UNIVERSITY OF KOTA

Syllabus and Scheme of
Semester Examination for the
Academic Year

2024-25

Master of Science

BOTANY

UNIVERSITY OF KOTA
MBS MARG, NEAR KABIR CIRCLE, KOTA (RAJASTHAN) 324 005

Syllabus Edition: 2024 (as per NEP 2020)

Syllabus and Course Scheme Academic year 2024-25

UNIVERSITY OF KOTA, KOTA

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

Master of Science BOTANY
Course Code: BOT12100 Faculty of Science

SCHEME OF EXAMINATIONS AND SYLLABUS

M. Sc. Third Semester Examinations

1. The M.Sc. Course in BOTANY is a two-year full-time curriculum offered in the form of Choice-based Credit System organized in **Four Semesters**. The number of papers and maximum marks for each theory paper/practical has been shown in the syllabus. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. The course of study for M.Sc. (BOTANY) examination shall be spread over a period of two years with examination at the end of each semester. There shall be F**our Semesters** in all.
3. Every semester will have four Theory papers and one practical. Syllabus of every theory paper of each semester will be divided into 5 units.
4. Scheme of examination:

Each Semester	Maximum Marks	Minimum Marks	Internal Assessment	Minimum Marks
Paper I	70	28	30	12
Paper II	70	28	30	12
Paper III	70	28	30	12
Paper IV	70	28	30	12
Practical	200	100	---	

Continuous Assessment or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members in the Department during each semester. There will be one internal assessment test. Internal assessment test shall be of one-hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.

(b) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after production of satisfactory evidence about the reason of his/her absence in the test(s) and deposition of the defaulter / improvement fee. A record of such candidates shall be kept in the Department.

(c) Regular attendance of the student shall be considered in the internal assessment.

Semester	Number, Code or ID and Nomenclature of Paper				Duration of Exam (in Hrs)	Teaching Hrs/Week			Distribution of Assessment Marks					
									Continuous of Internal Assessment (30%)		Semester or External Assessment (70%)		Total	
	Number of Paper	Code/ID Paper		Nomenclature of Paper		Teaching		Credit Point	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks
						Th	Pr							
Semester III	Paper 3.1	BOT-12121		Plant Development and Reproduction	3	4		4	30	12	70	28	100	40
	Paper 3.2	BOT-12122		Cytogenetics	3	4		4	30	12	70	28	100	40
	Paper 3.3	BOT-12123		Taxonomy of Angiosperms	3	4		4	30	12	70	28	100	40
	Paper 3.4	BOT-12124		Lab Course III(General)	6		12	6			150	75	150	75
	Paper 3.5	BOT-12125		Advanced Plant Pathology	3	4		4	30	12	70	28	100	40
	Paper 3.6	BOT-12126		Advanced Plant Ecology										
	Paper 3.7	BOT-12127		Lab Course III-Advanced Plant Pathology-I (Special Paper)	5		8	2			50	25	50	25
				Lab Course III-Advanced Plant Ecology-I (Special Paper)										
				CBCS Pool B				2	50	20			50	20
Total Semester-III							20	26	170	58	480	212	650	280
Semester IV	Paper 4.1	BOT-12131		Biotechnology and Biometrics	3	4		4	30	12	70	28	100	40
	Paper 4.2	BOT-12132		Plant Morphology and Anatomy	3	4		4	30	12	70	28	100	40
	Paper 4.3	BOT-12133		Seed Biology and Plant Breeding	3	4		4	30	12	70	28	100	40
	Paper 4.4	BOT-12134		Lab Course IV(General)	6		12	6			150	75	150	75
	Paper 4.5	BOT-12135		Advanced Plant Pathology-II	3	4		4	30	12	70	28	100	40
	Paper 4.6	BOT-12136		Advance Plant Ecology-II (Arid Zone Ecology)										
	Paper 4.7	BOT-12137		(a) Dissertation (Advanced Plant Pathology-II)	5		8	2			50	25	50	25
				(b) Dissertation (Advanced Plant Ecology-II)										
Total Semester-IV						16	20	24	120	48	480	212	600	260

M.Sc. (Botany) Semester-III
Scheme of Examination
Semester-III

BOT-121121-Paper 3.1	Plant Development and Reproduction
BOT-121122-Paper 3.2	Cytogenetics
BOT-121123-Paper 3.3	Taxonomy of Angiosperms
BOT-121124-Paper 3.4	Lab Course-III (General)
BOT-121125-Paper 3.5	Advanced Plant Pathology-I
BOT- 121126-Paper 3.6	Advanced Plant Ecology-I
BOT-121127-Paper 3.7	(a) Lab Course-III Advanced Plant Pathology (Special paper)
BOT-121127-Paper 3.7	(b) Lab Course-III Advanced Plant Ecology (Special paper)

CHO102 Students are advised to visit website of UOK to choose one paper/course of 50 marks for CBCS.

