

## 4. Botany

### B.Sc. Part- I

Scheme:

Max. Marks: 100

Min. Pass Marks: 36

Paper I	3 Hrs duration	33	Marks
Paper II	3 Hrs duration	33	Marks
Paper III	3 Hrs duration	34	Marks
Practicals:	4 Hrs. duration	50	Marks

Duration of examination of each theory paper-

3 hours

Duration of examination of practicals

4 hours

**Note:**

1. There will be 5 questions in each paper. All questions are compulsory. Candidate has to answer all questions in the main answer book only
2. Q.No. 1 will have 20 very short answer type Questions (not more than 20 words) of half marks each covering entire syllabus.
3. Each paper is divided into four units. There will be one question from each unit. These Q.No. 2 to 5 will have internal choice.

**M.S.B. UNIVERSITY, BHARATPUR****B.Sc. Part I****Paper- I****ALGAE, LICHEN AND BRYOPHYTA****Unit- I**

General characters, Classification (Smith). Diverse Habitat. Range of thallus structure. Photosynthetic pigments and Food reserves. Reproduction (Vegetative, Asexual, Sexual). Types of life cycles: Economic Importance.

**Unit- 2****Type Studies**Cyanophyceae - *Oscillatoria*, *Nostoc*Chlorophyceae- *Volvox*, *Oedogonium*, *Chara*.Xanthophyceae - *Vaucheria*Phaeophyceae - *Ectocarpus*.Rhodophyceae- *Polysiphonia*.**Unit-3**

General characters. Origin, and evolution of Bryophyta. Classification (Eichler); Habitat. Range of thallus structure. Reproduction (Vegetative and Sexual); Alternation of generations; Economic importance.

**Unit-4****Type Studies**Hepaticopsida - *Riccia*, *Marchantia*.

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Anthocerotopsida - *Anthoceros*.

Bryopsida - *Funaria*.

Lichens- General characters, Habitat, Structure, Reproduction, Economic and Ecological importance of Lichens.

#### Suggested Laboratory Exercises

1. Study of class material by making suitable temporary slides and study of permanent slides of, *Oscillatoria*, *Nostoc*, *Volvox*, *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus*, *Polysiphonia*.
2. Study of external morphology and preparation of suitable sections of vegetative/reproductive parts of *Riccia*, *Marchantia*, *Anthoceros*, *Funaria*.
3. Study of lichens.

#### Suggested Readings

- Bold .H.C. Alexopoulos, C.J. and Delivoryas, T Morphology of Plant and Fungi (4th Ed.) Harper & Foul Co, New work, 1980.
- Ghemawat, M.S. Kapoor, J.N. and Narayan, H.S. A text Book of Algae, Ramesh Book Depot, Jaipur, 1976.
- Gilbart, M. Smith. Cryptogamic Botany, Vol. I & II (2nd Ed.) Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1985.
- Kumar, H.D. : Introductory Phycology, Affiliated East- West Press, Ltd. New York, 1988.
- Puri, P. : Bryophytes, Atmaram & Sons, Delhi, Lucknow, 1985.
- Sarabhai, R.C. and Saxana, R.C. : A text book of Botany, Vol I & II, Ratan Prakashan Mandir, Meerut, 1980.
- Singh, V., Pande, P.C. and Jain, D.K.: A text book of Botany, Rastogi, & Co., Meerut, 2001.
- Vashista, B.R.: Botany for Degree Students ( Algae, Bryophytes) S.Chand & Co., New Delhi, 2002.

#### Paper II

#### Microbiology, Mycology and Plant Pathology

#### Unit-I

Microbiology: Meaning and scope, history and development in the field of microbiology. concept of quorum sensing and biofilms.

Eubacteria: General account, occurrence, morphology (structured and shapes), flagella, capsule, nutritional types, endospore, reproduction (binary fission, transformation, conjugation, transduction), economic and biological importance.

Mycoplasma and Phytoplasma: occurrence, morphology, reproduction and importance.

