



**MAHARAJA SURAJMAL BRIJ UNIVERSITY,
BHARATPUR**

SYLLABUS

**M.Sc. BOTANY (P &F)
(ANNUAL SCHEME)**


अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)


M.Sc. (BOTANY) – Examination

(M.Sc. Previous) :

Paper I	Cell & molecular Biology of Plants
Paper II	Cytology, Genetics and Cytogenetics
Paper III	Biology & Diversity of Seed Plants: Cryptogams
Paper IV	Taxonomy & Diversity of Seed Plants
Paper V	Plant Physiology and Metabolism
Paper VI	Microbiology and Plant Pathology

(M.Sc. Final) :

Paper VII	Plant Development & Reproduction
Paper VIII	Plant Ecology
Paper IX	Plant Resource Utilization & Conservation
Paper X	Biotechnology & Genetic Engineering of Plants & Microbes
Paper XI (a)	Advanced Plant Pathology – I
Paper XII(a)	Advanced Plant Pathology – II
Paper XI(c)	Ecosystem Ecology
Paper XII(c)	Environmental Biology


23.0.10

Syllabus for M.Sc. Botany (Previous)

Paper – I :Cell and Molecular Biology of Plants –

Scheme of Examination

Max.Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit -1

The dynamic cell: structural organization of plant cell, specialized plant cell types, chemical foundation: covalent and non-bonds, biochemical energetics: various forms of energy and their interrelationships in living systems.

Cell wall : biochemistry and molecular biology of cell wall, biogenesis, nature of cell wall, growth and its function.

Plasma membrane : structure, models and functions ; sites for ATPase carriers, channels, pumps and receptors.

Plasmodesmata : composition and structure, signaling and movement of molecules and macromolecules; other functions; comparison with gap junctions.

Unit -2

Plant vacuole :tonoplast membrane transporters and storage organelles.

Chloroplast : structure, genome organization, gene expression

Mitochondria : structure, division, biogenesis and development to mitochondria, genome organization.

Cell shape and motility : the cytoskeleton, organization and role of microtubules and microfilaments, motor movements, implications in flagellar and other movements.

Other cellular organelles : structure and functions of micro bodies, Golgi apparatus, lysosomes,peroxisomes and endoplasmic reticulum.

Unit – 3

Nucleus : Ultra structure, nuclear pores, mechanism of export and import of macromolecules, molecular structure of DNA , A ,B and Z forms, DNA replication and DNA polymerases, DNA damage and repair, nucleolus. Transcription, transcription factors, promoters and RNA splicing, m RNA transport, r RNA biosynthesis.

Restriction enzymes : cleavage of DNA into specific fragments, construction of restriction maps from the fragments, restriction sites, genetic markers, RFLP and their uses in plant breeding.

RNA synthesis and processing : Transcription factors, formation of initiation complex, RNA polymerases capping, elongation and termination, RNA processing, RNA editing , splicing and polyadenylation, structure and function of different types of RNA, m RNA transport.

Unit -4

Protein synthesis and processing : Ribosome, formation of initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of t RNA, aminoacyl , t RNA synthetase , protein sorting : targeting of proteins to organelles.

Cell cycle and apoptosis : Mitosis and meiosis, their regulation, steps in cell cycle and control mechanisms, cytokinesis and cell plate formation, mechanism of programmed cell death in plants and its importance.

Techniques in cell biology : flow cytometry, principles of microscopy and optics (light, fluorescence, electron, confocal microscopy, immunotechniques.

Suggested Reading –

1. Lewin, B. 2000. Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe, S.L. 1993 Molecular and Cellular Biology. Wadsworth Publishing Co-California, USA.
4. Rost, T. et al. 1998. Plant Biology. Wadsworth Publishing Co., California, USA.
5. Krishnamurthy, K.V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
6. Buchanan B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of plants. American Society of Plant Physiologists, Maryland, USA.
7. De, D.N. 2000. Plant Cell Vacuoles : An Introduction. CSIRO Publication, Collingwood, Australia.
8. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
9. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology (4th Edition). W.H. Freeman and Co., New York, USA.
10. Krishnamurthy, K.V. (2000). Methods of cell Wall Cytochemistry. CRC Press. Boca Raton, Florida.
11. Reeve, ECR. (2001). Encyclopedia of Genetics, F. D. Publication, Chicago, USA
12. De, DN. (2000). Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
13. De Robertis, E.D.P. and Robertis, E.M.F. (2006). Cell and Molecular Biology. (VIII Edition). Lippincott Williams and Wilkins, Philadelphia.
14. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (V Edition). ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
15. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Berton, G.P. (2009). The World of the Cell. (VII Edition). Pearson Benjamin Cummings Publishing, San Francisco.
16. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College publishers, New York, USA.
17. Harris, N. and Oparka, K.J., (1994). Plant Cell Biology: A Practical Approach. IRL Press, at Oxford University Press, U.K.

18. Gunning, B.E.S. and Steer, M.W. (1960). Plant Cell Biology : Structure and Function. Jones and Bartlett Publishers. Boston, Massachusetts.
19. Karp, G. (2010). Cell and Molecular Biology : Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.

Suggested Laboratory Exercises :

1. EM study of cell organelles
2. Fluorescence staining with FDA for cell viability.
3. Cell wall staining with calcofluor white.
4. Study of stages in cell cycle.
5. Mitosis and Meiosis.
6. Histochemical localization of protein, fats, starch, lignin, nucleic acids.
7. Isolation of mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
8. Isolation of chloroplast and study of its percentage intactness.
9. Isolation of Chloroplast and study of light reaction system.
10. Demonstration of SEM and TEM.
11. Karyotype analysis.
12. Polytene, lampbrush, B-chromosomes and sex chromosomes.
13. Preparation of Polytene chromosome from Chironomous larva/Drosophila larva
14. Orcein and Feulgen staining of the salivary gland chromosomes of chironomas and Drosophila.
15. Characteristics and behavior of B chromosomes using maize or any other appropriate material.
16. Any other practical based on theory syllabus.
17. Isolation of chloroplasts and SDS-PAGE profile of proteins to demarcate the two subunits of Rubisco.
18. Isolation of nuclei and identification of histones by SDS-PAGE.
19. Isolation of plant DNA and its quantitation by a spectrophotometric method.
20. Isolation of DNA and preparation of 'cot' curve.
21. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
22. Isolation of RNA and quantitation by a spectrophotometric method.
23. Separation of plant RNA by agarose gel electrophoresis and visualization by EtBr staining.
24. Southern blot analysis using a gene specific probe.
25. Northern blot analysis using a gene specific probe.
26. Immunological techniques :ouchterlony method, ELISA and western blotting.
27. Fluorescence staining with FDA for cell viability and cell wall staining with calcofluor.

Note : Chemicals and kits for conducting some of the above molecular biology experiments are available in India, for example from M/s Bangalore Genei, and Centre for Biotechnology (CSIR), Mall Road, Delhi.

Suggested Readings (for laboratory exercises)

Glick, B.R. and Thompson, J.F. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.

Glover, DM. and Hames, B.C. (Eds.), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. RAS, IRL Press at Oxford University Press, Oxford.

Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology : Structure and Function. Jones and Bartlett Publishers. Boston, Massachusetts.

Hackett, P.B., Fuchs, J.A. and Messing, J.W. 1988. An Introduction to Recombinant DNA Techniques : Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing co., Inc. Menlo park, California.

Hall, J.L. and Moore, A.L. 1983. Isolation of Membranes and Organelles from Plant Cells. Academic Press, London, UK.

Harris, N. and Oparka, K.J. 1994. Plant Cell Biology : A Practical Approach. IRL Press, at Oxford University Press, Oxford, U. K.

Show, C.H. (Ed.) 1988. Plant Molecular Biology : A Practical Approach IRI Press Oxford.

Paper – II :Cytology, Genetics and Cytogenetics-

Scheme of Examination

Max.Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit - 1

Genome organization : Chromosome structure and packaging of DNA, molecular organization of centromere and telomere; euchromatin and heterochromatin; Chromosomal banding patterns, karyotype analysis and evolution; specialized types of chromosomes; polytene, lampbrush, B-and sex chromosome Molecular basis of chromosome pairing.

Structural and numerical alterations in chromosomes : origin, meiosis and breeding behavior of duplications, deficiency, inversion and translocation heterozygotes. Origin and occurrence of haploids, meiosis in haploids. Polyploids (aneuploids, euploids, autopolyploids and allopolyploids). Trisomics and monosomics.

Unit- 2

Genetics of prokaryotes and eukaryotes: Genetic recombination of phage genome; genetic transformation, conjugation and transduction in bacteria. Fine structure of prokaryotic and eukaryotic genes. Regulation of gene expression in prokaryote : initiation of transcription, RNA polymerases, lac operon, tryptophan operon, attenuation and RNA regulators.