Course Objectives

1. To provide the knowledge about the tracheary elements by tissue maceration technique.
2. To impart basic knowledge about the structure of male and female gametophyte.
3. To understand fundamental concept of special chromosome euchromatin heterochromatin and structure of nucleosome.
4. To provide the knowledge of identification of plant and their families. To impart the knowledge about the taxonomical tools and modern evidences.
5. To impart basic understanding technique for isolation, purification, culture and inoculation of pathogens. Study of fungal and other diseases causal organism and symptoms.
6. To determine the plant community characters and estimate IVI of plant species of study area and to understand the different pollutions and their consequence

Paper 3.1 Plant Development and Reproduction

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

UNIT-I

Unique features of plant development.

Root development : Organization of root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, lateral roots, root hairs. Root microbial interactions.

UNIT-II

Shoot development : Organization of the shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell to cell communication, control of tissue differentiation, especially xylem and phloem, secretory ducts and laticifers, wood development in relation to environmental factors.

Leaf growth and differentiation : Determination, phyllotaxy, control of leaf form, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

UNIT-III

Reproduction : Vegetative and sexual reproduction, flower development, genetics of flora organ differentiation, homeotic mutants in *Arabidopsis* and *Antirrhinum*.

Male gametophyte : Structure of anthers, microsporogenesis, role of tapetum, pollen development and gene expression, male sterility, sperm dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen embryos.

Female gametophyte : Ovule development, megasporogenesis, organization of the embryo sac, structure of the embryo sac cells.

UNIT-IV

Pollination, Pollen-pistil interaction and fertilization : Floral characteristics, pollination mechanisms and vectors, breeding systems, commercial considerations, structure of the pistil, pollen- stigma interactions, saprophytic and gametophytic self-incompatibility (GSI,SSI) (cytological, biochemical and molecular aspects), double fertilization, in-*vitro* fertilization.

UNIT-V

Seed development and growth : Endosperm development during early maturation and desiccation stages, embryogenesis, ultra structure and nuclear cytology, cell lineages during late embryo development, storage proteins of endosperm and embryo, polyembryony, apomixis, Parthenocarpy, embryo culture, dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

Suggested Readings :

1. Atwll, B.J. Kriedcrmann, P.E. and Jumbull, C.G.N. (eds). 1999. Plant in Action : Adaption in Nature Performance, in Cultivation, MacMillan Education, Sydney, Australia.
2. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4^{th} revised and enlarged edition). Vikas Publishing House, New Delhi
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Combridge University Press, Cambridage.
4. Fageri, K. and Van der Pijl, L. 1979. The Principle of Pollination Ecology. Pergamon Press, Oxford.
5. Fahn, A. 1982. Plant Anatomy. (3^{rd} edition). Pergamon Press. Oxford.
6. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Dieo.
7. Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
8. Leins, P., Tucker, S.C. and Endress, P.K. 1998. Aspects of Floral Development. J. Cramer, Germany.
9. Lyndon, R.F. 1990. Plant Development. The Cellular Basis, UnninByman, London.

10. Murphy, T.M. and Thompson, W.E., 1988. Molecular Plant Development. Prenitice Hall, New Jersey.
11. Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins, London.
12. Raghavan, V. 1997. Molccular Embryology of Flowering Plant. Cambridge University Press, Cambridge.
13. Raghavan, V. 1999. Development Biology of Flowering Plants. Springer-Verlag, NewYork.
14. Raven, P.H., Evrt, R.F. and Eichhorn, S. 19992. Biology of Plant (5th edition). Worth, New York.
15. Steeves, T.A. and Sussex, I.M., 1989. Patternsin Plant Development (2nd edition). Cambridge University Press, Cambridge.
16. Sdgely, M. and Griffin, A.R. 1989. Sexual Reproduction to Tree Crops. Academic Press, London.
17. Waisel, Y., Eshel, A. and Kafkaki, U. (eds.) 1996. Plant Roots : The Hidden Hall (2nd edition), Marcel Dekker, New York.
18. Shivanna, K.R. and Sawhney, VK. (eds.) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
19. Shivanna, K. R. and Rangaswamy, N.S. 1992. Pollen Biology : A Laboratory Manual. Springer-Verlag. Berlin.
20. Shivanna, K.R. and Johri, B.M. 1995. The Angiosperm Pollen : Structure and Function. Wiley Eastern Ltd. New York.

Hyperlink of e-Books-

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://dpbck.ac.in/wp-content/uploads/2022/09/Cell-Biology-Verma-and-Agarwal.pdf&ved=2ahUKEwiV07Lw4pKJAxX4oWMGHfGRFNQQFnoECBcQAQ&usg=AOvVaw2-eWAZ864TmxbzbXWRvhUM

Suggested Laboratory/Field Exercises :

1. Effect of gravity, unilateral light and growth regulators on the growth of young seedlings.
2. Study of tracheary elements by elements by maceration technique.
3. L.S. of shoot tip to study the organization of meristem and origin of leaf primordial.
4. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla.*
5. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus, Kalanchoe, Tobacco.*

Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordial.

6. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement, Examination of rosette plants *(Launaea, Mollugo, Raphanus, Hyoscyamus* etc.) and induction of bolting under natural conditions as well as by GA treatment.
7. Microscopic examination of vertical sections of leaves such as *Cannabis, Tobacco, Nerium,* maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C_3 and C_4 leaf anatomy of plants.
8. Study of epidermal peels of leaves such as *Coccinia, Gaillardia, Tradescanti* etc. Study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.
9. Study of whole roots in monocots and dicots. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives (use maize, aerial roots of banyan, *Pistia, Jussiaea* etc.). Origin of lateral roots. Study of leguminous roots with different types of nodules.
10. Study of microsporogenesis in sections of anthers.
11. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotolaria, Tradescantia, Brassica, Petunia, Solanum Melongena* etc.
12. Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
13. Estimating percentage and average pollen tube length *invitro*.
14. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
15. Pollen storage, pollen-pistil interaction, self-incompatibility, *invitro* pollination.
16. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development thorough examination of permanent, stained serial sections.
17. Field study of several types of flower with different pollination, mechanisms (Wind pollination, bee/butterfly pollination, bird pollination).
18. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate out crossing systems. Study of cleistogamous flowers and their adaptations.

Paper 3.2 Cytogenetics

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

UNIT-I

Chromatin organization : Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotypes of chromosomes, polytene, Lampbrush, B-chromosomes and sex chromosome, molecular basis of chromosome pairing.

UNIT-II

Structural and numerical alterations in chromosomes : Origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes, Origin, occurrence, production and meiosis of haploids, aneuploids and euploids, origin and production of auto polyploids, chromosome and chromatid segregation, allopolyploids, types, genome constitution and analysis, evolution of major crop plants, induction and characterization of trisomics and monosomics.

UNIT-III

Gene Structure and expression : Genetic fine structure, cis-trans test, fine structure analysis of eukaryotes, introns and their significance, RNA splicing, regulation of gene expression in prokaryotes and eukaryotes, Panoply of operon, catabolite repression, attenuation and anti-termination.

Genetic recombination and genetic mapping : Recombination, independent assortment and crossing over, molecular mechanism of recombination, role of RecA and RecBCDenzymes, site- specific recombination, chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps.

Mutations : Spontaneous and induced mutations, physical and chemical mutagens, molecular basis of gene mutation.

UNIT-IV

Somatic-cell genetics : An alternative approach to gene mapping. Transposable elements in prokaryotes and eukaryotes, mutation induced by transposons, site-directed mutagenesis, DNA damage and repair mechanisms.

Sex determination, sex linked inheritance, sex limited characters and sex reversal, multiple allele's and blood groups in man.

UNIT-V

Molecular cytogenetics : Nuclear DNA content, C-value paradox, cot curve and its significance, restriction mapping-concept and techniques, multigene families and their evolution, physical mapping of genes of chromosomes, computer assisted chromosome analysis, chromosome microdissection and microcloning, flow cytometry and confocal microscopy in karyotype analysis.

Suggested Readings :

1. Albert B. Bray, D., Lewis, J., Raff, M., Robert, K. and Watson, J.D.1989., Molecular Biology of the Cell (2nd edition), Garland Publishing Inc., New York.
2. Burnham, C. R. 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
3. Busch, H. and Rothblum, J.1982. Volume X. The Cell Nucleusr DNA Part. A. Academic Press.
4. Hart l, D.L. and Jones, E.W. 1998. Genetics : Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts.USA.
5. Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G.1999. Cell and Molecular Biology : Concepts and Experiments. John Wiley & Sons, Inc., USA.
7. Lewin.B.2000. Gene VII. Oxford University Press, New York, USA.
8. Lewis, R.1997. Human Genetics : Concepts and Applications (2nd edition). WCB Mc Graw Hill, USA.

9. Malacinski, G. M. and Freifeldo, D. 1998 : Essentials of Molecular Biology (3rd edition). Jones and B Art let Publishers Inc. London.
10. Russel, P.J. 1998.Genetics (5th edition). The Benjamin Cummings Publishing Company Ind., USA.
11. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetic (2nd edition). John Wiley & Sons Inc., USA.

Hyperlink of e-books :

Suggested Laboratory Exercises :

1. Linear differentiation of chromosomes through banding techniques, such as G-banding, C- banding and Q-banding.
2. Silver banding for staining nucleolus-organizing region, where 18S and 28sr DNA are transcribed.
3. Orecein and Feulgen. Staining of the salivary gland chromosomes of Chironomas and Drosophila.
4. Characteristics and behavior of B chromosomes using maize or any the appropriate material.
5. Working out the effect of mono-and tri somyon plant type, fertility and meiotic behaviour.
6. Induction of polyploidy using colchicines, different methods of the application of Colchicines.
7. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
8. Effect of translocation heterozygosity on plant phenotype. Chromo some pairing and chromosome disjunction and pollen and seed fertility.
9. Meiosis of complex translocation heterozygotes.
10. Isolation of chlorophyllmutants, following irradiation and treatment with chemical mutagens.
11. Estimation of nuclear DNA content through microdensitomerty and flow cytometry.
12. Fractionation and estimation of repetitive and unique DNA sequences innuclear DNA.