Virus: General characteristics and importance. Structure of TMV and Pox virus, Structure and multiplication of Bacteriophage.

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## Unit-II

Fungi: General characters, occurrence, thallus organization, reproduction, economic importance, classification of fungi (Alexopoulos).

Brief account, structure, importance and life history and/or disease cycle and control of the following:

*Albugo* and white rust; *Sclerospora* and Downy mildew/Green ear disease of Bajra; *Aspergillus*; *Peziza*.

## Unit -III

Brief account, structure, importance and life history and/or disease cycle and control of the following:

*Puccinia* and Black rust of wheat; *Ustilago* and loose smut of wheat and covered smut of barley; *Agaricus*; *Alternaria* and early blight of potato.

## Unit-IV

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

## Suggested Laboratory Exercises:

1. Study of bacteria using curd or any other suitable material, Gram's staining of bacteria.
2. Study of Mycoplasma, TMV, bacteriophage (Photographs/3-D models).
3. Study of symptoms of plant diseases- Downy mildew of Bajra, Green ear of bajra, Powdery mildew.
4. Study of specimen, permanent slides and by making suitable temporary slides. *Albugo*- white rust; *Sclerospora*- downy mildew, green ear; *Aspergillus*; *Claviceps*- ergot; *Peziza*, *Ustilago*- Loose smut of wheat, covered smut of barley, *Puccinia*- Black rust of wheat; *Agaricus* and *Alternaria*- early blight of potato.
5. Media preparation; potato dextrose agar, Nutrient agar.
6. Culture techniques of fungi and bacteria.

## Suggested Books:

- Alexopoulos, C.J. and Mims, C.W. : Introductory Mycology, John Wiley and Sons, New York, 2000.
- Dube, H.C.: Fungi, Rastogi Publication, Meerut, 1989.
- Sarabhai, R.C. and Saxena, R.C.: A Text book of Botany, Rastogi Publication, Meerut, 1990.
- Sharma, O.P: Fungi, Today and Tomorrow Printers and Publishers, New Delhi, 2000.
- Vashista, B.R. Botany for degree students- Fungi, S.Chand & Co. New Delhi, 2001.
- Bilgrami, K.S. and Dube, H.C.: A Text book of modern plant Pathology, Vikas Publications, New Delhi 2000.

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- Biswas, S.B. and Biswasa: An Introduction to Viruses, Vikas Publications, New Delhi 2000
- Clifton, A.: Introduction of Bacteria, McGraw Hill co. Ltd., New York, 1985.
- Madahar, C.L.: Introduction of Plants Virus, S.Chand and Co., New Delhi, 1978.
- Palzar M.J. Jr. Chan, E.C.S. and Krieg, N.R. : Microbiology, McGraw hill Edu. Pvt. Ltd., London 2001.
- Purohit, S.S : Microbiology, Agro. Bot. Publication, Jodhpur 2002.
- Sharma, P.D. : Microbiology and Pathology, Rastogi Publication, Meerut, 2003.
- Singh, V. and Srivastava V. : Introduction of Bacteria. Vikas Publication, 1998.
- Cappuccino, J. and Sherman, N.: Microbiology: A Laboratory Manual (10 Th Ed.), Benjamin Cummings, 2013
- Aneja, K.R. Experiments in Microbiology, Plant Pathology and Biotechnology New age International (P) Ltd., Publishers, New Delhi 2003.
- Mehrotra, R.S. and Aggarwal, Ashok: Plant Pathology, Tata McGraw- Hill Education, 2003.

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**B.Sc. Part- I BOTANY:**

**PAPER III- CELL BIOLOGY, GENETICS AND PLANT BREEDING**

**Unit- I : Cell organelles and Nuclear material:**

Ultrastructure and function of different cell organelles ( cell wall, plasma membrane, nucleus, mitochondria, chloroplast, ribosome, peroxisomes, Lysosome, Golgi bodies and Endoplasmic Reticulum). Chromatin structure and chromosome organisation: eukaryotic and prokaryotic, Transposons.