Regulation of gene expression in eukaryotes : transcription; RNA polymerases, regulator binding sites, transcription activator factors, post transcription, translation and post translation modifications/regulations. Introns and their significance, RNA splicing. Hardy Weinberg Law, gene frequency and genotype frequency.

Unit-3

Genetic recombination and genetic mapping: Independent assortment, crossing over, linkage groups and chromosome mapping. Correlation of genetic and physical maps; somatic cell genetics-an alternative approach to gene mapping. Molecular mechanism of recombination: ss DNA and ds DNA breakage models, role of RecA and RecBCD enzymes; site-specific recombination. Mutations : spontaneous and induced mutations, molecular mechanisms of physical and chemical mutagens;

repair mechanisms, reverse genetics. Transposable elements in prokaryotes and eukaryotes; mutation induced by transposons, site directed mutagenesis.

Molecular cytogenetics: concept and technique of restriction mapping and *in situ* hybridization Construction of genetic or molecular maps. Genetic analysis; complementation, dominance, codominance, variable expressivity and incomplete penetrance. Chromatin remodeling, epigenetic. Population genetics: allele and genotype frequencies, enzyme and DNA polymorphism.

Unit-4

Nuclear DNA Content c-value paradox, cot curve & its significance multi gene families & their evolution, flow cytometry and confocal microscopy in karyotype analysis in RNA degradation, Riboswitches, RNA interference, mutation detection by various test, (Replica Planting, Ames test & Complementation test). Developmental Genetics (Genetic control of flower development in Arabidopsis)

Suggested Readings:-

1. Albert, B., Bray, D. Lewin, J. Raff, M. Robert, K. and Watson, J.D. 1989., Molecular Biology of the Cell (2nd edition), Garland Publishing Inc., New York.
2. Atherly, A.G., Gorton, J.R. and Donald. J.F. 1999. The Science of Genetics, Saunders College Publishing, Fort Worth USA.
3. Bumhan, C.R. 1962 Discussion in Cytogenetic, Burgess Publishing Co. Minnesotz.
4. Busch, H. and Rothblum, L. 1982 volume X. The Cell Nucleus DNA Part A Academic Press.
5. Harl, D.L. and Jones, E.W. 1998. Genetics : Principles and Analysis (4th edition), Jones & Barler Publishers, Massachusetts., USA
6. Khush, G.S. 1973, cytogenetics of aneuploids, Academic Press, New York, London.
7. Karp, R.G. 1999. Cell and Molecular Biology : Concepts and Experiments, John Wiley & Sons. Inc. U.S.A.
8. Lewin, B. 2000, Gene VII., Oxford University Press, New York, USA
9. Lewis, R. 1997, Human Genetics : concepts and Applications (2nd edition), WCB McGraw Hill, USA.
10. Malacinski, G.M. and Freilfelder, D. 1998, Essentials of molecular Biology (3rd edition) Jones and B Artler Publishers Inc. London.
11. Russel, P.J. 1998, Genetics (5th edition). Benjamin/Cummings Publishing Company Inc. USA
12. Soustad, D.P. and Simmons, M.J. 2000, Principles of Genetics (2nd edition), John Wiley & Sons Inc. USA.

Suggested Laboratory Exercise :-

1. Linear differentiation of chromosomes through banding techniques such as G-banding and C-banding and Q-banding.
2. Silver banding for staining nucleolus-organizing region, where 18S and 28S DNA are transcribed.
3. Orcein and Feulgen, Staining of the salivary gland chromosomes of chironomas and Drosophila.
4. Characteristics and behavior of B chromosomes using maize or any other appropriate material.
5. Working out of the effect of mono and trisomy on plant phenotype fertility and meiotic behavior
6. Induction of polyploidy using colchicines, different methods of the application of Colchicines.
7. Effect on induced and spontaneous polyploidy on plant phenotype, methods, pollen and seed fertility and fruit set.
8. Effect on translocation heterozygosity on plant phenotype, chromosome pairing and chromosome disjunction and pollen and seed fertility.

9. Meiosis of complex translocation heterozygotes.
10. Isolation of chlorophyll mutants, following irradiation and treatment with chemical mutagens.
11. Estimation of nuclear DNA content through micro densitometry and flow cytometry.
12. Fractionation and estimation of repetitive and unique DNA sequences in nuclear DNA.

Suggested Readings :-

1. Fukui, k. and Nakayana, S. 1996; Plant chromosomes : Laboratory Methods, CRC Press, Boca rattan, Florida.
2. Sharma, A.K. and Sharma, A.1999, Plant chromosome Analysis Manipulation and Engineering. Hoarwood Academic Publisher, Australia.

Paper – III :Biology and Diversity of Lower Plants: Cryptogams

Scheme of Examination

Max.Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of short type of questions with a Limit of 20 words.

Unit – I

Phycology : Algae in diversified habitats (terrestrial, fresh water, marine), thallus organization, cell structure, reproduction (vegetative, asexual and sexual) criteria for classification of algae, Pigments, Reserve food, Flagella, Classification, Silent features of Cyanophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Pheophyta and Rhodophyta: with special reference to Microcystis, Hydrodictyon, Botrydium, Cosmarium, Closterium and Liagora.

Unit – II

Mycology : General characters of fungi, Substrate relationship in fungi, Cell structure, Unicellular and multicellular organization, Cell wall composition, nutrition (Saprophytic, Parasitic, symbiotic), heterothallism, heterokaryosis, Parasexuality, Recent trends in classification, phylogeny of fungi, general account of Masigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina with special reference to Pilobolus, Chaetomium, Morchella, Melampsora, Polyporus, Fungi in industry, medicine and as food, fungal diseases in plants and humans. Mycorrhizae, fungi as biocontrol agents. Poisonous fungi.

Unit – III

Bryophyta : Morphology, structure, reproduction and life history, distribution, classification, Evolutionary trends in Bryophyta, general account of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales, with special reference to Plagiochasma, Notothylus and Polytrichum, economic and ecological importance.

Unit – IV

Pteridophyta : Morphology, Anatomy and reproduction; classification; Stele system evolution of stele. Heterospory and origin of seed habit, general account of fossil pteridophyta; Introduction to Psilotopsida, Lycopsidea, Sphenopsida and Pteropsida; with special reference to Lycopodium, Selaginella, Gleichenia, Pteris, Isoetes and Ophioglossum.

Suggested Reading :-

- Alopoulus, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology, John Wiley & Sons. Ind.
- Clifton, A. 1958. Introductory to the Bacteria. McGraw-Hill Book co., New York.
- Kumar, H.D. 1988. Introduction phycology. Affiliate East-west Press Ltd. New Delhi.
- Mandahar, C.L. 1978. Introduction to Plant Viruses. Chand & Co. Ltd, New Delhi.
- Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology, Now Age Intermediate Press.
- Morris, I. 1986. An Introduction Algae., Cambridge University, U.K.
- Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
- Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
- Puri, P. 1980. Bryophytes. Atma Ram & Sons. Delhi.
- Rangaswamany, G. and Mahadevn, A. 1999 Diseases of Crop Plants in India (4th edition) Prentice Hall of India Pvt. Ltd. New Delhi.
- Round, F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.
- Sporne, K.K. 1991, The Morphology of Pteridophyta. B.I. Publishing Pvt. Ltd., Mumbai.
- Stewart, W.N. and Rathwell G.W. 1993. Paleobotany and the Evolution of Plant, Cambridge University Press.
- Webster, J. 1985: Introduction to Fungi. Cambridge University Press.

Suggested Laboratory Exercise :-

Morphological study of representative member of algae, fungi, bacteria, bryophytes and Pteridophytes : Microcystis, Pediastrum, Hydrodictyon, Ulva, Pithophora, Stigeoclonium, Draperanaldiopsis, Closterium, Cosmarium, Chara, Stemonitis, Pernospora, Albugo, Mucor, Pilobolus, Yeast, Chaetomium, Pleospora, Morchella, Phallus, Polyporus, Penicillium, Colletotrichum, Marchantia, Anthoceros, Polytrichum, Psilotum, Lycopodium, Selaginella, Equisetum, Glehnia, Pteris, Ophioglossum, Isoetes.

Symptomology of some diseased specimens; White rust downy mildew, powdery mildew, rusts, smuts, ergot, groundnut leaf spot, red rot of sugarcane, wilts, Paddy blast, citrus canker, bacterial blight of paddy, angular leaf spot of cotton, tobacco mosaic, little leaf of brinjal, sesamephyllody, mango malformation.

Study of morphology, anatomy and reproductive structures of bryophytes and pteridophytes.

Gram staining of bacteria.

Identification of fungal cultures : Rhizopus, Mucor, Penicillium, Emericella, Chaetomium, Fusarium, phoma, Colletotrichum.