Paper 3.3 Taxonomy of Angiosperms

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

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In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

UNIT-I

Angiosperm Taxonomy : Brief history, Aims and fundamental components, taxonomic key, Pheneticversus phylogenetic systems, Salient features of main system of classification and their relative merits and demerits.

UNIT-II

The species concept : Taxonomic hierarchy, species, genus, family and other categories, principles used in assessing relationship, delimitation of taxa and attribution of rank. Salient features of the International Code of Botanical nomenclature.

UNIT-III

Taxonomic tools and evidence : Herbarium, floras, morphology, anatomy, palynology, embryology, cytology, phytochemistry, taximetrics, serological, molecular techniques, computers and GIS, Relevance of taxonomy to conservation.

UNIT-IV

Evolutionary tendencies and range of flower variations in following families-Asteraceae, Cucurbitaceae, Myrtaceae, Sterculiaceae, Combretaceae and Rubiaceae.

UNIT-V

Phylogeny of Angiosperms : Ancestors of Angiosperms, time and place of origin of Angiosperms, Habit of Angiosperm, Primitive families (Ranunculaceae, Magnoliaceae, Nymphaceae, Annonaceae, Winteraceae) and their Important genera.

Suggested Readings :

1. Cole, A.J.1969. Numerical Taxonomy, Academic Press, London.
2. Devis, P.H. and Heywood, V.H. 1973, Principles of Angiosperms Taxonomy, Robert E. Kreiger Publ Co., New York.
3. Grant, V.1971. Plant Speciation. Columbia University Press, NewYork.
4. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
5. Harrison, H.J. 1971. New Conceptsin Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy, English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
7. Heywood, V.H. and Moore, D.M. 1984. Current Conceptsin Plant Taxonomy. Academic Press, London.
8. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptationsin Plant Species. Hiemand & Co. Educational Books Ltd. London.
9. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
10. Nordenstam, B., ElGazaly, G., and Kassas, M.2000. Plant Systematics for 21st Century. Portl and Press Ltd. London.
11. Radford. A.H. 1986, Fundamentals of Plant Systematics. Harper & Row Publications, USA.
12. Solbrig, O.T. 1970. Principals and Methods of Plant Biosystematics. The Macmillan Co-collier-Mac Millan Ltd. London.
13. Solbrig, O.T. and Solbrig, D.J. 1979. Population Biologyand Evolution, Addison-Weslley Publicating Co. Ind. USA.
14. Stebbings, G.L. 1974, Flowering Plant-Evolution Above Species Level. Edward Arnold Ltd. London.
15. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition) Edward, Arnold Ltd. London.

16. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
17. Woodland, D.W. 1991, Contemporary Plant Systematics. Prentice Hall. New Jersey.

Hyperlink e-books :

Suggested Laboratory Exercises :

Description of aspecimen from representative, locally available families.

1. List of Locally Available Families:

(1) Ranunculaceae, (2) Capparidaceae, (3) Portulacaceae, (4) Caryophyllaceae, (5) Malvaceae, (6) Tiliaceae, (7) Streculiaceae, (8) Zygophyllaceae, (9) Rhamnaceae, (10) Sapindaceae, (11) Leguminosae, (12) Combretaceae, (13) Myrtaceae, (14) Cucurbitaceae, (15) Apiaceae, (16) Rubiaceae, (17) Asteraceae, (18) Primulaceae, (19) Plumbaginaceae, (20) Asclepiadaceae, (21) Convolvulaceae, (22) Solanaceae,(23) Boraginaceae, (24) Polemoniaceae, (25) Acanthaceae, (26) Pedaliaceae, (27) Martyniaceae, (28) Bignoniaceae, (29) Lamiaceae, (30) Nyctaginaceae, (31) Polygonaceae, (32) Chenopodiaceae, (33) Amaranthaceae, (34) Aizoaceae, (35) Molluginaceae, (36) Euphorbiaceae, (37) Commelinaceae and (38) Cyperaceae.