**Unit-2: Cell divisions**

**Cell Cycle, Mitosis:** stages, structure and functions of spindle apparatus; anaphasic chromosome movement; Meiosis: its different stages- meiosis I, meiosis II, synaptonemal complex, chiasmata formation and crossing over.

**Basis of genetic material:** Griffith's transformation experiment and the Hershey and Chase blender experiment to demonstrate DNA as the genetic material.

**Concept of Gene:** *Neurospora* genetics: one gene one enzyme hypothesis.

**Extra nuclear genome:** Mitochondrial and chloroplast genome, plasmids.

**Chromosomal aberrations:** Deletion, Duplication, Translocation, Inversion, Aneuploidy and Polyploidy.

**Unit-3: Genetic Inheritance**

Mendel's laws of inheritance and their exceptions: allelic ( incomplete and co-dominance, lethality) and non-allelic interactions ( complementary genes, epistasis and duplicate genes). Quantitative inheritance: grain colour in wheat, corolla length in *Nicotiana tubacum*.

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**Cytoplasmic inheritance:** Maternal influence, shell coiling in snails, kappa particles in *Paramecium*, multiple allelism : ABO blood groups in men.

#### Unit-4 : Plant Breeding

Introduction and objectives of plant breeding ; general methods of plant breeding- in self-pollinated, cross-pollinated and vegetatively propagated crop plants.

Introduction and acclimatization, selections, hybridizations, hybrid vigour and inbreeding depression. Role of mutation and polyploidy in plant breeding. Famous Indian and international plant breeders and their contribution. National and International agricultural research institutes.

Plant breeding work done on wheat and rice in India, Green revolution.

#### Suggested Laboratory Exercises:

- Study of cell structure from Onion, *Hydrilla* and *Spirogyra*
- Study of cyclosis in *Tradescantia* spp.
- Study of plastid for pigment distribution in *Lycopersicon*, *Cassia* and *Capsicum*.
- Study of electron microphotographs of eukaryotic cells for various cell organelles.
- Study of electron microphotographs of virus, bacteria and eukaryotic cells for comparative study of cellular organization.
- Study of different stages of mitosis and meiosis in root-tip cells and flower buds respectively of onion.
- To solve genetic problems based upon Mendel's Laws of inheritance: Monohybrid, Dihybrid, Back cross and Test cross.
- Permanent slides/Photographs of different stages of mitosis and meiosis, sex chromosomes, polytene chromosome and salivary gland chromosomes.
- Emasculation, bagging & Tagging techniques.
- Cross pollination Techniques.

#### Suggested Readings:

- Choudhary, H.K. (1989), Elementary Principles of Plant Breeding, Oxford and IBM Publishing Co, New Delhi.
- Gupta, P.K. (2009) Cytology, Genetics Evolution and Plant Breeding, Rastogi Publications, Meerut.
- Miglani, GS (2000), Advanced Genetics, Narosa Publishing House, New Delhi.
- Russel, PL (1998). Genetics The Benjamins/Cummings Publishing Co., Inc. U.S.A.
- Shukla, R.S and chandel, P.S, (2000) Cytogenetics, Evolution and Plant Breeding, S.Chand & Co. Ltd. New Delhi.
- Singh, R.B.(1999), Text Book of Plant Breeding, Kalyani Publishers, Ludhiana.
- Dnyansagar, VR. ( 1986). Cytology and Genetics, Tata McGraw Hill Pub.Co. Ltd. New.
- Roy, SC, and De, KK. (1999) Cell Biology, New Central Book Agency (P) Ltd, Calcutta.
- Verma, PS and Agarwal, V (2012) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S.Chand and Co. Ltd. New Delhi.

