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

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, Primary and Secondary tissue differentiation. Secretary 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.

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

Seed coat development: External and internal morphology of seed.

Unit-III

Reproduction: Flower development, homeotic mutants in Arabidopsis and Antirhinum, 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 allergy, pollen embryos.

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

Pollination, Pollen-pistil interaction and fertilization: Floral characteristics. pollination mechanisms and vectors, double fertilization, in vitro fertilization.

Unit-IV

Seed development and fruit growth: Endosperin development, embryogenesis. **Polyembryony, apomixes, embrayo culture:** Dynamics of fruit growth, biochemistry.

Latent life - dormancy: Importance and types of dominancy, 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.

Suggested Readings:

1. Bewely, 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. (3 edition). Pergamon Press, Oxford.
4. Raven, P.H., Evrt, 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 (4h edition), wadsworth Publishing, Belmont. California.
6. Carlquist, S. 2001. Comparative wood Anatomy. Springer-Verlag, Germany.
7. Cutler DF 1978. Applied Plant Anatomy, Longman, United Kingdon,
8. Cutter 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 antony, Pergmon 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 Foresty, 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, glunds and lenticels).

3. Study of xylem and phloem elements using maceration, staining, Light and election 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), viablitiy (TTC and FDA slaning) and germinability (in vitro) of pollen grains, 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 micropraphs.
13. Dissection of embryo and endosperm.

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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

Population: Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern. population growth. Competition and coexistence, intra-specific, Interactions, interspecific (mutualism) interactions.

Vegetation organization: Concepts of community, concept of habitat, ecotone and ecological niche.

Unit-II

Vegetation development: Mechanism of ecological succession (relay floristic and initial floristic composition), succession models (facilitation, tolerance).

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, Ecologycal energetic. Biogeochemical cycles of carbon and nitrogen.

Unit-III

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

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

Biodiversity: Concept & level, role of biodiversity in ecosystem function, speciation and extinction, Biodiversity act of India, diversity indices, IUCN Categories of threat, Hot spots.

Unit-IV

Conservation: Conservation (ex-situ and in situ), International Conservational organizations, sustainable development, natural resource management in changing environment.

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

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. Ludwing, 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, Beniamin/Cummings Publication Company, California.
8. Kormondy, E.J., 1996. Concept of ecology. Pretice-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 Wily 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/wooland 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 byazide modification of Wrinkler's method.
9. To estimate the dissolved oxygen chlorophy 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 asan EIA method.

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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. I 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

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

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.

Green revolution: Benefits and adverse consequences.

Unit-IV

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

Strategies for conservation-ex situ conservation: Field gene banks, Seed banks, in vitro repositories, cryobanks, 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, Rare and endangered species of plants in Rajasthan.

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 Plans 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 Franciso.
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, Earthican Press, London.
10. Conway, G. and Barbler, 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, carmabis.
   b) Cordage fibres : coir
   c) Fibres for stuffing: silk cotton or kapok

   Morphology, 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 paniculata, Aloc barbadens Mentha arvensis, Rosa sp. Pogostemon cablin, origanum vulgare, Vectiria zizanjoides, lasminum grandiflorum. Cymbopogon spprndsatis oboraticimus

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, tannis, dyes : Perform simple tests for gums and risins. Prepare a water extract of vegetable latmins (Acacia Terminalia, mangroves, tea, Casis spp Myrobalans) and dyes (turmeric, Bixa orellans, indigo. Batea 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 selections 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, Misuesd 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 orgon 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, Fundamental aspects of somatic embryogenesis, organogenesis; mechanism.

Somatic hybridization: Protoplast isolation, fusion, culture, hybrid selection, limitations of protoplast research, Variousmeans of Micropropagation.

Unit-II

Application of plant tissue culture: production of hybrids, artificial seed, production of secondary metabolites/natural products, cryopreservation and germplasm storage, IPR.