2. Description of species based on various specimens to study in traspecificvartation : a collective exercise.
3. Description of various species of a genus, location of key characters and preparation of keys at generic level.
4. Location of key characters and use of key at family level.
5. Field trips with in and around the campus, compilation of field notes and preparation of herbarium sheets of such plants, natural or cultivated as are abundant.
6. Training in using floras and herbaria for identification of specimens described in the class.
7. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
8. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

University of Kota (Kota)

M.Sc. Semester-III (2024-25) Botany

Skeleton Paper

3.4 Lab. Course–III (General)

Time : 6 Hrs. **Max. Mark : 150**

1. (a) Study the Root apical meristem / Shoot apical meristem. 10
   (b) Study the Phyllotaxy of selected Plants. 05
2. Study the epidermal Peels of leaves/Stomatal index of given material 10

   Or

   Study the tracheary elements in the given material by maceration techniques.
3. Study the floral/epidermal/embryological structure of the material provided
   Prepare slide, draw labelled diagram and discuss character. 10
4. Perform the Cytogenetical exercise/experiment, describe the Methodology and write your Observation and Conclusion. 15
5. Analyse the Karyotype of given plants.
6. (a) Describe the given material in Semitechnical language with diagrams, assign it to the relevant family with reasons and draw floral diagram. 15
   (b) Describe reproductive parts with diagrams of given material assign to it to the relevant family with reasons and draw Floral diagram 10
7. Prepare an artificial key of given plant materials. Prepare Phenogram or Dendrogram in given exercise. 10
8. Spots 3x5=15
9. Seminar 15
10. Record 15
11. Viva Voce 10

Paper 3.5 Advanced Plant Pathology-I

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

Duration of Examination : 3 Hours

Maximum Marks : 100 Marks
Semester Assessment : 70 Marks
Continuous (Internal) Assessment : 30 Marks

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UNIT-I

Phenomenon of plant infection, penetration, post infection development, factors affecting infection, defense mechanisms.

Host pathogen interaction : There sponse of the host, pathogenecity and virulence, host specific toxins in relation to pathogenesis and disease resistance.

UNIT-II

Plant disease control : Physical control, chemical control, plant quarantines, plant disease resistance and breeding of resistance varieties.

Methods : Techniques of isolation, purification, culture and inoculation of pathogens. Technique of tissue culture and its applications in plant pathology. Raising virus free plants in culture.

UNIT-III

Fungal diseases : Symptomatology and disease identification, some important diseases of cereals : Smuts, rusts, leaf blights, spots, mildews, karnal bunt and flag smut of wheat; covered smut and stripe disease of barley. Brown spot and blast of paddy, downy mildews and Drechlera (Helminthosporium) blights of Maize; ergot and smut of Bajra, leaf spots and smuts of jowar, green ear disease of Bajra.

UNIT-IV

Other Diseases : Red rot and smut of sugarcane; Wilt of cotton, flax and pigeon pea; Flax rust; Blight of gram; Early blight of tomato and potato; Late blight of potato; Tikka disease of groundnut, and downy and powdery mildews of grapes.

UNIT-V

Molecular base of host-parasitic interactions, signal transduction and plant disease development, acquired immunity, SAR, role of salicylic acid in plant disease development, culture of obligate parasites.

Suggested Readings :

1. Agrios, G.N.2005 Plant Pathology. 5th edition Academic Press. New York, USA
2. Alexopoulus, C.J, C.W. Mims and M. Blackwel, 1996. Introductory Mycology, 4th edition, John Wiley and Sons, inc., New York, USA
3. Khan, J.A. and J.Dijkstra. 2002 Plant Virusas Molecular Pathogens. The Haworth Press Inc. USA
4. Mehrotra R.S. and A. Agarwal. 2003 Plant Pathology. 2nd Edition TATA Mc Graw 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, R.S. 1989.Plant Pathogens. The Prokaryotes. Oxford and IBH Publishing 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.
9. Kaushik, P 1996 Introductory Microbiology Emkay Pub. New Delhi.
10. Mehrotra R.S. 1987 Plant Pathology. TATA MacgrawthllPub. Company Ltd., New Delhi.
11. Purohit S.S. 2002 Microbiology-Fundamentals & applications Agrobios (India) Pub. Jodhpur.

Hyperlink e-books :

Suggested Laboratory Exercises :

1. Culture transfer techniques
2. Techniques for isolation of pureculture

3. Isolation of discrete colonies from a mixed culture
4. Isolation of pure culture from spread plate and streak plate preparation.
5. Culture characteristics of microorganisms
6. Grams staining.
7. To draw camera lucida drawings of fungal spores.
8. Calibration of Microscopes
9. Study of fungal and other disease

Paper 3.6 Advanced Plant Ecology-I (Environmental Biology)

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice .Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

UNIT-I

Ecosystem : Concept, structure and function of grassland, forest, fresh water and marine ecosystems, biogeochemical cycles, evolution of ecosystem, ecological energetic and flow of energy.

UNIT-II

Natural Resources : water, soil, energy and wild life management and their remediation, biodiversity conservation, sanctuaries, national parks, non-conventional energy resources, solar, wind, tidal and geothermal energy sources, 3 R's (Reduction, Recycle & Reuse).

UNIT– III

Noise, Land, Radiation and Thermal Pollution : Sources and characteristics. Global Warming, ozone depletion and acid rains. Ganga Action Plan, Ecolabeling and Environmental Auditing, water pollution (Prevention and control of Pollution Act 1974). Air Pollution Act.