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4. BOTANYB.Sc. Part- II

Scheme

Min Pass Marks: 36

Max Marks: 100

Paper I

3 Hrs duration

Max.Marks 33

Paper II

3 Hrs duration

Max Marks 33

Paper III

3 Hrs duration

Max. Marks 34

Practical Min. Marks: 18

4 Hrs. duration

Max. Marks 50

3 hours

4 hours

Duration of examination of each theory paper-

Duration of examination of practicals -

Note:

1. There will be 5 question in each paper all questions are compulsory. Candidate has to answer all questions in the main answer book only.
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**B.SC. PART-II**  
**Paper I : Molecular Biology and Biotechnology**

**UNIT- 1**

**Genetic Material:** Biological, chemical and physical nature of hereditary material, structure of DNA and RNAs ( mRNA, tRNA and rRNA). Watson and crick model of DNA, Nucleosome model.

**DNA replication:** Meselson- stahl experiment of semiconservative replication of DNA; RNA Primers, okazaki-fragments, polymerases; DNA- Protein interactions. Preliminary account of DNA damage and repair.

**UNIT- 2**

**Central dogma of life, Transcription in eukaryotes:** role of promoter, gene, pre mRNA synthesis, pre mRNA processing: capping, splicing and polyadenylation.

**Translation:** genetic code (Codon), initiation, elongation and termination.

**Regulation of gene expression in prokaryotes and eukaryotes:** Negative and positive control, attenuation and antitermination, Reverse transcriptase and its application.

**UNIT- 3**

**Biotechnology:** Functional definition. Basic aspects of plant tissue culture, basal medium, media preparation and aseptic culture technique. Concept of cellular totipotency; Callusing; Differentiation and Morphogenesis; Micropropagation; Tissue culture and its applications. Basic concept of Protoplast culture, Anther culture, Embryo culture nad their applications.

**UNIT- 4**

**Recombinant DNA Technology:** Tools and Techniques used in rDNA technology. Restriction enzymes. Vectors for gene transfer, Bacteriophage, plasmids, cosmids and Artificial chromosome, cDNA technology, gene amplification, Polymerase chain reaction, Application of PCR technique, DNA fingerprinting and its uses, Application of Biotechnology and transgenic plants.

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पुठान

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**B.Sc. Part II**  
**Paper- II (Pass Course Syllabus)**  
**Plant Physiology and Biochemistry**

(2 Hrs/week)

Max. Marks 33; Duration of examination of theory paper: 3hours

**Unit-1**

**Water:** Structure, physio-chemical properties, importance to plant life, concept of water potential. Absorption and transport of water; Ascent of sap. Transpiration, stomatal factors affecting transpiration. Guttation.

**Mineral Nutrition :** Essential micro and macro nutrients; their uptake, hydroponics-and nutrient requirement deficiency and toxicity symptoms.

**Transport of organic substances:** Mechanisms of phloem transport, factors regulating the translocations of nutrients.

**Unit- 2**

**Photosynthesis:** Pigments, Photosynthetic apparatus, Light reaction, photo system I & II, Z scheme, photophosphorylation, C3 ( Calvin cycle), C4 Cycle, and factors affecting the photosynthesis.

**Respiration :-** Aerobic and anaerobic respiration; RQ (Respiratory Quotient), Kreb's cycle, electron transport system, oxidative phosphorylation and factors affecting the process. Fermentation.

**Unit-3**

**Carbohydrates:** Introduction, importance, nomenclature, classification, molecular structure & function of mono, di and polysaccharides, their properties, glycosidic linkages and glycoprotein.

**Proteins:** Amino acids-structure, electrochemical properties, peptide bonds, chemical bonds and nomenclature, structure and classification of proteins, physical and chemical properties.

**Enzymes:** Structure, nomenclature & classification of enzyme. Characteristics of enzymes. mechanism of action, multi-enzyme system, regulation of enzyme activity.

**Lipids:** Importance of fatty acids ( Saturated and unsaturated), Alpha and Beta Oxidation. Brief introduction and application of secondary metabolites.

