

UNIVERSITY OF KOTA

SEMESTER SCHEME

(w.e.f. 2018-19)



M.Sc. Botany

SEMESTER-IV

(Syllabus and Scheme of Examination)

MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005

Syllabus of M.Sc. Botany

Semester-I

- Paper I. Biology and Diversity of Lower Plants
- II. Pteridophyta, Gymnosperms and Paleobotany
- III. Plant Physiology
- IV. Microbiology and Plant Pathology
- V. Practicals

Semester-II

- Paper VI. Plant Ecology
- VII. Plant Resource Utilization & Conservation
- VIII. Cell and Molecular Biology
- IX. Biochemistry
- X. Practicals

Semester-III

- Paper XI. Plant Development and Reproduction
- XII. Cytogenetics
- XIII. Taxonomy of Angiosperms
- XIV. **Elective Paper**
 - XIV (a).AdvancedPlant PathologyI
 - XIV (b).Advanced PlantEcologyI-Environmental Biology
- XV. Practicals

Semester-IV

- Paper XVI. Biotechnology and Biometrics
- XVII. Plant Morphology and Anatomy
- XVIII. Seed Biology and Plant Breeding
- XIX. **Elective Paper**
 - XIX (a).Advanced Plant PathologyII
 - XIX (b).AdvancedPlantEcologyII-Arid Zone Ecology
- XX. Practicals

M.Sc. Botany Syllabus

Semester-IV

Paper XVI. Biotechnology and Biometrics

Duration of Examination: 3 Hours	Maximum Marks	: 100 Marks
	Semester Assessment	: 70 Marks
	Continuous (Internal) Assessment	: 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Concepts and scope of plant biotechnology. Plant cell totipotency, Cellular differentiation. Plant tissue culture, Micropropagation-organogenesis, somatic embryogenesis, shoot bud differentiation and plantlet formation.

Protoplast isolation, purification, culture, regeneration and fusion. Somatic hybrids and cybrids and their applications.

Germplasm conservation and cryopreservation.

Unit-II

Secondary Metabolites: Production of useful compounds through cell culture. Construction, operation and application of bioreactors. Production of bioactive compounds-alkaloids, antioxidants, flavanoids, terpenoids etc.

Biotransformation, hairy root culture, elicitation-chemical and biological elicitors.

Unit-III

Genetic Engineering of Plants: Aims and strategies for development of transgenics. Tools and techniques of recombinant DNA technology. Methods of gene transfer- Direct and indirect methods. *Agrobacterium* mediated gene transfer, biolistics, microinjection, electrofusion. *In Planta* transformation.

Gene cloning and vectors-plasmids, cosmids, Lambda phage, BAC, YAC.

Unit-IV

Genomic and cDNA library, genetic and physical mapping of genes, structural and functional genomics, molecular markers (RAPD, RFLP, AFLP). Transposon mediated gene tagging. High throughput sequencing, genome projects (wheat, Rice, Tomato), protein profiling and its significance. Chloroplast transformation.

Intellectual property rights. Ecological risks and ethical concerns of GM crops. DNA and Protein microarray.

Unit-V

Biometry: Mean, median and mode, standard deviation and standard error, variance, coefficient of variance, probability distribution, chi-square test hypothesis, simple correlation.

Suggested Readings:

1. Bhojwani, S.S. and Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice (a revised edition), Elsevier Science Publishers, New York, USA.
2. Bhojwani, S.S. (1990). Plant Tissue Culture. Applications and Limitations. Elsevier Science Publishers, New York, USA.
3. Brown, T.A. (1999) Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
4. Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. (1997) Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.