Sterilization methods, preparation of media and stains.

Paper – IV : Taxonomy and Diversity of Seed Plants -

Scheme of Examination

Max. Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of short type of questions with a Limit of 20 words.

Unit-I

GYMNOSPERMS

Introduction : Gymnosperms: the vessel-less and fruitless seed plant varying in the structure of their sperms, pollen grains, pollen germination and the complexity of their female gametophyte; Evolution of Gymnosperms. Classification of Gymnosperms and their distribution in India.

Brief account of the families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). General account of Cycadeoidales and Cordaitales.

Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

Unit-II

TAXONOMY OF ANGIOSPERMS :

1. Aims, components, and principles of taxonomy; Alpha and Omega Taxonomy, documentation and scope.
2. Systems of Angiosperm classification: Natural System of classification (Bentham and Hooker) Croquets, Dahlgren, and Thorne
3. International Code of Botanical Nomenclature: Principles, rules and recommendations; Taxonomic concept: Hierarchy, species, genus, family and other categories.

Unit-III

Numerical Taxonomy- Principles, concepts, operational taxonomic units (OUT), data processing and taxonomic studies, taximetric methods for study of population variation and similarity coding, cluster analysis, cladistics, cladogram.

Taxonomic literature: Floras, Monographs, Icons, Library, Manuals, Index, Taxonomic keys.

Taxonomic tools and techniques: Herbarium, Serological, Molecular technique, GIS and Mapping Biodiversity

Unit-IV

Taxonomic evidences: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry and Genome analysis.

Phylogeny of Angiosperms: Ancestors of Angiosperms, time and place of origin of Angiosperms; habit of Angiosperm, primitive living Angiosperms, inter relationship among the major group of Angiosperms.

Suggested Readings :

- Sambamurty, A.V.S.S. 2010. Taxonomy of Angiosperms. I.K. International Pvt. Ltd
Tyagi, Y.D. and Kshetrapal, S. 1973. An Introduction to Angiosperms.
Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms, New Age International Pvt. Ltd, New Delhi.
Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London.

Davis, P.H. and Heywood, V.H. 1973, Principles of Angiosperms Taxonomy, Robert E. Kreiger Pub. Co., New York.

Grant, V. 1971. Plant Speciation, Columbi University Press, New York.

Nordenstam, B., EJ Gazaly, G. and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd. London.

Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper & Row Publications, USA

Singh, H. 1978. Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X. GebruderBortraeger, Berlin.

Solbrig, O.T. 1970, Principles and Methods of Plant Biosystematics. The MacMillan Co. Collier-MacMillan Ltd. London.

Solbrig, O.T. and Solbrig, D.J. 1979. Population Biology and Evolution. Addison-Wesley Publishing Co. Ind. USA.

Stebbins, G.L. 1974. Flowering Plant-Evolution Above Species Level. Edward Ltd., London.

Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold Ltd., London.

Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.

Woodland, D.W. 1991. Contemporary Plant Systematics, Prentice Hall, New Jersey.

Suggested Laboratory Exercises:-

Gymnosperms

1. Comparative study of the anatomy of vegetative and reproductive parts of Cycas, Ginkgo, Cedrus, Abies, Pinus, Cupressus, Araucaria, Cryptomeria, Taxodium, Podocarpus, Agathis, Taxus, Ephedra and Gnetum.
2. Study of important fossil gymnosperms from prepared slides and specimens.

Angiosperms

3. Description of a specimen from representative, locally available families.

List of Locally Available Families:

(1) Ranunculaceae, (2) Capparidaceae, (3) Portulacaceae, (4) Caryophyllaceae, (5) Malyaceae, (6) Tiliaceae, (7) Sterculiaceae, (8) Zygophyllaceae, (9) Rhamnaceae, (10) Sapindaceae, (11) Leguminosae, (12) Combretaceae, (13) Myrtaceae, (14) Cucurbitaceae, (15) Umbelliferae, (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) Labiatae, (30) Nyctaginaceae, (31) Polygonaceae, (32) Chenopodiaceae, (33) Amaranthaceae, (34) Aizoaceae, (35) Molluginaceae, (36) Euphorbiaceae, (37) Commelinaceae and (38) Cyperaceae.

4. Description of a species based on various specimens to study intraspecific variation : a collective exercise.
5. Description of various species of a genus; location of key characters and preparation of keys at generic level.
6. Location of key characters and use of keys at family level.
7. Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.
8. Training in using floras and herbaria for identification of specimens described in the class.
9. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

10. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.
11. Study of the flora or college campus.

Paper – V :Plant Physiology and Metabolism-

Scheme of Examination

Max.Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of short objective type of question such as multiple choice type one line answer type, one word type and fill in the blanks type with a limit of 20 words.

Unit-I

Water relation of plants : unique physiochemical properties of water, chemical potential, water potential, apparent free space, Bulk movement of water, soil plant atmosphere continuum (SPAC), Stomatal regulation of Transpiration, Signal Transduction in guard cell.

Membrane Transport : Passive-non mediated transport and Passive-mediated transport. ATP-driven active transport, uniport, symport, antiport, Ionchannels.

Amino Acids, Proteins and Enzymes: Nod factors, root nodulation and Nitrogen Fixation, Structure of amino-acids. Amphoteric properties, Synthesis of Amino Acids by reductiveamination, GS-GOGAT system and Transamination.

Structure of Proteins : Primary, secondary, tertiary, quaternary and domain structure, Protein Solubility, electrostatic forces, hydrogen bonding, disulfide bonding and hydrophobic interaction.

Enzymes : Structure and properties, substrate specificity, classification and mechanism of enzymes action significance of ribozymes, abzymes and artificial enzymes.

Unit-II

Carbohydrates : Classification, structure and function of Monosaccharides, polysaccharides, and glycoproteins including starch, cellulose and proteins.

System Physiology : Structure, function and mechanism of action of Phytochromes, Cryptochromes and Phototropins. Photosynthetic pigments, absorption and transformation of radiant energy, photo-oxidation, four complexes of thylakoid membranes. Photosystem I, cytochrome b, cytochrome f-complex, Photosystem II, and coupling factors, Photolysis of water and O₂ evolution, Noncyclic and cyclic transportation of electrons, Water cycle, Proton gradient and Photophosphorylation, Calvin cycle, regulation of RUBISCO activity, control of calvin cycle. C₄ Pathway and its adaptive significance. CAM pathway differences between C₃ and C₄ plants, glycolate pathway and photorespiration, chlororespiration and CO₂ concentrating mechanism in Micro-organism.

Unit-III

Respiration : Anaerobic and aerobic respiration, amphibolic nature of TCA cycle, Pentose Phosphate pathway, glyoxylate pathway, oxidative phosphorylation, gluconeogenesis, high energy compounds, their synthesis and utilization.

Fat metabolism : Synthesis of long chain fattyacids, lipid biosynthesis and oxidation.

Secondary Metabolites : Biosynthesis and function of secondary metabolites, with special reference to tannins , alkaloids, steroids and phenols.

Unit-IV

Plant growth regulation :Auxins – chemical nature, bioassay, physiological effects and mode of action.

Gibberellins – chemical nature, bioassay, physiological effects and mode of action.

Cytokinins - chemical nature, bioassay, physiological effects and mode of action.

Abscissic acid - chemical nature, bioassay, physiological effects and mode of action.

Physiology of flowering :Photoperiodism and vernalization.

Stress physiology- Responses of plant to biotic (Pathogen and insects) and abiotic (water, temperature and salt) Stresses.

Suggested Readings :

1. Buchanan, B.B. Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Denais, D.T. Turpin, D.H. Lefebvre, D.D. and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants scientific American Library, Springer Verlag, New York, USA.
4. Hooykants, P.J. Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam. The Netherlands.
5. Hopkins, W.G. 1995. Introduction of Plant Physiology, John Wiley & Sons Inc. New York, USA.
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira P., Baltimore D. and Darnell, J. 2000. Molecular Cell Biology (fourth edition). W.M. Freeman and Company, New York, USA.
7. Moore, T.C. 1989. Biochemistry And Physiology of plant Hormones (second edition). Springer-verlag, New York, USA.
8. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
9. Salisbury, R.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co. California, USA.
10. Singhal, G.S. Rengel, G., Sopory, S.K., Irrgang, K.D. and Govindjee 1999. Concepts in Photobiology :Photosynthesis and Photomorphogenesis, Narosa, Publishing House, New Delhi.
11. Taiz, I. and Zeiger, E. Plant Physiology (2nd edition). Sinauer Associates, Inc. Publishers, Massachusetts, USA.
12. Thomas, B. and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition), Academic Press San Diego, USA.
13. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant, Oxford University Press, Oxford, UK.
14. Ainsworth, C. 2006. Flowering and its Manipulation, Annual Plant Reviews, Vol.20, Blackwell Publishing, Oxford, U.K.
15. Brown T.A. 2002 Genomes, BIOS Scientific Publishers Ltd, Oxford, UK.
16. Buchanan B, Gruissem G and Jones R. 2000. Biochemistry and molecular Biology of Plants, American Society of plant Physiologists, USA.
17. Davies P, J. 2004. Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.