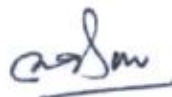
**Unit- 4**

**Phases of growth and development:** Seed dormancy and germination, plant movement, Biological clock-their regulatory factors.

**Photoperiodism & vernalisation:** Physiology and mechanism of action, concept of florigen and phytochrome.

**Plant Hormones:** Auxins, Gibberellins, Cytokinins, Ethylene and ABA: discovery & Physiological effects.

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## Laboratory Exercises

## Exercises:

1. To determine the osmotic potential of vacuolar sap by plasmolytic method.
2. To study the permeability of plasma membrane using different concentrations of organic solvents.
3. To study the effect of temperature of permeability of plasma membrane.
4. To Separate chloroplast pigments by solvent method.
5. To Separate chloroplast pigments using paper chromatography.
6. To separate amino acids in a mixture by paper chromatography.
7. To prepare the standard curve of protein.
8. To demonstrate the tests for proteins in the unknown samples.
9. To demonstrate the enzyme activity Catalase, peroxidase and amylase.
10. To demonstrate the tests for different types of carbohydrates and lipids
11. Bioassay of growth hormone auxin, cytokinin, gibberellins.
12. Demonstration of phenomenon of osmosis by use of potato osmometer
13. To demonstrate root pressure.
14. To demonstrate rate of transpiration by use of photometers.
15. Photosynthesis by inverted funnel method. Moll's experiment.
16. To demonstration anaerobic and aerobic respiration.
17. R.Q. by Ganong's respirometer.
18. Measurement of growth using auxanometer.

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**B.Sc. Part II**  
**Paper- III : Pteridophytes, Gymnosperms And Palaeobotany**

Exam Duration : 3 Hrs.

Maximum Marks : 34

**Unit-I**

General characters of pteridophytes, classification by (G.M.Smith). Distribution and alternation of generation. Stelar system in pteridophytes. Eusporangiate and Leptosporangiate development of Sporangia, Apogamy and Apospory. Economic importance of pteridophytes.

**Unit-II**

Morphology, anatomy and reproduction of Psilotum, Lycopodium, Selaginella, Equisetum and Marsilea. Characteristics of Gymnosperms, distribution and classification (K.R.Sporne)

**Unit-III**

Morphology, anatomy, reproduction and life cycle of Cycas, Pinus and Ephedra, Economic importance of Gymnosperms.

**Unit-IV**

Process of fossilization, types of fossils, techniques of study of fossils. Geological time scale. Primitive land plant: Rhynia, Fossil pteridophytes: reconstructed plants-Lepidodendron and Calamites. Fossil Gymnosperm- Williamsonia.

*Ar. Kumar*  
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*Ar. Kumar*

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*प्रति*

*Ar. Kumar*  
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## (B.Sc PART -II)

## BOTANY

Paper III

(Readings)

~~Platophytes, Gymnosperms & Angiosperms~~**Suggested Laboratory Exercises**

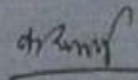
1. Study of external morphology, anatomy of vegetative and reproductive parts of *Psilotum*, *Selaginella*, *Equisetum* and *Marsilea*
2. Study of external morphology, anatomy of vegetative and reproductive parts of *Cycas*, *Pinus* and *Ephedra*
3. Study of fossils and slides of Fossils
4. Preparation of charts of Geological time scale

**Suggested Readings**

1. Harold C. Bold, Constantine J. Alexopoulos & Therodore Delevoryas  
Morphology of Plants and fungi  
Pub - Harper & Row (New York)
2. Ernest M. Gifford & Adriance S. Foster  
Morphology and Evolution of Vascular plants  
Pub - W. H. Freeman
3. Hirendra Chandra Gangulee & Asok Kumar Kar  
College Botany (Volume-2)  
Pub - New Central Book Agency (Calcutta)
4. R.C. Sarabhai & R.C. Saxena  
A text book of Botany  
Pub - Rastogi Publication (Meerut)
5. B.R. Vashistha  
Botany for degree students - Gymnosperms,  
Pub - S. Chand & Co. (New Delhi)
6. B.R. Vashistha  
Botany for degree students - Pteridophytes  
Pub - S. Chand & Co. (New Delhi)
7. S.P. Bhatnagar & A. Mitra  
Gymnosperms  
Pub - New Age International Pvt Ltd. (New Delhi)



