpson, M.C. 2006. Plant Systematics. Elsevier, Amsterdam.
7. Singh, G. 2001. Plant systematics. Oxford and IBH, New Delhi.
8. Sivarajan, V.V. 1991. Introduction to Principles of Plant Taxonomy**.** Oxford and IBH, New Delhi.
9. Taxonomy of Angiosperm,V.N. Nair(1995) IMH Publishing Company
10. A.K. Mondol ,Advanced Taxonomy,NCBA Publication
11. N.S. Subramanium, Modern Plant Taxonomy, Vikas Publication House

SEMESTER- V

PAPER - III : ECONOMIC BOTANY

Course Code: BOT (H) - 503

Max. Marks: 75
45 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:

A general account of primary and secondary centres of diversity, plant introduction. General account of Wheat, Maize, Rice, Bajra, Sorghum, Sweet potato, Beet root and Sugarcane. Legumes: Chana and Moong and fodder legumes: Barseem, Alhagi. **11 Hrs.**

UNIT II:

Fat and Vegetable oil: Mustard, Ground nut, Soyabean and Coconut, fiber yielding plants (Cotton, Jute and Coir), Distribution, Characteristicsand uses of timber yielding plants Teak, Shishum and Babool. Beverages (Tea and Coffee), fumigatories and masticatories.

11Hrs

UNIT III:

General account and identification of locally available vegetables, spices and condiments (any five) of Rajasthan, dyes (*Indigo* and *Lawsonia*), History, cultivation, processing and economic use of rubber. Essential Oils. **11 Hrs.**

UNIT IV:

A brief account of ten important medicinal plants and their chief constituents used in indigenous and allopathic system of medicine with special reference *to Azadiracta indica, Emblica officinalis, Aloe vera, Ocimum sanctum, Rauwalfia serpentia, Vinca rosea, Datura stramonium, Withania somnifera, Curcuma.* A concise account on ornamental plants familiarity with seasonal and perennials grown in your locality. **12 Hrs.**

Suggested Readings

1. Gupta, S.K. and Kaushik, M.P. 1973. AnIntroduction to Economic Botany. K. Nath and Co., Meerut.
2. Hill, A.W. 1952. Economic Botany. McGraw Hill Book Co., New York.
3. Jain, S.K. 1981. Glimpses of Indian Ethnobotany. Oxford and IBH, New Delhi.
4. Jain, S.K .1987. A Manual on Ethnobotany**.** Scientific Publisher, Jodhpur.
5. Prakash, G., Sharma, S. K. 1975. Introductory Economic Botany. Jai Prakash Nath and Cosec, Meerut.

6. Sambamurthy, A.V.V.S. and Subrahmanyan, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd., New Delhi.
7. Sen, S. 1992. Economic botany. New Central Book Agency, Calcutta.
8. Singh, V., Pandey, P.C. and Jain, D.K. 1998-99. Economic Botany. Rastogi Publications, Meerut.
9. Verma, V. 1974. A Text Book of Economic Botany. Emkay Publications, New Delhi.

SEMESTER- V

PAPER – IV: EMBRYOLOGY OF ANGIOSPERM

Course Code: BOT (H) - 504

Max. Marks: 75
45 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:

Reproduction: Vegetative and sexual reproduction. Structure of typical angiosperm flower,

Microsporangia: Structure and development, wall structure and function, microsporogenesis, development of male gametophyte, Pollen wall structure, Pollen germination, Pollen tube growth.

11Hrs.

UNIT II :

Megasporangia: Structure and types of ovules; Special structures–obturator, aril, caruncle, epistase and hypostase. Megasporogenesis (monosporic, bisporic and tetrasporic) Development of female gametophyte(Embryo sac),Organization and ultrastructure of mature embryo sac. **11 Hrs**.

UNIT III:

Pollination and fertilization: Pollination types and significance; mechanism agencies and adaptations of pollination. Structure of stigma and style. Pollen pistil interaction. Pollen tube entry and path of pollen tube in pistil. Syngamy and triple fusion-double fertilization.
Self-incompatibility (GSI & SSI) and methods to overcome self- incompatibility. **12 Hrs**.