18. Jordan, BR.2006. The Molecular Biology and Biotechnology of Flowering, 2nd Edition CAB International, Oxfordshire, UK.
19. Lodish H, Berk A, Kaiser CA and Krieger M. 2008 Molecular Cell Biology, 6th Edition, W.H. Freeman and Company, New York, USA.
20. Nelson DL and Cox MM. 2004 Lehninger Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, New York, USA.
21. Bajracharya D.1999 Experiments in plant Physiology : A Laboratory manual. Nocrosa Publishing House, New Delhi.

Laboratory Exercises :

1. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase, nitrate, reductase).
2. Demonstration of the substrate inducibility of the enzyme nitratereductase.
3. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of Chlorophylls and carotenoids.
4. To determine the chlorophyll a and chlorophyll b ratio in C3 and C4 Plants.
5. Extraction of seed proteins depending upon the solubility.
6. Desalting of proteins by gel filtration chromatography employing Sephadex G25.
7. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by lowry's or Bradford's method.
8. Fractionation of proteins using gel filtration chromatography by Sephadex G100 or Sephadex G200
9. SDS-PAGE for soluble proteins extracted from the given plant material and comparison of their profile by staining with Coomassie Brilliant Blue or Silver Nitrate.
10. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoresis.
11. Principles of colorimetry, spectrophotometry and fluorimetry.
12. Effect of substrate concentration on activity of any enzyme and determination of its Km value.
13. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.
14. To demonstrate Photophosphorylation in intact chloroplasts, resolve the phosphoproteins by SDS-PAGE and perform autoradiography.
15. Radioisotope methodology, autoradiography, instrumentation (GM counter and Scintillation counter) and principles involved.
16. To study the localization of Biochemicals viz- Tannins, Suberins, Lignins, Phenols, Proteins etc. in the different parts of the selected plant organs.

Paper – VI : Microbiology and Plant Pathology -

Scheme of Examination

Max.Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of short type of questions with a limit of 20 words

Unit-I

Microbiology

1. Important landmarks in the history of microbiology archeobacteria and eubacteria : General account, ultrastructure, nutrition and reproduction, biological and economic importance, cyanobacteria, salient features and biological importance.
2. Microbial toxins : Pathogenic types of toxins (exotoxin, endotoxin & enterotoxin) non specific and specific defence Mechanisms.

Paper – VI : Microbiology and Plant Pathology -

Scheme of Examination

Max.Marks : 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of short type of questions with a limit of 20 words

Unit-I

Microbiology

1. Important landmarks in the history of microbiology archeobacteria and eubacteria : General account, ultrastructure, nutrition and reproduction, biological and economic importance, cyanobacteria, salient features and biological importance.
2. Microbial toxins : Pathogenic types of toxins (exotoxin, endotoxin & enterotoxin) non specific and specific defence Mechanisms.
3. Viruses : Classification, characteristics and ultrastructure of virus, chemical nature, replication, transmission of viruses, cyanophages, economic importance.
4. Phytoplasma : General characteristics and role in causing plant diseases.

Unit – II

5. Scope and application of microbes in agriculture, industry, food , pollution and biological control of pests.
6. Microbial association :Symbiotic nitrogen fixation, mycorrhiza (VAM fungi).
7. General account of immunity, allergy, properties of antigens and antibodies, Antibody structure and function, affinity and antibody specificity. Monoclonal antibodies and their uses, Antibody engineering, serology, types of vaccines. Preliminary account of Biofilms, Biochips, Biosensors and biosurfactants.

Unit – III

Plant Pathology

8. History and scope of plant pathology : General account of diseases caused by plant pathogen attack and defense mechanisms, physical, physiological, biochemical and molecular plant pathology.
9. Plant disease management : Chemical, biological, IPM systems, development of transgenics, Biopesticides, plant disease clinics, Preliminary account of application of Biotechnology in plant pathology.

Unit – IV

Symptomology: Identification and control of following plant diseases.

Fungal Diseases : Wheat (Rust, Smut, Bunt), Bajra (Green ear, ergot and smut), crucifer (rust).

Paddy (Paddy blast), Cotton (wilt), Grapes (Downy mildew and powdery mildew).

Bacterial disease : Wheat (Tundu), Citrus canker.

Viral disease : Tobacco mosaic, Bhindi yellow mosaic.

Phytoplasma disease : Little leaf of brinjal.

Nematode Disease : Root-knot of vegetables.

Suggested Readings :

1. Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996. Introductory, Mycology. John Wiley & Sons, Inc.
2. Agrios, G.N. 1997. Plant Pathology, Academic Press, London.
3. Albajes, R., Gullino, M.L. VanLenteren, J.C., Elod, Y. 2000. Integrated pest and Disease Management in Green house Crops, Kluwer Academic Publishers.
4. Bridge, P., Moore, D.R. & Scorf, P.R. 1998. Information technology, Plant Pathology and Biodiversity, CAB International, UK.
5. Clifton, A. 1958. Introduction to the bacteria, McGraw Hill Book Co. New York.
6. Mandahar, C.I. 1978, Introduction to Plant viruses, Chand & Co. Ltd. Delhi.
7. Mahotra, R.S. Plant Pathology. Tata McGraw Hill.
8. Rangaswamy, G. & Mahadevan, A. 1999; Diseases of crop plants in India (4th edition) Prentice Hall of India, Pvt. New Delhi.
9. Horsfall, J.G. & A.L. Dimond, Plant Pathology Vols. 1, 2 & 3 Academic Press, New York, London.
10. Trivedi, P.C. 1998. Nematode Diseases in Plants. CBS Publisher & Distributor, New Delhi.

Suggested Laboratory Exercises (Microbiology) :

1. Calibration of microscope : determination of dimensions of micro organisms (suggested model organisms : yeast, lactobacilli, cyanobacteria).
2. Cultivation media for autotrophic and heterotrophic microorganism (cleaning of glass wares, mineral media, complex media, solid media, sterilization) (based on topics 3.)
3. Isolation of microorganisms, streaking on agar plates/pour plate method, isolation of clones, preservation (based on topics 2 and 3).
4. Determination of growth of microorganism (model organism: *Escherichia coli*, effects of nutrients, e.g. glucose, fructose, sucrose, principle of colorimetry/spectrophotometer) (based on topic 3).
5. Determination of microbial population size (suggested model organism yeast, use of haemocytometer, serial dilution technique, relationship between dilution and cell count, determination of standard error, reliability in cell counts) (based on topic 3).
6. Preparation of Winogradsky column using pond bottom mud, observations on temporal sequence of appearance of microbes (visual appearance, microscopic observations) (based on topic 7)
7. Observation on virus infected plants (symptoms) (based on topic 5)
8. Fermentation by yeast (inverted tube method, use of different substrates, e.g. glucose, fructose, cane sugar, starch) (based on topic 8).
9. Diseases as per theory syllabus.

M.S. Brij University, Bharatpur – 321001
M.Sc. Final (BOTANY)

Paper VII :Plant Morphology, Development, Anatomy and Reproductive Biology -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Introduction: Unique features of plant development, differences between animal and plant development.

Seed germination and seedling growth: Metabolism of proteins and mobilization of food reserves, tropisms during seed germination and seedling growth, hormonal control of seedling growth; gene expression, use of mutants in understanding seedling development.

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

Unit-II

Leaf growth and differentiation: Inception, phyllotaxy, control of leaf form (leaf meristems and other factors), differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll, Kranz anatomy, Leaf traces and leaf gaps, transfer cells.

Root development: Organization of root apical meristem (RAM), vascular tissue differentiation, lateral roots, root hairs, root-microbe interactions. Hormonal Control of root development.

Seed coat development: External and internal morphology of seed, seed appendages, ontogeny of seed coat in various families, mature structure, spermoderm patterns.

Unit-III

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

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 allergy, pollen embryos.

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

Pollination, Pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors, structure of the pistil, pollen-stigma interactions, sporophytic and gametophytic self-incompatibility double fertilization, *in vitro* fertilization.

Unit-IV

Seed development and fruit growth: Endosperm development, embryogenesis, cell lineages during late embryo development, storage proteins of endosperm and embryo.

Polyembryony, apomixes, embryo culture: Dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

Latent life – dormancy: Importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy.

Senescence and programmed cell death (PCD): Basic concepts, types of cell death, PCD in the life cycle of plants. Metabolic changes associated with senescence and its regulation influence of hormones and environmental factors on senescence.