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# 4. BOTANY

B.Sc. P.T. III

## Scheme

Min. Pass Marks : 36

Paper I

3 hrs. duration

Max Marks: 100

Max. Marks 33

Paper II

3 hrs. duration

Max. Marks 33

Paper III

3 hrs. duration

Max. Marks 34

Practical Min. Marks: 18

4 hrs. duration

Max. Marks 50

3 hours

4 hours

Duration of examination of each theory paper-

Duration of examination of practicals-

## Note:

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Paper I

PLANT MORPHOLOGY AND ANATOMY

(2 hrs /week)

Unit-1

The basic body plan of flowering plant-modular type of growth. Diversity of Plant form in annuals, biennials and perennials; branching pattern: monopodial and sympodial growth; canopy architecture; meristematic, simple, complex and secretory tissues, tissue systems.

Unit-2

The Shoot system: The shoot apical meristem and its histological organization; vascularisation of primary shoot in monocotyledons and dicotyledons; cambium and its functions; formation of secondary xylem; a general account of wood structure growth rings, sapwood and heartwood; secondary phloem-structure and function; periderm; Anomalous secondary growth.

Unit-3

The Leaf: origin, development, arrangement and diversity in size and shape; Stomata-Structure and types, stomatal index, vascularisation of leaf-nodal structure and venation. Senescence and abscission.

The root system: Root apical meristem; differentiation of primary and secondary tissues and their functions; structural modification for storage, respiration, reproduction and root-microbe interaction.

Unit-4

Morphology and anatomy of seed (monocotyledons and dicotyledons). Significance of seed-suspended animation: dispersal strategies. Vegetative propagation.

Suggested readings :

Cutter, E.G. 1969. Part I Cells and Tissues. Edward Arnold, London.

Cutter, E.G. 1971. Plant Anatomy : Experiment and interpretation, part-II, organs. Edward Arnold; London.

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

Fahn, A. 1985. Plant Anatomy. Pergamon Press, Oxford.

Hartman, H.T. and Kestler, D.E. 1976. Plant Preparation: Principles and of India Pvt. Ltd., New Delhi.

Manseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Co. Inc. Menlo Park, California, USA.

Raven, P.M. Evert, R.F. and Eichhien, S. E. 1994. Biology of Plants, W.H. Freeman and Co. Worth Publishers, New York.

Thomas, P. 2000. Trees Their National History. Cambridge University Press, Cambridge.

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**Suggested Laboratory Exercises:**

1. Study of any commonly occurring dicotyledonous plant to understand the body plan and modular type of growth.
2. Life forms exhibited by flowering plants (by visit to a forest or a garden).
3. L.S. of shoot tip to study the organization of meristem and origin of leaf primordial.
4. Monopodial and sympodial types of branching in monocots & dicots.
5. Anatomy of primary and secondary growth in monocots and dicots using hand out sections of sunflower, maize, cucurbita stem and roots.
6. Anamolous secondary growth in stem: *Salvadora*, *Bignonia*, *Bougainvillia*, *Bouhaenia*, *Myctanthes*, *Leptadenia*, *Deacena*
7. Study of diversity in leaf shape and size. Internal structure of leaf-Dorsiventral and isobilateral leaves; study of stomatal types.
8. Examination of seed (monocot and dicot). Structure. seed viability test.
9. Specimen study of modifications of plant parts for Vegetative reproduction.