5. Chrispeels, M.J. and Sadava, D. (1994) *Plants, Genes and Agriculture*. Jones & Bartlett Publishers, Biston, USA.
6. Collins, H.A. and Edwards, S. (1998) *Plant Cell Culture*. Bios. Scientific Publishers, Oxford, UK.
7. Glazer, A.N. and Nikaido, H. (1995) *Microbial Biotechnology*. W.H. Freeman & Company, New York, USA.
8. Gustafson, J.P. (2000) *Genomes*. Kluwer Academic Plenum Publishers, New York, USA.
9. Henry, R.J. (1997) *Practical Applications of Plant Molecular Biology*. Chapman Hall, London, UK.
10. Jain, S.M., Sopory, S.K. and Veilleux, R.E. (1996) *In vitro Haploid Production in Higher Plants*, Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, The Netherlands.
11. Joles, O. and Jornvall, F. (Eds.) (2000) *Proteomics Functional Genomics*. Birkhauser Verlag, Basel, Switzerland.
12. Kartha, K.K. (1985). *Cryopreservation of Plant Cells and Organs*. CRC Press, Boca Raton, Florida, USA.
13. Old, R.W. and Primrose, S.B. (1989) *Principles of Gene Manipulation*, Blackwell Scientific Publications, Oxford, UK.
14. Primrose, S.B. (1995) *Principles of Genome Analysis*. Blackwell Science Ltd., Oxford, UK.
15. Raghavan, V. (1986) *Embryogenesis in Angiosperms: A Developmental and Experimental Study*. Cambridge University Press, New York, USA.
16. Raghavan, V. (1997) *Molecular Biology of Flowering Plants*. Cambridge University Press, New York, USA.
17. Shantharam, S. and Montgomery, J.F. (1999) *Biotechnology, Biosafety and Biodiversity*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
18. Vasil, I.K. and Thorpe, T.A. (1994) *Plant Cell and Tissue Culture*. Kluwer Academic Publishers, The Netherlands.
19. Gupta, S.C. (2016) *Fundamental of Statistics*. Himalaya Publishing House, Mumbai.
20. Gupta, S.C. and Kapoor, V.K. (2000) *Fundamentals of Mathematical Statistics (A Modern Approach)*. 10th Edition, Sultan Chand & Sons, N. Delhi.
21. Rao, P.H. and Janardhan K. (2010) *Fundamentals of Biostatistics*. I.K. International Publishing House, New Delhi.

Suggested Laboratory Exercises:

1. Preparation of different explants and their surface sterilization.
2. Media preparation, sterilization and inoculation of explants.

3. Organogenesis and somatic embryogenesis and preparation of artificial seeds.
4. Demonstration of androgenesis in *Datura*.
5. Isolation of protoplasts from various plant tissues and testing their viability.
6. Effect of physical (e.g. temperature) and chemical (e.g. osmoticum) factors on protoplast yield.
7. Demonstration of protoplast fusion employing PEG.
8. Electroporation of protoplasts and checking of transient expression of the reporter gene.
9. Growth characteristics of *E. coli* using plating and turbidimetric methods.
10. Isolation of plasmids from *E. coli* by alkaline lysis method and its quantitation spectrophotometrically.
11. Restriction digestion of plasmid and estimation of the size of various DNA fragments.
12. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
13. Demonstration of DNA sequencing by Sanger's di-deoxy method.
14. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.

Suggested Readings for Laboratory Exercises:

1. Butenko, R.G. (2000) Plant Cell Culture, University Press of Pacific.
2. Collin, H.A. and Edwards, S. (1998) Plant Cell Culture, Bios Scientific Publishers, Oxford, UK.
3. Dixon, R.A. (Ed.) (1987) Plant Cell Culture: Practical Approach. IRL Press, Oxford.
4. Gelvin, S.B. and Schilperoort, R.A. (Eds.) (1994) Plant Molecular Biology Manual. 2nd edition, Kluwer Academic Publishers, Dordrecht. The Netherlands.
5. George, E.F. (1993) Plant Propagation by Tissue Culture, Part I. The Technology, 2nd edition, Exegetics Ltd., Edington, UK.
6. George, E.F. (1993) Plant Propagation by Tissue Culture, Part 2, In Practice 2nd edition. Exegetics Ltd., Edington, UK.
7. Glick, B.R. and Thompson, J.E. (1993) Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
8. Glover, D.M. and Hames, B.D. (Eds.) (1995) DNA Cloning I: A Practical Approach, Core Techniques, 2nd edition. PAS. IRL Press at Oxford University Press, Oxford.

9. Hackett, P.B., Fuchs. J.A. and Meesing J.W. (1988) An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co., Inc. Menlo Park, California.
10. Hall, R.D. (Ed.) (1999) Plant Cell Culture Protocols. Humana Press, Inc., New Jersey, USA.
11. Shaw, C.H. (Ed.) (1988) Plant Molecular Biology: A Practical Approach, IRL Press, Oxford.
12. Smith, R.H. (2000) Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.

Note:Excursionsto visitthe various Agricultural Research Stations and other Institutes/University Departments of Plant Biotechnological Research in Rajasthan.