Suggested Readings:

1. Bewley, J.D. and Black, M. 1994. *Seeds: Physiology of Development, Germination*, Plenum Press, New York.
2. Burgess, J. 1985. *An Introduction to Plant Cell-Development*, Cambridge University Press, Cambridge.
3. Fahn, A. 1982. *Plant Anatomy*. (3rd edition), Pergamon Press, Oxford.
4. Raven, P.H., Evert, R.F. and Eichhorn, S. 1992. *Biology of Plants* (5th edition), Worth, New York.
5. Salisbury, P.B. and Ross, C.W. 1992. *Plant Physiology* (4th edition), Wadsworth Publishing, Belmont, California.
6. Carlquist, S. 2001. *Comparative wood Anatomy*, Springer-Verlag, Germany.
7. Cutler DF 1978. *Applied Plant Anatomy*, Longman, United Kingdom.
8. Cutler EG 1978. *Plant Anatomy*, Part I & II, Edward Arnold, United Kingdom.
9. Dickinson WC 2000. *Integrative Plant Anatomy*, Harcourt Academic Press, USA.
10. Fahn, A. 1974. *Plant anatomy*, Pergamon Press, USA & UK.
11. Fosket DE. 1994 *Plant, Growth and Development : A Molecular Approach*, Academic Press.
12. Hopkins WG. 2006. *The Green World : Plant Development*, Chelsea House Publication.
13. Howell SH. 1998. *Molecular Genetics of Plant Development*, Cambridge University Press.
14. Leyser O and Days S. 2003 *Mechanism of Plant Development*, Blackwell Press.
15. Mauseth JD 1988. *Plant Anatomy and Major Uses of Wood*, Faculty of Forestry, University of Malaysia.
16. Nair MNB 1998. *Wood Anatomy and Major Uses of wood*, Faculty, University of Malaysia, Malaysia.

PRACTICALS:

1. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
2. Origin and development of epidermal structures (*trichomes, glands and lenticels*).
3. Study of xylem and phloem elements using maceration, staining, Light and electron micrographs (*xerophytes, hydrophytes and halophytes*).
4. Study of secretory structures (*nectaries and laticifers*).
5. Study of secondary growth (*normal and unusual*) of selected woods with the help of wood microtome and permanent slides.
6. Study of the stages of pollen and ovule development in the wild and mutant plants using permanent slides, electron micrograph and available phenotypes.
7. Pollen *in vitro* germination methods: Sitting drop culture, suspension culture, surface culture.

8. Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (*in vitro*) of pollen grains.
9. Assessment of stigma receptivity by localizing peroxidases, non-specific esterases and phosphatases.
10. Aniline blue fluorescence method to localize pollen tubes to study different aspects of pollen-pistil interaction.
11. Use of DNA fluorochromes to localize nuclei during pollen and ovule development.
12. Study of post-fertilization stage with the of permanent slides and electron micrographs.
13. Dissection of embryo and endosperm.

Paper VIII :Plant Ecology -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Science of Ecology: Introduction to ecology, evolutionary ecology, models;

Population: Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure, population growth. Competition and coexistence, intra-specific, Interactions, interspecific (mutualism) interactions, scramble and contest competition model, mutualism, commensalism and allelopathy, prey-predator interactions.

Vegetation organization: Concepts of community and continuum, community coefficients, interspecific associations, ordination, species diversity and pattern diversity in community, concept of habitat, ecotone and ecological niche.

Unit-II

Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition), succession models (facilitation, tolerance and inhibition models), Changes in ecosystem properties during succession, concept of climax.

Ecosystems: Nature and size of ecosystem, components of an ecosystem (producers, consumers and decomposer), Grazing (grassland) and Dtritus food chain in freshwater ecosystems, food webs, Ecological energetic. Solar radiation and energy intakes at the earth's surface, energy flow models. Productivity of various ecosystems of the world and global biogeochemical cycles of carbon and nitrogen.

Unit-III

Ecosystem stability: Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on plant and ecosystems, Restoration of degraded ecosystems, ecology of plant invasion, Environment impact assessment, ecosystem restoration.

Biomes, Biodiversity: Major biomes of the world and Impact of changing climate on biomes.

Biodiversity: Concept & level, role of biodiversity in ecosystem function and stability, assessment (local, national and global), speciation and extinction, Biodiversity act of India and related international conventions, diversity indices, IUCN Categories of threat, Hot spots.

Unit-IV

Conservation: Conservation (ex-situ and in situ) and management, International Conservational organizations, sustainable development, natural resource management in changing environment, molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioural ecology, conservation genetics, Global warming, climatic changes.

Energy: Sources, Fossil fuels, Nuclear fuel, Solar Energy, Fuel Cells, Biomass, Hydropower, Wind Power, Geothermal, Tidal & Wave energy, Energy conservation.

Suggested Readings:

1. Smith, R.L. 1996. Ecology and Field Biology, Harper 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, Blackwell Science, Cambridge, USA.
4. Ludwig, J. and Reynolds, J.F. 1988. Statistical Ecology. John Wiley & Sons.
5. Odum, E.P. 1971. Fundamentals of Ecology, Saunders, Philadelphia.
6. Odum, E.P. 1983. Basic 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. Concept of ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
9. Chapman, J.I. and Reiss, M.J. 1988. Ecology, Principles and Applications. Cambridge University Press, Cambridge, UK.
10. Molan, B. and Billharz, S. 1997. Sustainability Indicators, John Wiley Sons, New York.
11. Heywood, V.H. and Watson, R.I. 1985. Global Bruosity Associate, University Press.
12. N.S. Subrahmanyam and A.V., S.S. Sambamurty 2000. Ecology. Narosa Publishing House, Delhi.
13. S.K. Maiti. 2004. Handbook of Methods in Environmental Studies Vol. 1 &2. ABD Publisher, Jaipur.
14. J.L.Chapman and M.J. Reiss.1995. Ecology principle and applications. Cambridge University Press.
15. C. Faurie, C.Ferra,P.Medori and J.Devaux. 2001. Ecology Science & Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
16. G.T. Miller Jr. 2005. Essentials of Ecology. III Edition, Thomson, Brooks/cole
17. P.D. Sharma Ecology and Environment, Rastogi Publication.

Suggested Laboratory Exercises

1. To determine minimum size and number of quadrat required for reliable estimate of biomass in grasslands.
2. To compare protected and unprotected grassland stands using community coefficients (Similarity Indices).
3. To estimate IVI of the species in a grassland/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 organic matter in the soils of cropland grassland and forest.
8. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
9. To estimate the dissolved oxygen chlorophyll II content SO₂ fumigated and unfumigated plants leaves.
10. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
11. To study environmental impact of a given developmental activity using checklist as an EIA method.

Paper IX :Plant Resource Utilization and Conservation -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Plant Biodiversity: Concept, Status in India, Utilization and concerns

Sustainable Development: Basic Concepts, Origins of Agriculture.

World centres of primary diversity of domesticated plants: The Indo-Burmese centre, plant introductions and secondary centres.

Unit-II

Origin, evolution, botany cultivation and uses of: (i) Food forage and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants and (iv) vegetable oil-yielding crops.

Unit-III

Important fire-wood and timber-yielding plants and non-wood forest products (NWFPs): such as bamboos, rattans, raw materials for paper making, gums, tannins, dyes, resins and fruits.

Green revolution: Benefits and adverse consequences, Innovations for meeting world food demands.

Unit-IV

Strategies for conservation-in situ conservation: International efforts and Indian initiatives, protected areas in India-sanctuaries, national parks, Biosphere reserves, Wetlands, Mangroves and Coral reefs, Conservation of wild biodiversity.

Strategies for conservation-ex situ conservation: Principles and practices, botanical gardens, field gene banks, Seed banks, *in vitro* repositories, cryobanks, general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts, Rare and endangered species of plants in Rajasthan.