UNIT IV:

Embryo and Endosperm: Structure and general pattern of development of dicot and monocot embryo and types of endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features of embryo development in *Paeonia*. Polyembryony and apomixes.
11 Hrs.

Suggested Readings

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

BOTANY PRACTICAL - V

Maximum practical Marks = 150

Internal marks = 60

External marks = 90

60 HOURS

Suggested Laboratory exercises

1. Preparation of MS media.
2. Aseptic culture of different explants, methods of in vitro sterilization, inoculation and subculture methods.
3. Study of genetic engineering techniques (photographs): PCR, DNA fingerprinting, DNA sequencing, Gene gun, Ti plasmid.
4. Demonstration of Southern, Northern, and Western blotting (Photographs)
5. Study of steps of genetic engineering techniques from photographs (Bt cotton, Golden rice, Flavr Savr tomato)
6. Demonstration of a technique of Gel Electrophoresis.
7. Protoplast isolation by Enzymatic method.
8. Restriction digestion of DNA.
9. Description of the locally available plants of the following Families in semi-technical language

- Ranunculaceae: *Ranunculus,Delphinium*
- Brassicaceae:*Brassica, Alyssum,Iberis,Coronopus*
- Capparidaceae: *Capparis,Cleome*
- RFabaceae-Faboideae:*Lathyrus,Clitoria,Melilotus,Cajanus*
- Caesalpiniodeae:*Cassia,Caesalpinia*
- Mimosoideae: *Prosopis,Mimosa,Acacia*
- Apiaceae:*Coriandrum,Anethum*
- Rubiaceae:*HameliaMussaenda*
- Asteraceae-*Tridex,Helianthus,Calendula,Ageratum,Sonchus,Launaea*
- Solanaceae: *Solanum*
- Acanthaceae:*Adhatoda*
- Lamiaceae:*Ocimum*
- Euphorbiaceae:*Euphorbia,Phyllanthus,Jatropha*
- Liliacaeae-*Aspdodelus,Asparagus,Poa*

10. Preparation of taxonomic keys.
11. Familiarity with local flora and preparation of herbarium sheets.
12. Visit to a local Botanical Garden /Herbarium/National Park/ Study of local flora.
13. Study world map of centres of origin of cultivated Plants and Zhukovskys concept of megagene centre.
14. Study of starch grain in wheat and potato.
15. Study of all economically important crops mentioned in syllabus.
16. Study of different types of placentation, ovules and special structures of ovule through permanent slides, specimens or photographs.

17. Study of female gametophyte through permanent slides/ photographs.
18. Types and ultra-structure of mature embryo sac.
19. Study of pollen grains: fresh and acetolyzed showing ornamentation and aperture, pseudomonads, pollinia (slides/photographs/ fresh materials).
20. Study of the different stages of anther development.
21. Study of pollen morphology of available plants.
22. In vitro pollen germination using sugar solution.
23. Study of monocotyledons and dicotyledons embryo of angiosperms through slides/photographs.
24. Dissect and display embryo at various developmental stages using mustard seeds

SEMESTER-VI

PAPER-I: GENETIC ENGINEERING

Course Code: BOT (H) - 601

Max. Marks: 75
45Hrs.

Scheme of Examination: There will be two parts in the 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 the 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:

Role of Plant Biotechnology in Agriculture: pest resistant plants (Bt – cotton); herbicide resistance; disease and stress-resistant plants.

11 Hrs.

UNIT II:

Transgenic crops with improved quality traits (*Flavr Savr tomato, Golden rice*), Plants as bioreactors, Biosafety regulations in India.
Genetic Engineering in Floricultural Plants: Improved horticultural varieties (Moondust carnations)
Role of transgenics in bioremediation (Superbug).

11 Hrs.

UNIT III:

Medical Biotechnology: Disease diagnosis - Infectious diseases and genetic diseases; Therapeutics-Antisense oligonucleotides, RNAi as therapeutics.