Paper XVII. Plant Morphology and Anatomy

Duration of Examination: 3 Hours

[Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks]

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Modular type of growth. Diversity in plant forms in annuals, biennials and perennials. Convergence and evolution of tree habit in Gymnosperms and Angiosperms.

Unit-II

Morphology of roots: Structural modifications for food storage, respiration, reproduction and interaction with microbes.

Anatomical study of monocot and dicot roots.

Unit-III

Morphology of shoots: Branching patterns. Monopodial and sympodial growth. Canopy architecture. Modifications in stem and leaf.

Nodal anatomy: Leaf and branch traces and gaps.

Unit-IV

Anatomical study of monocot and dicot stems, Epidermal tissue system (stomata, trichomes, secretory glands). Secondary growth with special reference to anomalous structures in various stems.

Wood science: Types of woods, anatomy of wood of *Magnolia*, *Shorea*, and *Pinus*. Heart wood and sap wood.

Unit-V

Different types of leaves. Internal structure of various types of leaves in monocot and dicot plants.

Morphology of Flowers: A modified shoot, structure and development of flowers. Morphology of accessory parts of flowers. Pollens and Carpels morphology.

Suggested Readings:

1. Esau, K. (1966) Plant Anatomy. John Wiley & Sons, New York, USA.
2. Esau, K. (2006) Anatomy of Seed Plants. John Wiley & Sons, New York, USA.
3. Pandey, B.P. (2001) Plant Anatomy. S. Chand Publishing, New Delhi
4. Bhojwani, S.S. and Bhatnagar, S.P. (2000) The Embryology of Angiosperms. Vikas Publishing House, New Delhi.
5. Fahne, A. (1982) Plant Anatomy. Pergamon Press, Oxford.
6. Leins, P., Tucker, S.C. and Endress, P.K. (1988) Aspects of Floral Development. J. Cramer, Germany.
7. Raghavan, V. (1999) Developmental Biology of Flowering Plants. Springer-Verlag, New York.
8. Raven, P.H., Evert, R.F. and Eichhorn S. (1992) Biology of Plants. Worth, New York
9. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development. Cambridge University Press, Cambridge.
10. Waisel, Y., Eshel, A. and Kafkaki, U. (Eds.) (1996) Plant Roots: The Hidden Hall. Marcel Dekker, New York.
11. Shivanna, K.R. and Rangaswamy, N.S. (1992). Pollen Biology: A Laboratory Manual, Springer-Verlag, Berlin.
12. Koelling, C. (Ed.) (2016) Plant Anatomy, Morphology and Physiology. Syrawood Publishing House, New York, USA
13. Shivanna, K.R. and Johri B.M. (1995). The Angiosperm Pollen: Structure and Function. Wiley Eastern Limited, New York.

14. Eames, A.J. (1961) Morphology of the Angiosperms. McGraw-Hill Book Company, Inc., New York.
15. Eames, A.J. (1947) Introduction to Plant Anatomy, 2nd Edition. McGraw-Hill Book Company, Inc., New York.
16. Shivana, K.R. and Rangaswamy, N.S. (1992) Pollen Biology: A Laboratory Manual. Springer-Verlag, Berlin.

Suggested Laboratory Exercises:

1. Anatomical study of dicot and monocot stems with special reference to anomalous secondary growth.
2. Microscopic examination of vertical sections of leaves such as *Cannabis*, Tobacco, *Nerium*, maize and wheat to understand the internal structure of leaf tissue and trichomes glands etc.
3. Study of epidermal peels of leaves such as *Coccinia*, *Gaillardia*, *Tradescantia* etc. to study the development and structure of stomata and prepare stomatal index.
4. Study of whole roots in monocots and dicots.
5. Anatomical study of monocot and dicot roots.
6. Study of leguminous roots with different types of nodules.
7. Microscopic examination of anthers of *Datura*, *Tradescantia*, *Brassica*, maize etc. to study the pollen grains.
8. Tests for pollen viability and pollen germination.

Note:Field survey/visit to study the different types of flowering plants.

Paper XVIII. Seed Biology and Plant Breeding

Duration of Examination: 3 Hours

Maximum Marks : 100 Marks

[Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks]

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- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Significance of seed, suspended animation in seeds, seed dormancy, methods of breaking dormancy, types of seeds, structure of seeds, transformation of seed parts, germination of seeds.