Recombinant DNA technology: Gene cloning principles and techniques, vectors and PCR, DNA fingerprinting, Genetic engineering of plants.

Unit-III

Genetic engineering of plants: Aims strategies for development of transgenics (with suitable examples), Agrobacterium- the natural genetic engineering, intellectual property right, possible ecological risks and ethical concerns.

Plants as bioreactors: Secondary plant products from cultured cells and their industrial application.

Unit-IV

Genomics and proteomics: Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, bioinformatics, functional genomics, microarrays.

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. Geomes. 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 Hploid Production in Higher Plants, Vols. 1-5, Fundamental Aspects and Methods, Kluwer Academic Publishers, Dordrecht. The Nedherlands.

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. Restrication 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

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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.

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

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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, Pathogenesis.

Unit-II

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

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

Unit-III

IPM, Application of biotechnology

Molecular Plant Pathology: Molecular diagnosis, 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,

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.
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 Discase Management in Greenhouse Crops. Kiuwel 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. I 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 covered smut of barley, blast of paddy, Red rot of sugarcane, early blight of potato, Ergot of Bajra, 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, Crown gall disease.

Unit-III

Virus, Viroid and Phytoplasma disease: Transmission of viral diseases, Tobacco mosaic, yellow vein mosaic of Bhindi.

Phytoplasmageneral account and diseases little leaf of Brinjal, witches.

Unit IV

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

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, AlternariaCurvularia, Helminthosparium. Drechslera, Fusarium. Phoma, Colletotrichum.
6. Microscopic study of pathogenic bacteria: Agrobacterium. Xanthomonas and Pseudomonas.
7. Microscopic study of biocontrol agents: Trichoderma, Glivcladium, Metarrhizium, Paeciliomyces, Beavaria, Streptomyces and Bacillus thuriengenesis.
8. In vitro study of effect of different fungicide on growth of pathogenic microbes.

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9. In vitro study of effect of different biocide on growth of pathogenic microbes.
10. Antagonistic effect of bicontrol 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.Kiuwel 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. I 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 types with special reference to Prairie and Savannah, Indian grasslands.

Forest Ecosystems: Temperate and Tropical forests, Forest animal life.

Unit-II

Freshwater Ecosystems: Classification of Freshwater Habitats, Lentic: Lakes & Ponds: Temperature and Oxygen stratification, Flora and fauna, Marshes and Swamps, Bogs.

Lotic: Spring, Streams and Rivers.

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

Unit-III

Urban Ecosystem: Urban environment and Climatic conditions, 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, Social Forestry.

Unit-IV

Desert Ecosystem: Desert Definition, classification (hot and cold), 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), afforestation in salt affected soils, Importance of halophytes.

Suggested Readings:

1. P.L. Jaiswal, A.M. Wadhwani and N.N. Chhabra (Eds.) 1983. Decertification 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. Sambamuity 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, Aerua) 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. I 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 Secondary Air Pollutants (Smog. Acid rain, nitrate in air), Effects of air pollutants, man and animals; Biomonitoring, Air pollution control (particulates and gaseous pollutants), Green belt, ozone depletion.

Unit-II

Water Pollution: Eutrophication-Process and Control; Oil Pollution, Thermal Pollution, Heavy metal Pollution, Treatment, Disposal & Recycling of Wastewaters.

Solid & Hazardous waste management & Resource Recovery: Solid wastes, Types, collection, Shrinking waste streams: 3R's (Reduction, Recycle & Reuse), composting, energy from waste, demanufacturing.

Unit-III

Climate Issues: Greenhouse gases (CO_2, CH_4, N_2O_2CFCs : sources, trends and role) and consequence of greenhouse effects (CO_2, fertilization, global warning, sea level rise, Biodiversity erosion).

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, Environmental economics, green policies; Ecolabel, Rain, water harvesting, Orans, Indira Gandhi Canal and its ecological implication, water logging & salinity problems.

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, equatability 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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