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**Paper-II**  
**Ecology & Economic Botany**  
 (2 hrs/week)

**Unit-1**

Plants and Environment: Atmosphere (four distinct zone viz, stratosphere, troposphere, mesosphere and thermosphere) Adaptation (Morphological, anatomical and physiological responses) of plants to water (Hydrophytes and Xerophytes). Light (global radiation, photosynthetically active radiation. Zonation in water body: littoral, limnetic and profundal zones: photoperiodism, heliophytes and sciophytes) Temperature (Raunkier's classification of plants, megatherm, mesotherm, microtherm, hekistotherm; themoperiodicity and vernalisation). Soil (soil profile, development-weathering and maturation). Soil texture, soil types, role of pH, organic matter, soil water, soil nutrients. Interactions among organisms (neutralism, amensalism, allelopathy), competition, predation, parasitism, proto-cooperation, mutualism. Environmental protection act

**Unit-2**

Community, Ecosystem and Phytogeography: Community characteristics: stratification, life forms and biological spectrum, frequency density and cover. Ecological succession: types (primary and secondary) mechanism nudation, migration, ecesis, reaction and climax: xerosere, hydrosere. Ecosystems: Structure-abiotic and biotic components, trophic level, food chain, food web, ecological pyramids, energy flow (Box and Pipe model of Odum). Biogeochemical cycles of carbon, and phosphorus, Vegetation types of Rajasthan, Endangered plants of Rajasthan.

**Unit-3**

Basic concept of center of origin of cultivated plants. Food plants-rice, wheat, maize, potato, sugarcane. Vegetables: General account with a note on radish, onion, garlic, cabbage, spinach, cauliflower, cucumber, tomato, lady finger and pea. Fruits: General account with a note on apple, banana, ber, mango, mulberry, jamun, watermelon, muskmelon, guava and orange. Vegetable oil groundnut, mustard and coconut.

**Unit-4**

Spices: General account with an emphasis on those cultivated in Rajasthan (Cumin, Capsicum, Coriander). Beverages: Tea and coffee. Medicinal plants: General accounts with an emphasis on plant species cultivated in Rajasthan

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(Senna, Isabgol, Safed musli). Fibers: Cotton and jute. Wood: General account of sources of firewood, timber and bamboos; Rubber Ethnobotany: a general account.

**Practical Exercises:**

1. Study frequency and density, abundance of plant species of campus vegetation by quadrat method.
2. Variation in soil moisture in relation to depth.
3. To estimate bulk density of grassland and woodland soil.
4. To estimate the porosity of grassland and woodland soil sample.
5. To determine moisture content of grassland and woodland soil.
6. To measure dissolved oxygen content in polluted and unpolluted water samples.
7. To measure temperature of different water bodies.
8. Water holding capacity of the soil.
9. Find out pH of soil sample by universal Indicator method.
10. Find out pH of water sample by pH meter.
11. Find out transparency of a waterbody by Secchi disk.
12. Study morphology (external and internal) of hydrophytes (*Hydrilla* stem, *Typha* leaf and *Nymphaea/Eichhornia* petiole) and xerophytes (*Calotropis*, *Capparis* and *Casuarina* stem, *Nerium* leaf) with special reference to their adaptations.
13. Study following specimen with special reference to:
  1. Botany of the economically important part.
  2. Processing, if any involved.
  3. Specimen of cereals, pulses, spices Beverage (tea & coffee) beans, sugar, oil seeds (mustard, groundnut).
14. Study of starch grain in potato and pea. Histochemical test Cellulose, lignin, starch, fat, protein and tannin.
15. Submit 5 specimens of locally important medicinal plants.

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## Paper-III

## Angiosperm- Taxonomy and Embryology

(2 hrs /week)

## Unit-1

Introduction of Taxonomy, Units of classification, Concept of genus and species, Botanical Nomenclature, International Code of Botanical Nomenclature

Taxonomic literature: Floras, Gardens, Herbaria, Monographs, Icones, Library.

Types of systems of Classification: Bentham and Hooker's, Engler and Prantle's system.