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Suggested Readings

1. Anonymous, 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
 2. Arora, R.K. and Nayar, E.R. 1984. Wild Relatives of Crop Plants in India. NBPGR Science Monograph No. 7.
 3. Baker, H.G. 1978. Plants and Civilization (3rd edn.). CA Wadsworth, Belmont.
 4. Bole, P.V. and Vaghani, Y. 1986. Field Guide to Common India Trees. Oxford University Press, Mumbai.
 5. Chandel, K.P.S., Shukla, G. and Sharma, N. 1996. Biodiversity in Medicinal and Aromatic Plants in India: Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
 6. Chrispeels, M.J. and Sadava, D. 1977. Plants, Food and People, WII Freeman and Co., San Francisco.
 7. Cristi, B.R.(ed) 1999. CRC Handbook of Plants Sciences and Agriculture. Vol.I. In-situ conservation, CRC Press, Boca Raton, Florida, USA.
 8. Conway, G. 1999. The Doubly Green Revolution: Food for All in the 21st Century, Penguin Books.
 9. Conway, G. and Barbler, E. 1990. After the Green Revolution, Earthscan Press, London.
 10. Conway, G. and Barbier, E. 1994. Plant Genes and Agriculture Jones and Bartlen, Publisher, Boston.
 11. Council of Scientific and Industrial Research 1986. The Useful Plants of India. Publication and Information Directorate, CSIR, New Delhi.
 12. Council of Scientific and Industrial Research (1948, 1976). The wealth of India. A Dictionary of Indian Raw Materials and Industrial Product. New Delhi. Raw Materials (I-XII). Revised Vol.I-III (1985-1992). Supplement (2000).
 13. Croaquist, A. 1981. An Integrated System of Classification of Flowering Plant. Columbia University Press, New York, USA.
 14. Directory of India Wetlands, 1993. WWFINDIA, New Delhi and AWB Kuala Lumpur.
 15. Falk, D.A. Olwel, M. and Millan C. 1996.
- * **Suggested Practical Exercise :**

The Practical course is divided into three units : (1) Laboratory work, (2) Field survey, and (3) Scientific visits.

Laboratory Work :

1. Food Crops: Wheat, rice, maize, Chickpea (Bengal gram), potato, tapioca, sweet potato, sugarcane, morphology, anatomy, microchemical tests for stored food materials.
2. Forage /fodder crops : Study of any five important crops of the locality (for example fodder sorghum, bajra, berseem, clove, guar bean, gram, Ficus sp.)
3. Plant fibres :
 - a) Textile fibres : cotton, jute, linen, stinn bemp, carnabis.
 - b) Cordage fibres : coir
 - c) Fibres for stuffing : silk cotton or kapokMorphology, anatomy, (microscopic) study of whole fibres using appropriate staining procedures.

Medicinal and aromatic plants : Depending on the geographical location college/university select five medicinal and aromatic plants each from a garden crop field (or from the wild only if they are abundantly available).

Papaver somniferum, Atropa belladonna, Catharmthus roseus, Adhatodia cylanica (syn A visica) allium sativum, Rauwolfia serpentine, Withania somnifera, Phyllanthus & marus, (Pfraternus), Andrographis P aniculata, Aloc barbadens, Mentha arvensis, Rosa sp., Pogostemon cablin, origanum vulgare, Vectiria zizanjoideis, lasminum grandiflorum, Cymbopogon spprdsatis ohoratisimus

Study of liver or herbarium specimens or other visual materials, to become familiar with these resources.

4. Vegetable Oils : Mustard, groundnut, soybean, coconut, sunflower, castor, Morphology, microscopic structure of the oil yielding tissues, tests for oil and iodine number.
5. Gums, resins, tannins, dyes : Perform simple tests for gums and resins. Prepare a water extract of vegetable latmins (Acacia Terminalia, mangroves, tea, Casis spp Myrobalans) and dyes (turmeric, Bixa orellana, indigo, Bateia monosperma, Sonia inemis) and perform tests to understand their chemical nature.

Old Survey :

1. Firewood and timber yielding plants and NWF : Prepare a short list of 10 most important sources of firewood and timber in your locality. Give their local names, scientific names, and families to which they belong. Mention their properties.
2. Prepare an inventory of the bamboos and rattans of your area giving their scientific and local names and their uses with appropriate illustrations.
3. A survey of a part of the town or city should be carried out by the entire class, in batches. Individual students will select an avenue road and locate the trees planted on a graph paper. They will identify the trees mention their size canopy shape blossoming and fruiting period and their status (healthy, diseased, infested mutilated , Misused or dying) and report weather or not individual reports will be combined to prepare a larger map of the area, which can be used for subsequent monitoring either by the next batch of students/teachers/local communities/NGOs/or cleric authorities. The purpose of exercise in item C above is to make the students aware of the kinds of trees and value in urban ecosystems and ecological services.

Scientific Visits :

Students should be taken to one of the following:

1. A protected area (biosphere reserve, national park, or a sanctuary).
2. A wetland
3. A mangrove
4. National Bureau of Plant Genetic Resources, New Delhi-110012 or one of its field stations
5. Head Quarters of the Botanical Survey of India at one of its Regional Circles.
6. A CSIR Laboratory doing research on plants and their utilization.
7. An ICAR Research Institute or a field station dealing with one major crop or crops.
8. A recognized botanical garden or a museum (such as those at the Forest Research Institute, Dehradun, National Botanical Institute, Lucknow, Tropical Botanical Garden and Research Institute, Trivandram), which has collection of plant products.

Note: The students are expected to prepare a brief illustrated narrative of the field survey and scientific visits. After evaluation, the grades awarded to the students by the teachers should be added to the field assessment of the practical examination.

Paper X : Biotechnology and Genetic Engineering of Plants and Microbes -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Biotechnology: Basic concepts, principles and scope, Concepts of cellular differentiation and totipotency, Historical development of plant cell, tissue and organ culture, Fundamental aspects of somatic embryogenesis, organogenesis; mechanism, techniques and utility.

Somatic hybridization: Protoplast isolation, fusion, culture, hybrid selection, regeneration, Possibilities, achievements and limitations and limitations of protoplast research, Various means of Micropropagation.

Unit-II

Application of plant tissue culture: production of hybrids, somaclones and artificial seed, production of secondary metabolites/natural products, cryopreservation and germplasm storage, IPR, possible ecological risk and ethical concern.

Recombinant DNA technology: Gene cloning principles and techniques; vectors and PCR, DNA fingerprinting, Genetic engineering of plants; aims and strategies for development of transgenics.

Unit-III

Genetic engineering of plants: Aims strategies for development of transgenics (with suitable examples), Agrobacterium- the natural genetic engineering, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual property right, possible ecological risks and ethical concerns.

Plants as bioreactors: Secondary plant products from cultured cells and their industrial application. Future prospects for genetically modified crops.

Unit-IV

Genomics and proteomics: Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, high throughput sequencing genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

Suggest Reading:

1. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practices (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.E. 1994. Plants, Genes and Agriculture. Jones & Bartlett Publishers, Oxford, UK.
6. Collins, H-A and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxon, 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, G.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.

1. Preparation of media.
2. Surface sterilization.
3. Micro propagation technique
4. Organ culture
5. Callus propagation, organogenesis, transfer of plants to soil.
6. Anther culture, production of Haploids.
7. Preparation of synthetic seeds.
8. Cytological examination of regenerated plants.
9. Isolation of protoplasts from various plant tissues and testing their viability
10. Agrobacterium culture, selection of transformants, reporter gene (GUS) assays.
11. PCR
12. Techniques : Biolistics, Membrane Filtration, Cell Counting
13. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
14. Genomic DNA, Protein and RNA extraction from plants of arid environment.
15. Qualitative and quantitative analysis of DNA, RNA and Protein
16. Molecular analysis of somatic embryogenesis and organogenesis
17. Genetic diversity analysis of plants of arid environment
18. Genetic fidelity analysis of in vitro regenerated plants
19. Gene analysis by RT-PCR
20. Agrobacterium-mediated plant genetic transformation of tomato
21. Bioinformatics exercises:
 - a) Labeling and scoring of molecular markers and phylogenetic tree preparation through NTYSIS software, and analysis of genetic diversity relationship.
 - b) Database searching and sequence retrieval of nucleic acids and proteins.
 - c) BLAST (n and p- blast).
 - d) Primer designing.
 - e) Multiple sequence alignment using ClustalW.
 - f) Protein structural modeling.

Suggested readings (Laboratory Exercises):

Sambrook, J. and Russell, D.W. 2001. Molecular Cloning – A Laboratory Manual, Vols I-III, Cold Spring Harbor Laboratory, USA.

Gelvin, S.B. and Schilperoort, R.A. (eds) 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.

Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.

Glover, D.M. and Harnes, B.D. (eds) 1995. DNA Cloning: A Practical Approach. Core Techniques, 2nd edition, PAS, IRL Press at Oxford University Press, Oxford.

Hackett, P.B., Fuchs, J.A. and Messing, J.W. 1988. An Introduction to Recombinant DNA Techniques : Basic Experiments in gene Manipulation. The Benjamin/ cummings Publishing Co., Inc Menlo Park, California.

Peter, C. and Rolf, B. 2000. Computational Molecular Biology: An Introduction. John Willey & Sons Ltd.