UNIT-IV

Plant community characters (Analytic and synthetic), IVI, Consequences of growing human population on environment. Ecosystems: Manmade ecosystems–Urban and rural. Environmental Impact Assessment (EIA), Social Impact Assessment (SIA) and sustainable development. Solid Waste Management.

UNIT-V

Environmental Education and Awareness : Environmental laws & Ethics : Wild Life Protection Act 1972. Poaching and killing of wild life. Forest conservation Act 1980, eco feminism, Social forestry and role of tribals in conservation, environmental economics – issues in perspective global economy, ecopolitics and green policies.

Suggested Readings :

1. Smith, R.L. 1996. Ecology and Field Biology, Harpr Collins, New York
2. Muller-Dombois, D. and Ellenberg, H., 1974. Aims and Methods of Vegetation Ecology, Wiley, New York.
3. Begon, M. Harper, J.L. and Townsend, C.R. 1996. Ecology, Black well Science, Cambridge, U.S.A.
4. Ludwig. J.nad 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., 1996 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. Molan, B. and Billharz, S. 1997. Sustainability Indicators, John Wily Sons, New York.
11. Pandey, S.C., G.S. Furland J. Singh1967. Research methods in plant ecology Asia, Pub House, New Delhi.
12. Sharma P. D. 2000. Ecology and Environment, Rastogi Publications, Meerut.

Hyperlink of e-books

Suggested Laboratory Exercises :

1. To determine minimum size and number of quadrat required for reliable estimate of biomass in grassland.
2. To compare protected and unprotected grassland stand using community coefficients (similarity indices).
3. To estimate IVI of the species inagrass land/woodland using quadrat method.
4. To determine gross and net phytoplankton productivity by light and dark bottle method.

5. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
6. To determine the Water holding capacity of soils collected from different locations.
7. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
8. To estimate the dissolved oxygen content in eutrophic and oli gotrophic water samples by azide modification of Winkler's method.
9. To estimate chlorophyll content in SO_2 fumigated and unfumigated plant sleaves.
10. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
11. To study environment alimpact of a given developmental activity using check listasa EIA method.
12. To analyze plant community characters.
13. Soil/water test (different parameters).
14. Compare polluted and non-polluted plants (different parameters).
15. Study of morphological and anatomical adaptations of plants.

University of Kota (Kota) M.Sc.
Semester-III 2024-25 Botany
Skeleton Paper
3.7 a Lab. Course –III Advanced Plant Pathology

Time : 5 Hrs **Max. Mark : 50**

1. Study the histopathology of the material (A). Make suitable preparation of given material. Write symptoms, causal or ganism and identify the disease making pathological note of the given material. 10
2. Calibrate your Microscope and find out the average size of the fungal spore given to you. 10

Or

Demonstrate the technique used for isolation of given pure or mixed culture.

3. Preparation the given slide material. Draw labelled diagram. Write symptoms and etiology of the disease 10
4. Spots (2X5) 10
5. Record 05
6. Viva-Voce 05

Outcomes

1. Understand the concept of RAM and SAM.
2. Understand the principle of polyploidy, mutation and physical and chemical mutagens.
3. Course will provide the understand of history of plant taxonomy and classification of angiosperm.
4. Field trips within and out of campus compilation of field notes and preparation of herbarium sheets of plant species.
5. To develop conceptual skill of plant disease pathogens interaction and disease resistance.
6. To make aware about the environmental legislations and policies.

UNIVERSITY OF KOTA, KOTA

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

Master of Science BOTANY
Course Code: BOT12100 Faculty of Science

SCHEME OF EXAMINATIONS AND SYLLABUS

M. Sc. Fourth Semester Examinations

1. The M.Sc. Course in BOTANY is a two-year full-time curriculum offered in the form of Choice-based Credit System organized in **Four Semesters**. The number of papers and maximum marks for each theory paper/practical has been shown in the syllabus. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. The course of study for M.Sc. (BOTANY) examination shall be spread over a period of two years with examination at the end of each semester. There shall be F**our Semesters** in all.
3. Every semester will have four Theory papers and one practical. Syllabus of every theory paper of each semester will be divided into 5 units.
4. Scheme of examination:

Each Semester	Maximum Marks	Minimum Marks	Internal Assessment	Minimum Marks
Paper I	70	28	30	12
Paper II	70	28	30	12
Paper III	70	28	30	12
Paper IV	70	28	30	12
Practical	200	100	---	

Continuous Assessment or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members in the Department during each semester. There will be one internal assessment test. Internal assessment test shall be of one-hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.

(b) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after production of satisfactory evidence about the reason of his/her absence in the test(s) and deposition of the defaulter / improvement fee. A record of such candidates shall be kept in the Department.

(c) Regular attendance of the student shall be considered in the internal assessment.