Unit-II

Ecological adaptations in seeds, storage of nutrients in seeds, material stored in seeds, mobilization of stored products during seed germination, seed dispersal mechanism.

Unit-III

Seed testing, seed separation and processing, germination test, viability, seedling evaluation. Structure of seeds of important crop plants with special reference to Rajasthan (wheat, pearl millet, mustard, gram, pea, spices).

Terminator seed technology, seed bank, seed certification.

Unit-IV

Plant breeding: Aims and objectives, brief history, plant breeding work in India, crop varieties of important crops of India, research institutes related to plant breeding, plant introduction.

Unit-V

Plant selection methods (mass, pureline and clonal), hybridization, breeding methods in self& cross-pollinated and vegetatively propagated crops.

Heterosis and inbreeding depression and causes of hybrid vigour.

Suggested Readings:

1. Bewley, J D and Black, M (1994) Seeds: Psychology of Development and Germination. Plenum Press, New York.
2. Bewley J.D. and Black, M. (1982) Physiology and Biochemistry of Seeds in Relation to Germination. Springer-Verlag, Berlin.
3. Agrawal, G.K. and Rakwal, R. (Eds.) (2012)Seed Development: OMICS Technologies toward Improvement of Seed Quality and Crop Yield. Springer, Dordrecht.
4. Roberts, E.H. (2013) Seeds: Physiology of Development and Germination. Springer-Verlag New York.
5. Robert, R.W. (1999) Principles of Plant Breeding. John Wiley & Sons, New York, USA.
6. Mohanan, K.V. (2010) Essentials of Plant Breeding. Prentice Hall of India Private Ltd.
7. Chopra, V.L. (2001) Plant Breeding: Theory and Practice. Oxford IBH Pvt. Ltd., New Delhi.

Suggested Laboratory Exercises:

1. Seed structure of wheat, pearl millet, mustard, gram, pea, etc.
2. Seed viability and Seed testing.
3. Seed storage content and seed germination.
4. Seed coat types of *Pisum*, *Cucurbita* and wheat.
5. Emasculation technique and Hybridization methods

Note: Excursions to visit the CAZRI, NBPGR and other institutes in Rajasthan.

Paper XIX (a). Advanced Plant Pathology II

Duration of Examination: 3 Hours	Maximum Marks	: 100 Marks
	Semester Assessment	: 70 Marks
	Continuous (Internal) Assessment	: 30 Marks

Note: The syllabus is divided into five independent units and question paper will be divided into three sections.

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Concept of disease, animate and non-animate diseases. Classification of plant diseases. Major groups of plant pathogens and symptoms caused by them.

History of plant pathology and contribution of following scientists in the development of plant pathology: Dodge, Ganman, Butler, Walker, Stakeman, Horshfall, Diamond, T.S. Sadashivan, R.S. Singh, S.N. Dasgupta, S.P. Ray Chaudhary, G.Rangaswamy, N.Prasad, H.C. Arya and R.S. Mehrotra.

Disease pre-disposition factors and disease development, plant disease forecasting. Epiphytotics.

Unit-II

Bacterial diseases: Brown rot, Ring rot of potato, Fire blight of stone fruits, Tundu disease of wheat, Stalk rot of maize, Bacterial blight of rice, Soft rot of

vegetables, Red strip of sugarcane, Crown gall disease, Angular leaf spot of cotton, Citrus canker.

Unit-III

Virology: Classification, morphology, physiology and nature of viruses. Symptomatology, isolation, purification and culturing of viruses. Viral infection, nutrition, synthesis and mutation. Transmission of viral diseases, acquired immunity, interference and synergism. General account of viroids.

Viral diseases: Potato virus X and Y, Potato yellow dwarf, Tomato mosaic and tomato ring mosaic, Tobacco necrosis, Cucumber mosaic, Bunchy top of banana, Bhindi yellow mosaic.

Unit-IV

Nematology: Classification and identification of plant pathogenic nematodes. Morphology and anatomy of nematodes. Methods used in nematology.

Nematode diseases: Ear cockle of wheat, Root knot of vegetables, Molya disease of wheat. Non-parasitic diseases: Diseases due to deficiency of Nitrogen, Zinc, Boron, Oxygen.