Journals/ Research papers

1. Nature reviews

2. BMC Genomics
3. Genome
4. Journal of Genetics & Bioinformatics
5. DNA Research
6. Genomics Proteomics & Bioinformatics
7. Bioinformatics
8. Journal of Bioinformatics and Computational Biology

Paper XI (a) :Advanced Plant Pathology –I -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Terminology of Plant Pathology, General Symptoms of Plant diseases, Components of Plant diseases, Disease diagnosis, Host- parasite Interaction (Genetic and Molecular basis), Biotic and Abiotic Pathogens, penetration, Infection and Pathogenesis, Physiological Specialization in Phytopathogenic microbes.

Unit-II

Host factors in disease development: Inoculum Potential, Phenomena of resistance and susceptibility. Protective and defence mechanisms in plants, Phytoalexins, Breeding for disease resistance plant.

Environmental factors in disease development: Epiphytotics and plant disease forecasting.

Unit-III

IPM, Application of biotechnology and information technology in pest management.

Molecular Plant Pathology: Molecular diagnosis, identification of genes and specific molecules in disease development. Non-parasitic diseases and control measures. Transgenic plants for disease resistance.

Unit-IV

Principle of Plant Protection, Physical, Chemical and biological control of plant diseases.

Classification and anatomy of galls: Some insect induced plant galls of Rajasthan, mechanism and physiology of insect galls.

Laboratory Exercises:

1. Studies of some local Bacterial, Fungal, Nematode, Phytoplasma and Viral diseases.
2. Field visit for demonstration of diseases on wild and crop plants.
3. Isolation of fungal and bacterial pathogens from leaves.
4. Isolation of fungal and bacterial pathogens from stem, fruits and other aerial plant parts.
5. Isolation of seed borne mycoflora by standard blotter method.
6. Isolation of Seed borne mycoflora using potato dextrose agar plate method.
7. General study of Pesticides and their application.

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8. Symptomology of some diseased specimens : White rust, downy mildew, powdery mildew, rusts, smuts, ergot, leaf spot, red rot, wilt, bacterial canker, bacterial blight, angular leaf spot, mosaic, little leaf, phyllody.

Suggested Reading:

- Agrios, G.N. 1997. Plant Pathology. Academic Press, London.
- Albajes, R., Gullino, M.L., Van Lenteren, J.C. and Elad, Y. 2000. Integrated Pest and Disease Management in Greenhouse Crops. Kluwer Academic Publishers.
- Mehrotra, R.S. 1993. Plant Pathology, Tata McGraw Hill.
- Rangaswamy, G. and Mahadevan, A. 1999. Disease of crop plants in India. Prentice Hall of India, New Delhi.
- Trivedi, P.C. 1998. Nematode disease of crop plants CBS Publisher & Distributors, New Delhi.
- Roger, H. 2001. Mathew's Plant Virology, Academic Press, NY.
- Strange, R.N. 2003., Plant resistance mechanism (SAR, ISR) –Introduction to plant Pathology, John Wiley & Sons, USA.
- Singh, R.S. 1998., Plant disease, Oxford and IBH Publication Co. Pvt. Ltd.
- Singh, R.S. 2005. Introduction to Principles of Plant Pathology. Oxford & IBH Publication Co. Pvt. Ltd.
- Sharma, P.D. 2006. Plant Pathology. Narosa Publishing House, India.
- Panday, B.P. 1997. Plant Pathology, Pathogen and Plant Disease. S. Chand and Company Ltd.

Paper XII (a) : Advanced Plant Pathology – II -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Fungal diseases: Symptomatology, disease identification and control of flag smut of wheat, covered smut of barley, blast of paddy, smut Jowar, Red rot of sugarcane, flax rust, early blight of potato, Ergot of Bajra, Smut of Bajra Rust wheat, Tikka disease of groundnut.

Unit-II

Bacteria: Classification and nomenclature of bacterial Plant pathogens. Method of identification of bacteria.

Bacterial diseases: Citrus canker, Angular leaf spot of cotton, Brown rot of potato, Crown gall disease, Angular leaf spot of cotton.

Unit III

Virus, Viroid and Phytoplasma disease: Transmission of viral diseases, Potato spindle tuber, Tobacco mosaic, yellow vein mosaic of Bhindi, bunchy top of banana.

Phytoplasmageneral account and diseases little leaf of Brinjal, witches broom of groundnut.

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Unit IV

Nematology: Brief history, classification of plant pathogenic nematodes, morphology and methods used in Nematology, Control of plant parasitic nematode.

Laboratory Exercises:

1. Demonstration of Koch's postulates for pathogenic microbes.
2. Isolation and Purification of plant pathogenic viruses.
3. Detection of plant viruses from infected leaf tissue using ELISA and Western Blot.
4. Isolation of Male, Female, II stage larva and eggs of Nematode for disease cycle study.
5. Microscopic study of pathogenic fungi: *Mucor*, *Rhizopus*, *Chaetomium*, *Penicillium*, *Aspergillus*, *Alternaria*, *Curvularia*, *Helminthosporium*, *Drechslera*, *Fusarium*, *Phoma*, *Colletotrichum*.
6. Microscopic study of pathogenic bacteria: *Agrobacterium*, *Xanthomonas* and *Pseudomonas*.
7. Microscopic study of biocontrol agents: *Trichoderma*, *Gliocladium*, *Metarrhizium*, *Paecilomyces*, *Beauveria*, *Streptomyces* and *Bacillus thuringiensis*.
8. In vitro study of effect of different fungicide on growth of pathogenic microbes.
9. In vitro study of effect of different biocide on growth of pathogenic microbes.
10. Antagonistic effect of biocontrol agents on pathogenic microbes.

Suggested Readings:

- Agarwal, V.K. and Sissclair, J.B. 1993., Principles of Seed Pathology., Vol. I & II CBS Publishers and Distributors, India
- Agrios, G.N. 1997. Plant Pathology. Academic Press, London.
- Albajes, R., Gullino, M.L., Van Lenteren, J.C. and Elad, Y. 2000., Integrated Pest and Disease Management in Greenhouse Crops, Kluwer Academic Publishers.
- Mehrotra, R.S. 1993. Plant Pathology, Tata McGraw Hill.
- Neergaard, P. 1997. Seed pathology, Vol. I & II. The Macmillan Press Ltd. London.
- Panday, B.P. 1997. Plant Pathology, Pathogen and Plant Disease. S. Chand and Company Ltd.
- Rangaswamy, G. and Mahadevan, A. 1999. Disease of crop plants in India. Prentice Hall of India, New Delhi.
- Roger, H. 2001. Mathew's Plant Virology, Academic Press, NY.
- Sharma, P.D. 2006. Plant Pathology. Narosa Publishing House, India.
- Singh, R.S. 1998., Plant disease. Oxford and IBH Publication Co. Pvt. Ltd.
- Singh, R.S. 2005., Introduction to Principles of Plant Pathology. Oxford & IBH Publication Co. Pvt. Ltd.
- Strange, R.N. 2003., Plant resistance mechanism (SAR, ISR) –Introduction to plant Pathology, John Wiley & Sons, USA.
- Suryanarayana, D. 1978., Seed pathology. Vikas Publishing House, Pvt. Ltd.
- Trivedi, P.C. 1998. Nematode disease of crop plants CBS Publisher & Distributors, New Delhi.

Paper XI (c) :Ecosystem Ecology - Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Grassland Ecosystems: Characteristics of grasslands, stratification, grasslands and grazing, grasslands and drought, grassland and animal life, Grasslands types with special reference to Prairie and Savannah, Indian grasslands.

Forest Ecosystems: Stratification of the forest, Forest types- Boreal, Temperate and Tropical forests, Forest animal life.

Unit-II

Freshwater Ecosystems: Classification of Freshwater Habitats, Lentic: Lakes & Ponds: Temperature and Oxygen stratification, Zonation based on light penetration, Flora and fauna, Productivity classes of lakes, Marshes and Swamps, Bogs,

Lotic: Spring, Streams and Rivers.

Marine and Estuarine Ecosystems: Characteristics of marine environment: Salinity, Temperature and pressure, Zonation and Stratification, Tides, Estuarine ecosystem: types of Estuaries, Flora and fauna, estuarine productivity, Coral reef ecosystem, Mangrove ecosystem.

Unit-III

Urban Ecosystem: Urban environment and Climatic conditions, additional physical complexes (modified surfaces including parking lots, roofs, and landscaping, buildings, transportation networks, infrastructure and public amenities), flora and fauna (human beings as largest macro consumer), Implications of urbanization : problems of air pollutants, drinking water supply, floods, waste disposal.

Rural ecosystems: Rural environment and climate, physical complexes (fields, agricultural, implements and machines), Flora and fauna, Problems of discharge of chemical fertilizers, pesticides and drinking water, Management of waste, Principle; Social Forestry.