Metabolic Engineering: Basic concept of metabolic engineering, strategies used in metabolic engineering, biotransformation, cell permeabilization, elicitation, hairy roots.

12 Hrs.

UNIT IV:

Industrial Biotechnology: Large-scale production of alcohol and antibiotics. Industrial enzymes: Aspergillase, Protease, Lipase.

Basic concept of genome editing, ***CRISPR.*** **11 Hrs.**

Suggested readings:

1. J. Hammond, P. McGarvey. Plant Biotechnology. Springer Verlab.2000.

2. H.S. Chawla. Biotechnology in Crop Improvement. InternationalBookDistributingCompany.1998.

3. R.J. Henry. Practical Application in Plant Molecular Biology.Chapmanand Hall.1997

4. P.K. Gupta. Plant Biotechnology. Rastogi and Co. Merrut. 2010.

5. Bhojwani, S.S. and Rajdan, M. K. 1996. Plant Tissue Culture. Theory and Practice (A Revised edition). Elsevier Science Publication, New York,USA.

6. Metabolic Engineering. Stephenopoulos, Arisitidou,A.A.andNeilson,J.AcademicPress.

7. BioprocessEngineering. Shuler, M.I. and Kargi,F.P. H.I. privateLearningLtd.,NewDelhi.

8. Basic Biotechnology. Ratledge, C., Kristainsen, B. CambridgePublication.

SEMESTER-VI

PAPER- II: ETHNOBOTANY

Course Code: BOT (H) - 602

Max. Marks: 75

45Hrs.

Scheme of Examination: There will be two parts to 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 the 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:

Ethnobotany: Introduction, concept, scope, and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or tribals of India, and their life styles. Plants used by the tribals: Food plants, intoxicants and beverages, Resins and oils and miscellaneous uses**.** **11 Hrs.**

UNIT II:

Role of Ethnobotany in Modern Medicine: Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology*) Azadiracthaindica, Ocimum sanctum, Vitex negundo, Gloriosa superba, Tribulus terrestris, Pongamia pinnata, Cassia spp., Indigofera tinctoria, Aloe vera, Andrographis paniculata, Clotoria spp.* **12Hrs**.

UNIT III:

Role of ethnobotany in modern medicine with special example *Rauvolfia serpentina, Terminalia arjuna,Trichopuszeylanicus, Artemisia, Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management. **11 Hrs.**

UNIT IV:

Ethnobotany and Legal Aspects: Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge. **11Hrs.**

Suggested Readings:

1 S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

2 S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

3 Lone et al,. Palaeoethnobotany

4 S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

5 S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.

6 Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons Chichester

7 Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.

8 Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996_

9 Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd.

SEMESTER-VI

PAPER – III: BIODIVERSITY CONSERVATION AND HUMAN WELFARE

Course Code: BOT (H) - 603

Max. Marks: 75

45Hrs.

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:

Plant Diversity and its Scope: Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa, Values and uses of biodiversity: Ethical and aesthetic values, Methodologies for valuation, Loss of biodiversity.

11Hrs.

UNIT -II:

Management of Plant Biodiversity: *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. Organizations: IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication, concept of Bioeconomy. **12Hrs**.

UNIT-III:

Contemporary Practices in Resource Management: Environmental Impact Assessment (EIA), Geographical Information System (GIS), Participatory resource appraisal, Ecological footprint with emphasis on carbon footprint, Resource accounting; Solid and liquid waste management.

11Hrs.

UNIT- **IV:**

Role of Plants in Relation to Human Welfare: Importance of forestry, their utilization and commercial aspects Avenue trees, ornamental plants of India. Fruits and nuts; Important fruit crops their commercial importance. Wood, fibre and their uses. **11Hrs**.

Suggested Readings:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi

SEMESTER-VI

PAPER –IV: SEED SCIENCE

Course Code: BOT (H) - 604

Max. Marks: 75
45Hrs.

Scheme of Examination: There will be two parts tothe 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:

Development, Morphology and Anatomy of Seed: Development of dicotyledonous and monocotyledonous seed, exomorphic features; Morphology and anatomy: seed coat, pericarp, endosperm, perisperm and embryo. Difference between dicot and monocot seed.