M.Sc. (Botany) Semester-IV

Scheme of Examination
Semester-IV

Semester-IV

BOT-12131 - Paper 4.1 Biotechnology and Biometrics

BOT-12132 - Paper 4.2 Plant Morphology and Anatomy

BOT-12133 - Paper 4.3 Seed Biology and Plant Breeding

BOT-12134 - Paper 4.4 Lab Course-IV (General)

Elective paper -

BOT-12135 – Paper 4.5 Advanced Plant Pathology-II

BOT-12136 - Paper 4.6 Advanced Plant Ecology-II (Arid Zone Ecology)

BOT-12137 - Paper 4.7 (a) Dissertation (Advanced Plant Pathology)

BOT-12137 - Paper 4.7 (b) Dissertation (Advanced Plant Ecology)

Note :- Dissertation will carry 50 marks from special paper.

Course Objective

1 To provide the knowledge about the concept, scope, history of biotechnology and techniques of genetic engineering.
2 To impart basic knowledge about the primary and secondary metabolites,
3 To understand fundamental concept of biostatistics and biometry.
4 To provide the knowledge of morphology of stem, root, leaves and wood anatomy.
5 To impart the knowledge about the morphology of floral organ, pollen and carpel.
6 To impart basic understanding seed biology and concept of traditional plant breeding methods.
7 To provide the knowledge of different type of seed disposal mechanism.
8 To provide complete information about the plant breeding works in India.
9 To provide the knowledge of technique for isolation, purification, culture and inoculation of pathogens. Study of fungal and other diseases causal organism and symptoms.
10 To understand the morphological and anatomical adaptions of xerophytic and halophytic plants of Rajasthan.
11 To impart basic understanding about arid zone ecology and determine the plant community characters of desert ecosystem and estimate IVI of plant species of arid area and to understand the different deserts and their characteristics

Paper 4.1. Biotechnology and Biometrics

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

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, flavonoids, 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. Direct and indirect methods of gene transfer. 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 (IPR). 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-Lioyd, 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: Excursions to visit the various Agricultural Research Stations and other Institutes/University Departments of Plant Biotechnological Research in Rajasthan.

Paper 4.2 Plant Morphology and Anatomy

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

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, secretary 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. Fahn, A. (1982) Plant Anatomy. Pergamon Press, Oxford.
6. Ganguly and Das. College Botany. Vol I and II, central Book Agency, Kolkata (India).
7. Leins, P., Tucker, S.C. and Endress, P.K. (1988) Aspects of Floral Development. J. Cramer, Germany.
8. Raghavan, V. (1999) Developmental Biology of Flowering Plants. Springer- Verlag, New York.
9. Raven, P.H., Evrt, R.F. and Eichhorn S. (1992) Biology of Plants. Worth, New York
10. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Developments. Cambridge University Press, Cambridge.
11. Waisel, Y., Eshel, A. and Kafkaki, U. (Eds.) (1996) Plant Roots: The Hidden Hall. Marcel Dekker, New York.
12. Shivanna, K.R. and Rangaswamy, N.S. (1992). Pollen Biology: A Laboratory Mannual, Springer-Verlag, Berlin.
13. Koelling, C. (Ed.) (2016) Plant Anatomy, Morphology and Physiology. Syrawood Publishing House, New York, USA
14. Shibanna, K.R. and Johri B.M. (1995). The Angiosperm Pollen: Structure and Function. Wiley Eastern Limited, New York.
15. Eames, A.J. (1961) Morphology of the Angiosperms. McGraw-Hill Book Company, Inc., New York.
16. Eames, A.J. (1947) Introduction to Plant Anatomy, 2nd Edition. McGraw-Hill Book Company, Inc., New York.
17. 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.
9. Monopodial and sympodial types of branching in monocots and Dicots.
10. Study the morphology of root/shoot/floral parts of commonly occurring plants.

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

Paper 4.3. Seed Biology and Plant Breeding

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

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. Legislation and seed law enforcement.

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. Agarwal, RL (1980), Seed technology, oxford and IBH publishing co. pvt. Ltd. New Delhi.
2. Agrawal, G.K. and Rakwal, R. (Eds.) (2012)Seed Development: OMICS Technologies toward Improvement of Seed Quality and Crop Yield. Springer, Dordrecht.
3. Bewley, J D and Black, M (1994) Seeds: Psychology of Development and Germination. Plenum Press, New York.
4. Bewley J.D. and Black, M. (1982) Physiology and Biochemistry of Seeds in Relation to Germination. Springer-Verlag, Berlin.
5. Chopra, V.L. (2001) Plant Breeding: Theory and Practice. Oxford IBH Pvt. Ltd., New Delhi.
6. Khare, D and Bhale, MS (2014) seed technology scientific publishers, (India) Jodhpur, Revised 2nd Ed.
7. Kulkarni, G.N. (2002) Principles of seed technology, Kalyani publishers, New Delhi.
8. Mohanan, K.V. (2010) Essentials of Plant Breeding. Prentice Hall of India Private Ltd.
9. Roberts, E.H. (2013) Seeds: Physiology of Development and Germination. Springer-Verlag New York.
10. Robert, R.W. (1999) Principles of Plant Breeding. John Wiley & Sons, New York, USA.
11. Singh Rajesh and Singh Rajeev (2018). Seed technology. Kalyani publishers, New Delhi.