Unit-IV

Desert Ecosystem: Desert Definition, classification (hot and cold), physiography, desert features, flora, fauna and water, formation, topography, distribution and characteristics of world deserts; Thar desert : Sand dunes: types, origin and morphology of sand dunes; vegetation types and plant communities biological production, conservation of flora and fauna, wild life, Succession in vegetation of western Rajasthan and coastal sand dunes, economic importance of desert plants (general economic plants, medicinal, famine food plants and crops);

Saline Arid zones: Saline tracts of Rajasthan and plants of saline aridzones (Halophytes), Economic and social considerations in the management of salt affected soils, afforestation in salt affected soils, Importance of halophytes.

Suggested Readings:

1. P.L. Jaiswal, A.M. Wadhwani and N.N. Chhabra (Eds.) 1983. Desertification and its Control. ICAR, Delhi.
2. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York.
3. Subrahmanyam, N.S. and A.V.S.S. Sambamurthy 2000. Ecology Narosa Publishing House, New Delhi.

4. G.M. Masters and W.P. Ela. 2008. Introduction to environmental engineering and sciences. PHI Learning Private Limited, New Delhi.
5. W.P. Cunningham and M.A. Cunningham. 2003. Principles of Environmental Science: Inquiry and Applications. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Suggested Laboratory Exercises:

1. Find out stomatal index of Xerophytes (Nerium, Calotropis, Zizyphus) growing in your locality.
2. Study of trichomes of xerophytes (Zizyphus, Lantana, Calotropis, Acacia) growing in your locality.
3. Study spread of root system of a perennial species in the soil.
4. Study ecological adaptations of halophytes in your nearby area.

Paper XII (c) :Environmental Biology -

Scheme of Examination

Max Marks: 100

The paper will have 9 questions out of which a student has to attempt 5 questions including the question no. 1 which will be compulsory. The question no. 1 will carry 20 marks and will be of several short objective type questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Air Pollution: Important Primary (CO, CO₂, Oxides of Sulphur & Nitrogen, H₂S, Chlorine, Particulates, Odour Producing compounds) & Secondary Air Pollutants (Smog, Acid rain, Primary Photochemical reaction, Formation of ozone and peroxyacetyl nitrate in air), Effects of air pollutants on Buildings & Monuments, plants, man and animals; Biomonitoring, Air pollution control (particulates and gaseous pollutants), Green belt, ozone depletion, mechanism of depletion, control strategies.

Unit-II

Water Pollution: Eutrophication-Process and Control; Oil Pollution, Thermal Pollution, Heavy metal Pollution, Treatment, Disposal & Recycling of Wastewaters, drinking water standards, Minimum National Standards, Ganga Action Plan.

Solid & Hazardous waste management & Resource Recovery: Solid wastes, Types, collection, Shrinking waste streams: 3R's (Reduction, Recycle & Reuse), composting, energy from waste, demanufacturing; Methods of disposal: Land fill, Open dumps, Exporting waste; Hazardous waste: Definition, disposal and management, Odours and its control.

Unit-III

Climate Issues: Greenhouse gases (CO₂, CH₄, N₂O, CFCs : sources, trends and role) and consequence of greenhouse effects (CO₂, fertilization, global warming, sea level rise, Biodiversity erosion), Carbon footprints, Carbon sequestration, Applications of GIS and Remote Sensing technology in environmental studies, the future of planet earth.

Policies, Regulations & related issues: Water (Prevention and Control of Pollution) Act 1974; Air (Prevention and Control of Pollution) Act 1981; Environment (Protection) Act 1986, Wild Life Protection Act 1972, Forest (Conservation) Act 1980, Biodiversity Act 2002.

Unit-IV

Environmental concerns: Environment auditing, Ecological footprints, Environment Impact Assessment, Bioindicator and biomarkers of environmental health; Environmental economics, Ecopolitics and green policies; Ecolabel, Rain, water harvesting, Orans, Indira Gandhi Canal and its ecological implication, water logging & salinity problems, The Management alternatives.

Suggested Readings:

1. Treshow, M. 1985. Air Pollution and Plant Life. Wiley Interscience.
2. Mason, C.F. 1991. Biology of Freshwater Pollution, Longman.
3. Hill, M.K. 1997. Understanding Environmental Pollution, Cambridge University Press
4. BrijGopal, P.S. Pathak and K.G. Saxena (Eds.). 1998. Ecology Today: An anthology of Contemporary Ecological Research, International Scientific Publications, New Delhi.
5. P.K. Goel. 1997. Water Pollution: Causes, Effects and Control. New Age International Ltd., Publishers, New Delhi.
6. R.K. Trivedy and P.K. Goel. 1998. An Introduction to Air Pollution. Technoscience Publications, Jaipur.
7. I.P. Abroi and V.V. DhruvaNarayana (Editors) 1990. Technologies for Wasteland Development. ICAR, New Delhi.
8. G.M. Masters and W.P. Ela. 2008. Introduction to Environmental Engineering and Sciences. PHI Learning Private Limited, New Delhi.
9. W.P. Cunningham and M.A Cunningham. 2003. Principles of Environmental Science; Inquiry and Application. Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
10. S.K. Maiti. 2004. Handbook of Methods in Environmental Studies Vol.1 &2. ABD Publisher, Jaipur.

Suggested Laboratory Exercises:

1. To estimate pH, EC and Secchi Disc transparency for polluted and unpolluted water bodies.
2. To estimate Chemical Oxygen Demand of polluted water sample.
3. To estimate Biological Oxygen Demand of polluted water sample.
4. To estimate inorganic phosphorus content in water samples collected from polluted and unpolluted water bodies.
5. To estimate Total hardness, calcium and magnesium content in water samples collected from polluted and unpolluted water bodies.
6. To estimate chloride content in water samples collected from polluted and unpolluted water bodies.
7. To estimate Total alkalinity in water samples collected from polluted and unpolluted water bodies.
8. To determine diversity indices (Shannon-Wiener, concentration of dominance, species richness, equitability and B-diversity) for polluted and unpolluted water bodies.
9. Chlorophyll content of plant species growing in polluted (along JLN Marg) and unpolluted habitat (Botany Department).


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Skeleton Paper
M.Sc. (F) Papers VII, VIII, IX & X
Practical Examination

Time – 8 Hrs
Q.No.

M.M. – 200
Mark Allotted

- 1.(a) Make suitable preparation of the given material. Draw labeled diagram, and 14
Study the anatomical features with special reference to its vascular structure.
Discuss points of special interest.
- (b) With the help of suitable preparation study the floral/seedcoat / epidermal/ 14
Micro-sporangium wall structure of the material provided. Draw labeled
Diagram and comment upon its features.
2. (a) Identify any two.....materials from the given samples. Give economic importance 14
With special reference to origin, cultivation, part used and processing, if any.
- (b) Mark the highest yield producing areas in the map provided to you. 12
3. (a) Perform the given Ecological exercise. 14
- (b) Perform the given Ecological exercise. 14
4. (a) Perform biotechnological exercise given to you. 14
- (b) Write details about the exercise given to you. 10
5. Sports 1 to 8 24
6. Records 30
7. Viva-Voce 20
8. Sessional 20

Practical Examination
Second Day (4 Hrs)
Advance Plant Pathology (Paper-XI A & XII A)

Time – 4 Hrs

M.M. – 100

Q.No.

Mark Allotted

1. Study the histopathology of the material 'A'. Make suitable preparation of the given material. Assign symptoms, causal organism and identify the disease making pathological 10 note of the given material.
2. Calibrate your microscope. Find out the average size of the fungal spore given to you

OR

Draw the camera-lucida drawing of the given material.

3. Study the given material 'D'.


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4.	Make a comparative phyto-pathological note on the material "C" and "B"	10
5.	Study the histopathology of the material "E" write points of special interest.	10
6.	Prepare a Bacterial preparation of the given material "F" using Gram Staining. Write and conclude about the result.	10
7.	Comment up on the 1 to 5	10
8.	Viva-Voce	10
9.	Records	15
10.	Sessional	10

Skeleton Paper
M.Sc. (F) Practical Examination

Special Paper – Ecosystem Ecology and Environments Biology – XI (C) and XII (C) :

Time – 4 Hrs

M.M. – 100

Q.No

Mark Allotted

1.	Determine organic matter content of the given soil sample by Walkely & Black method	20
	Or	
	Determine the dissolved O ₂ in a given water body by Winkler iodometric method.	
2.	Prepare the glycerin mount of the given plant materials explaining their anatomical adaptations in relation to habitat.	20
	Or	
	Study the various types of trichomes and their rolling mechanism to withstand during drought of given plant material.	
3.	Determine the total hardness Co ₂ /Cl of the given water sample.	10
4.	Determine pH of the given soil sample by pH meter.	05
	Or	
	Determine the conductivity of the given soil sample.	
5.	Comment upon the spots (1-5)	10
6.	Practical Record	15
7.	Viva-Voce	10
8.	Sessional	10


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