Preliminary studies on diseases due to excess of Ozone; PAN (Peroxyacyl nitrate), Sulphur dioxide, Sulphur and Hydrogen Fluoride in atmosphere, soil and water.

Unit-V

Cecidology: Classification and anatomy of galls. Some insect induced plant galls of Rajasthan (*Pongamia* leaf galls, *Cordia* leaf galls, *Zyziphus* stem galls, *Prosopis* stem galls). Mechanism and physiology of insect galls.

Plant pathogenic mollicutes (*Spiroplasma*, *Phytoplasma*), symptoms caused by them, their transmission and translocation in plants.

Important diseases caused by Mollicutes: Sesame phyllody, Grassy shoot of sugarcane, Sandal spike, Corn stunt, Citrus greening.

Suggested Readings:

1. Agrios, G.N. (1997) Plant Pathology. Academic Press, London.
2. Albajes, R., Cullino, M.L., Van Lenteren, J.C. and Elad, Y. (Eds.) (1999) Integrated Pest and Disease Management in Greenhouse Crops. Kluwer Academic Publishers.
3. Clifton, A. (1958) Introduction to the Bacteria. McGraw Book Co., New York.
4. Khan, J.A. and Dijkstra, J.(2002) Plant Virus as Molecular Pathogens. The Haworth Press Inc., USA
5. Mandahar, C.I. (1978) Introduction to Plant Viruses. Chan Co. Ltd., Delhi.
6. Mehrotra, R.S. (1982) Plant Pathology. Tata McGraw Hill.
7. Mehrotra, R.S. and Agarwal, A.(2003) Plant Pathology. 2nd Edition TATA McGraw Hill. Pub.Company Ltd., New Delhi.
8. Singh, R.S. (1989) Plant Pathogens. The Prokaryotes.Oxford and IBH Publishing Company, New Delhi, India.
9. Purohit, S.S. (2002) Microbiology Fundamentals & Applications Agrobios (India) Pub., Jodhpur.
10. Rangaswamy, G. and Mahadevan, A. (1999) Diseases of Crop Plants in India (4th edition) Prentice Hall of India, Pvt. Ltd., New Delhi.
11. Horsfall, J.G. and Dimond, A.F. (1960) Plant Pathology vols. 1, 2 & 3. Academic Press, New York, USA.
12. Trivedi, P.C. (1998) Nematode Diseases in Plants, CBS Publisher and Distributor, New Dehli.
13. Trigiano, R.N., Windham, M.T. and Windham, A.S. (2008) Plant Pathology: Concepts and Laboratory Exercises. 2nd edition. CRC Press.

Suggested Laboratory Exercises:

1. Isolation of microorganisms, streaking on agar plates/pour plate method, isolation of clones and preservation.
2. Determination of growth of a microorganism (model organism: *Escherichiacoli*), effects of nutrients, e.g. glucose, fructose, sucrose.
3. Observations on bacterial and virus infected plants (symptoms).
4. Observations on important diseases caused by nematodes and mollicutes.
5. Observationsnon-parasitic diseases.

Note:Excursionsfor collection of diseased plant materialfrom different locations and to visit Agricultural Research Stations dealing pathological study in Rajasthan.

Paper XIX (b). Advanced Plant Ecology II-Arid Zone Ecology

Duration of Examination: 3 Hours	Maximum Marks	: 100 Marks
	Semester Assessment	: 70 Marks
	Continuous (Internal) Assessment	: 30 Marks

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- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units.

Note: Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc. Contact Hours will be 4 Hours per week for the faculty.

Unit-I

Deserts: Their formation, topography and distribution. Characteristics of deserts with special reference to water economy. The hot and cold deserts and other similar habitat. Arid regions of India with particular reference to Thar desert in Rajasthan.

Unit-II

Rajasthan: Geology, physiography, climate, vegetation and plant communities of deserts and soil. Saline tracts and their vegetation (Halophytes), Mangrove vegetation. Sand dunes-classification, stabilization and management.

Unit-III

Adaptation of plants and animals to arid conditions. Biotic factors including the role of man on the vegetation and fauna in arid zones. Types and distribution of wastelands in India.

Unit-IV

Habit studies and phenology of desert plants through various seasons, root investigation, reproductive capacity, seed output, germination, dormancy, viability, and perennation.

Unit-V

Desert as an ecosystem, biological productivity, cycles and balances in the desert ecosystems, wind break and shelter belts. Indira Gandhi Canal and its ecological implications. Dry land farming. Underground water resources.