Suggested Laboratory Exercises:

1. Seed structure of wheat, pearlmillet, mustard, gram, pea, etc.
2. Seed viability, Seed testing and Seed dormancy.
3. Seed storage content and seed germination.
4. Seed coat types of Pisum,Cucurbita and wheat.
5. Emasculation technique and Hybridization methods
6. Specimen study of modification of plants for vegetative propagation.
7. Specimen study of various seed dispersal mechanism (commonly occurring examples).

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

University of Kota (Kota)

M.Sc.Semester-IV (2024-25) Botany

Skeleton Paper

Paper 4.4 Lab. Course –IV (General)

Time : 6 Hrs. **Max. Mark- 150**

1. (a) Perform the Biotechnological exercise (Major) 15

   (b) Perform the Biotechnological exercise (Minor) 10

2.(a) Biometric exercise. 10

(b) Make a suitable preparation of the given material and Draw a labelled diagram and discuss the special points of interest. 15

3. Study the Morphology /Morphological adaptations of Root/ Shoot/Floral Parts of given Material

or

Draw labelled Diagram and Comment upon its features. 10

4. (a) Study the Seed type/Viability test 15

   (b) Study Seed Storage content /Germination of given material/Seed dispersal strategies 10

5. Perform exercise on plant breeding 10

6. Spots 3X5= 15

7. Record 15

8. Seminar 15

9. Viva Voce 10

Paper 4.5 (a). Advanced Plant Pathology II

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

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. Kiluwel 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:
3. Escherichia coli, effects of nutrients, e.g. glucose, fructose, sucrose.
4. Observations on bacterial and virus infected plants (symptoms).
5. Observations on important diseases caused by nematodes and mollicutes.
6. Observations non-parasitic diseases.

Note: Excursions for collection of diseased plant material from different locations and to visit Agricultural Research Stations dealing pathological study in Rajasthan.

Paper 4.6 Advanced Plant Ecology II-Arid Zone Ecology

Scheme of Examination **Duration : 3 hours** **Max. Marks : 100**

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 two sections.

There will be two sections A and B in the paper. Section A will be comprised of 10 questions having two questions from each unit having no choice. The weightage of each question is 2 marks hence the total weightage of section A is 20 marks.

In Section B, there will be 10 questions. Two questions from each unit having internal choice. Students have to attempt total 5 questions (one question from each unit). The weightage of each question is 10 marks hence the total weightage of the section B is 50 marks.

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. Distribution of wastelands in India.

Various arid zone related research institutes- CAZRI, AFRI, ICRISAT.

Unit-IV

Habit studies and phenology of desert plants through various seasons, root investigation, reproductive capacity, seed output, germination, dormancy, viability, and perennation. . Dry land farming. Underground water resources.

Unit-V

Desert as an ecosystem, biological productivity, Biogeochemical cycles and balances in the desert ecosystems, wind break and shelter belts. Indira Gandhi Canal and its ecological implications. Ecotourism : initiative challenges and benefits in the prospective of Rajasthan.

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 O_2 in eutrophic and oligotrophic water samples by azide modification of Winkler'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.
University of Kota (Kota) M.Sc. Semester-IV (2023-24)

University of Kota (Kota)

M.Sc.Semester-IV (2024-25) Botany

Skeleton Paper

Paper 4.7 Lab. Course –IV (Special Paper)

Time : 5 Hrs. **Max. Mark- 50**

(a) Dissertation (Advanced Plant Pathology) Lab.

(b) Dissertation (Advanced Plant Ecology) Lab.

Dissertation Will carry 50 Marks from special paper.

A dissertation may be undertaken in any related Research work/Field work/ Survey/ in the Department. The final evaluation of the dissertation will be though a panel involving internal and external examiners. The students shall compulsory submit the certificate of completion and report to the Department during the practical examination. The mark will be awarded by the external examiner on the day of the practical examination on the basis of the experimental, presentation and Viva-Voce.

The M.Sc. Course in Botany is a two year full time curriculums offered in the form of choice.

Course Outcomes

1. Understand the concept of biotechnology and techniques of genetic engineering.
2. Understand the principle of biostatistics and biometry.
3. Course will provide the understanding of anatomy of dicot and monocot stems with special reference to anamolous secondary growth.
4. Course will develop the understanding of seed biology, dormancy, terminator gene technology.
5. Student will aware about the different selection and hybridization methods in plants.

6. Develop conceptual skill of plant disease pathogens interaction and disease resistance.
7. Gain knowledge about the desert plants through the field visits and excursion tours.
8. To make aware about the arid zone ecology with special reference of thar desert.
9. Students will know about the CAZRI, AFRI and other related institutes.
10. Students will understand about the research work, hypothesis & publication process during the dissertation.