Diversity of flowering plants illustrated by members and economic importance of the following families: Ranunculaceae, Brassicaceae, Papaveraceae, Malvaceae, Fabaceae, Caryophyllaceae and Apiaceae.

## Unit-2

Rubiaceae, Asteraceae, Apocynaceae, Awolepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Arecaceae and Poaceae.

## Unit-3

Ontogeny of the flower parts-development and variations, Structure of anther, microsporogenesis, Tapetum types and functions, development of male gametophyte, structure of pollen grains.

Types of ovule, Megasporogenesis, development of female gametophyte (Embryosac), Pollination, Pollination types, Fertilization, double fertilization, significance of double fertilization.

## Unit-4

Development of dicot and monocot embryo, Formation of embryo, Types of Embryo, Eudicot, Types of Eudicot, Endosperm, Haustoria, Polyembryony, Induced polyembryony, Parthenocarp, Apomixis and adventive embryo.

Suggested Laboratory Exercises

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## (A) Taxonomy:

(1) The following genera are suitable for study of families

1. Ranunculaceae-*Ranunculus*, *Delphinium*.
2. Fabaceae-*Pisum sativum*, *Cassia* and *Acacia*.
3. Apiaceae-*Coriandrum*.
4. Convolvulaceae-*Ipomea*, *Jacquemontia*.
5. Apocynaceae-*Catharanthus*, *Thevetia*.
6. Asclepiadaceae-*Calotropis*.
7. Lamiaceae-*Ocimum*, *Salvia*.
8. Euphorbiaceae-*Euphorbia pulcherrima*, *Ricinus*.
9. Acanthaceae-*Adhatoda*.
10. Asteraceae-*Helianthus*.
11. Rubiaceae-*Hamelia*.
12. Poaceae-*Triticum*.

(II) Types of Inflorescence and Fruits

(III) Embryology

1. Dissection of anther, to study the wall layers and pollen sac with pollen grains.
2. Study the various types of ovule, draw the diagrams.
3. Study the various types of placentations.
4. Study the germination of pollen grain *in situ* and observe the path of pollen tube.
5. Study of various stages of embryo (*Raphanus* fruit)

## Suggested Readings:

1. Taxonomy of Angiosperms-V.N. Sair (1995) TMH Publishing Company Limited, New Delhi.
2. Introduction to the Principles of Plant Taxonomy V.V. Sivarajan (1984) Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Plant Taxonomy-Sushella Mathur (2003) Dominant Publishers and Distributors, New Delhi.
4. Plant systematics, Gurcharan Singh (2011) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

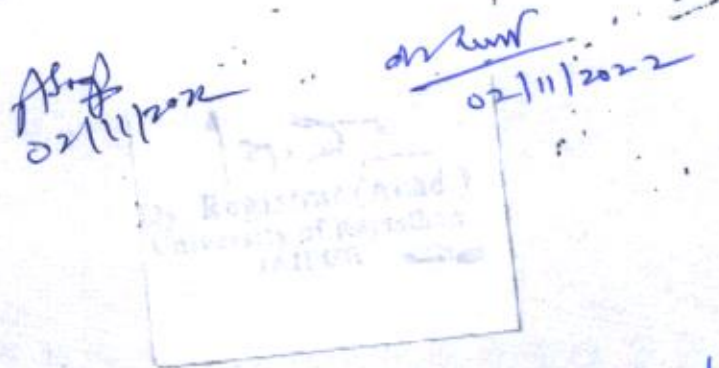
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5. Inveij, P.C.: N. Sharma and J. Sharma (2003) Structure, Development and Reproduction in Flowering Plant. Ramesh Book Depot, Jaipur.
6. Bhatnagar, S.S. and Bhatnagar, S.P. (2000) The embryology of Angiosperms- 4th Edition, Vikas Publishing House, New Delhi
7. An Introduction to the Embryology of Angiosperm. Maheshwari, P. (1950) New Delhi
8. Recent advances in the Embryology of Angiosperms. Ed. Maheshwari P. New Delhi.



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