Suggested Readings:

1. Muller-Dombois, D. and Ellenberg, H., (1974) Aims and Methods of Vegetation Ecology. Wiley, New York.
2. Agarwal, S.K. (2011) Fundamentals of Ecology. APH Publishing Corp., New Delhi.
3. Begon, M. Harper, J.L. and Townsend, C.R. (1996) Ecology. Blackwell Science, Cambridge, U.S.A.
4. Ludwig, J. and Reynolds, J.F. (1988) Statistical Ecology. John Wiley & Sons.
5. Odum, E.P. (2005) Fundamentals of Ecology. Saunders, Philadelphia.
6. Odum, E.P. (2005) Basic of Ecology. Saunders, Philadelphia.
7. Barbour, M.G., Burk, J.H. and Pitts, W.D. (1987) Terrestrial Plant Ecology. Benjamin/ Cummings Publication Company, California.
8. Kormondy, E.J.(996) Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
9. Chapman, J.L. and Reiss, M.J. (1988) Ecology, Principles and Applications, Cambridge University Press, Cambridge, U.K.
10. Sharma, P.D. (2000) Ecology and Environment, Rastogi Publications, Meerut.
11. Saxena, N.B. and Saxena, S. (2011) Arid Zone Ecology. Pragati Prakashan, Meerut.
12. Henderson-Sellers, A. and Pitman, A.J. (Eds.) (2012) Vegetation and Climate Interactions in Semi-arid Regions (Advances in Vegetation Science), Springer.

13. Thomas, D.S.G. (Ed.) (2011) Arid Zone Geomorphology: Process, Form and Change in Drylands 3rd Edition. Wiley-Blackwell.
14. Sen, D.N. (Ed.) (1990) Ecology and Vegetation of Indian Desert. Agro Botanical Publishers (India), Bikaner.

Suggested Laboratory Exercises:

1. To determine minimum size and number of quadrat required for reliable estimate of biomass in grassland/arid regions/saline tracts.
2. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
3. To determine the Frequency/Density/Species cover in arid area using quadrat method.
4. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
5. To determine the water holding capacity of soils collected from different locations.
6. To determine percent organic carbon and organic matter contents in the soils of different habitat.
7. To estimate the dissolved O₂ in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
8. To determine the total hardness of the given water samples.
9. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
10. Draw the map of arid and semi-arid regions of Rajasthan showing the major vegetation types.
11. Study the different plant communities of Rajasthan.
12. Seed germination and seed viability in the seeds of xeric environment.
13. Soil/water test (pH and Conductivity).
14. Study of morphological and anatomical adaptations of xerophytes and halophytic plants.

Note: Excursions to visit the CAZRI, AFRI and other Institute, and saline areas of Rajasthan.

M.Sc. Botany Semester-IV

Paper XX: Practicals Skeleton Paper

Duration: 6 hrs.

Max. Marks: 100

1. (a) Perform the biotechnological exercise. **10**
(b) Solve the biometric problem. **05**
2. (a) Make a suitable preparation of the given material **A**. Draw a labeled diagram and study the anomalous secondary growth. Discuss the points of special interest. **10**
(b) Study the morphology/morphological adaptations of root/shoot/floral parts of the given material **B**, draw the labeled diagrams and comment upon its features. **05**
3. (a) Study the seed types/viability/testing/storage/germination of a given material **C**. **10**
(b) Perform the emasculation technique/hybridization method. **05**
4. **Plant Pathology:**
(a) Study the given material **D**, write symptoms and etiology of the disease. **07**
(b) Bacterial preparation of the given material **E**, write and conclude about the results. **04**
(c) Make a comparative phyto-pathological note on the materials **F** and **G**. **04**

OR

4. **Plant Ecology:**
(a) Prepare a glycerin mount of the given plant material **D**, write anatomical adaptations. **07**
(b) Draw the map of arid and semi-arid regions of Rajasthan showing the major vegetation types. **04**
(c) Study the various types of trichomes and their rolling mechanism to withstand during drought of given plant material **E**. **04**

or

Determine organic matter content/dissolved Oxygen/total hardness in the given soil/water sample **E**.

5. Spots (2x6) **12**
6. Records **12**
7. Sessional assignments **08**
8. Viva-Voce **08**