Structure of monocot seed: Maize and wheat

Structure of dicot seed: Pea, Gram, Soybean and Castor; Development of fruit, fruit maturation, ripening and dispersal. **12 Hrs**.

UNIT II:

Desiccation in seeds, Seed maturation and longevity in orthodox and recalcitrant seed. Chemical composition of seed and storage of reserve material.

Seed dormancy: Definition and types of dormancy, causes and factors affecting seed dormancy, mechanisms of induction and release, breaking of seed dormancy, significance in agriculture, advantages and disadvantages. Seed Deterioration-symptoms and causes. **11 Hrs**.

UNIT III:

Seed germination: Pattern, types and Basic requirement for seed germination.

Normal and abnormal seedlings, Germination inhibitors, metabolism of storage products during germination, Physiological and biochemical changes and role of hormone. Physiology of seed germination seed and Seedling vigor. **11 Hrs**.

UNIT IV:

Seed production: Hybrid seed production. Principles and methods of seed production in self and cross-pollinated crops hybrid seed production foundation and certified seeds. Synthetic seeds-method of preparation and importance. Terminator seeds: Technology, advantages and disadvantages. **11Hrs**.

Suggested readings:

1. Agarwal,V.K. and Sinclair, J.B. (1987). Principles of seed-pathology, II edition CRC Lewis Publishers, Boca Raton, New York, London.
2. Agarwal, R.L. 1980.SeedTechnology, Oxford and I B H Publishing Co.Pvt.Ltd.NewDelhi.
3. Anonymus (1985). International rules for seed testing. International Seed Testing Association (ISTA). Seed Sci. &Tech.
4. Bewley, J.D. and Black, M.1983. Physiology and Biochemistry ofseeds in relation to germination, Volume I & II, Springer-Verlag, Berlin, Heidelberg, NewYork.
5. Copeland,L.O. 1976 Principles of Seed Sci. and Technology Minnesota, USA.
6. Kulkarni,G.N. 2002.PrinciplesofseedTechnology,KalyaniPublishers,NewDelhi.
7. Neergaard,P. 1986. Seed- A horse of hunger or a source of life. Revised print of Danish Government Institute of seed pathology for Developing Countries, Hellerup,Denmark.
8. Winton, A.L. and Winton, K.B. (1932-1939). The structure and Composition of foods Vol I and II, John Willey and Sons, Inc., NewYork.

BOTANY PRACTICAL - VI

Maximum practical Marks = 150

Internal marks = 60

External marks = 90

60 HOURS

Suggested Laboratory exercises

1. Study of genome maps of pBR 322, pUC18 vectors through photograph.
2. Study of *Agrobacterium tumefaciens* mediated crown gall disease.
3. To learn the technique of Dot ELISA for the detection of an antigen.
4. Study of prokaryotic vector BAC
5. Study of eukaryotic vector YAC
6. Study of BT Cotton
7. Study of principle and working of PCR
8. To perform restriction digestion exercise
9. Methodology of Ethnobotanical studies: Field work, Herbarium, Ancient Literature, Archaeological findings, temples and sacred places
10. Study of exotic species- Identification and morphological characteristics.
11. Identification of forest trees through bark, wood, flowers, leaves and fruits.
12. Maceration, Study of wood (Tracheary elements, fibres).
13. Methods of preservation and canning of fruits.
14. Visit to the local ecosystem to study the plants.
15. Write up on the conservation efforts of international organizations.
16. Study of solid and liquid waste management systems in rural/urban areas.
17. Structure of seeds of some crop plants (wheat, pearlmillet, mustard, gram, pea)
18. Common weed seeds in crop seed lots and their identification (*Amaranthus* and *Cynodon)*.
19. Study of purity of seed samples.
20. Study of seed germination, seedling abnormality and seedling index.
21. Determination of moisture content of seeds.
22. TZ test for seed viability.
23. Biochemical testing of starch, protein,lipids, tannins, phenols and lignin in seed sections.