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A. G. Kowaluk and R. G. Barron, Eds. Academic Press, London, 1978.
Guitens, R.C. 2000. Molecular Biology of the Cell. Garland Science, London.
Collip, H.A. and Edwards, R. Eds. In Vitro Cell Culture: Practical Approaches
Scientific Publishers, Oxford, 1987.
Dixon, R.A. (Ed) 1987. In Vitro Cell Culture: Practical Approaches
IRL Press, Oxford.
Colvin, S.B. and Schipert, R. Eds. 1994. Ethical Molecular
Biology Manual. 2nd edition. Academic Publishers,
London: The Netherlands.

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44

20. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent, stained serial sections.
21. Field study of several types of flower with different pollination mechanisms.
22. Emasculation, bagging and hand pollination to study pollen germination.
23. Study of nuclear and cellular endosperm through dissections and staining.
24. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds
25. Polyembryony in citrus, jamun (*Syzygium cumini*) etc. by dissections.
26. Biochemical estimation (qualitative and quantitative) of metabolites of seeds.

Suggested Readings. (for Laboratory Exercises)

1. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology : A Laboratory Manual, Springer-Verlag, Berlin-Heidelberg (and references therein).
2. Chopra, V.L. 2001. Plant Breeding : Theory and Practice, Oxford IBH Pvt. Ltd., New Delhi.
3. Chopra, V. L. 2001. Plant Breeding: Field Crops, Oxford IBH Pvt. Ltd., New Delhi

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31

Paper VIII. PLANT ECOLOGY

Unit I

Science of Ecology: Introduction to ecology, evolutionary ecology, ecological 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 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 and ecotone, 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 decomposers), Grazing (grassland) and Detritus 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. *Ecological services*

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

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22

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.

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, U.S.A.
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. Concepts 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, U.K.
10. Molar, B. and Billhartz, S. 1997. Sustainability Indicators. John Wiley Sons, New York.

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Biome: Biogeography, Major Biomes of the world, Conservation of Biomes, Ecotones, Ecotone dynamics, Ecotone succession, Ecotone diversity, Ecotone management, Ecotone restoration, Ecotone conservation, Ecotone diversity index, Ecotone management of threat Hot spot.

Unit IV

Conservation: Conservation (ex situ and in situ) and management, International Conservation 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.

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

Suggested Readings

1. Sibly, R.E. 1996 Ecology and Field Biology, Harper Collins, New York.
2. Miles-Dambor, D and Ellenberg, H. 1974 Aim and Methods of Vegetation Ecology, Wiley, New York.
3. Begon, M, Harper, J.L. and Townsend, C.R. 1996 Ecology, Blackwell Science, Cambridge, U.S.A.
4. Ludwig, J. and Reynolds, J.F. 1988. Statistical Ecology John Wiley & Sons.
5. Odum, E.P. 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. Kenneddy, E. 1996 Concepts of ecology Prentice Hall of India Pvt. Ltd., New Delhi
9. Clappner, H. and Emlen, M.P. 1988 Ecology, Principles and Applications, Cambridge University Press, Cambridge, U.K.
10. M. J. Griffin, 1996, Sustainability Indicators, Earthscan Publications, New York

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13. S. M. Jain and M. S. Ghosh. 1995. Ecology: Principles and Applications. New Age International, New Delhi.
14. S. M. Jain. 2001. Handbook of Methods in Environmental Studies (Vol. 1 & 2). ABH Publisher, Jaipur.
15. E. I. Chapman and M. F. Reiss. 1995. Ecology: principles and applications. Cambridge University Press.
16. C. Faure, C. Ferra, P. Medori and J. Devaux. 2001. Ecology Science & Practice. Oxford and IBH Publishing Co Pvt. Ltd. New Delhi.
17. G. J. Miller Jr. 2005. Essentials of Ecology. III Edition. Thomson, Brooks/Cole.

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 (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 and organic matter in the soils of cropland, grassland and forest.
8. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by side modification of Winkler's method.
9. To estimate chlorophyll content in SO₂ fumigated and unfumigated plants leaves.
10. To estimate rate of carbon dioxide evolution from different soil using soda lime or alkali absorption method.
11. To estimate community diversity of soil microbe diversity using quadrat method.

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Paper - IX: Plant Resource Utilization and Conservation
Scheme of Examination

Max. Marks : 100

Each 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 of questions such as multiple choice type, true/false answer type, one word type and fill in the blanks type. *a limit of 20 words*

Unit-I

Plant Biodiversity : Concepts, 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

Origins, 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.

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Plants used as avenue trees for shade, pollution control and aesthetics, Principles of conservation, extinctions, environmental status of plants based on International Union for Conservation of Nature.

Unit-IV

Strategies for conservation—*in situ* conservation—International efforts and India's 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 accounts 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.

Suggested Readings

- Anonymous 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
- Arora, R.K. and Nayar, E.R. 1984. Wild Relatives of Crop Plants in India. NBPGR Science Monograph No.7.
- Baker, H.G. 1978. Plants and Civilization (3rd edn.) C.A. Wadsworth, Belmont.
- Bole, P.V. and Vaghani, Y. 1986. Field Guide to Common Indian Trees. Oxford University Press, Mumbai.
- 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.
- Christpects, M.J. and Salava, D. 1977. Plants, Food and People. W.I.L. Freeman and Co., San Francisco.
- Cristi, B.R. (ed.) 1999. CRC Handbook of Plant Sciences and Agriculture. Vol. 1. *In situ* conservation. CRC Press, Boca Raton, Florida, USA.
- Conway, G. 1999. The Doubly Green Revolution: Food for All in the 21st Century. Penguin Books.

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36

9. Conway, G. and Barbier, E. 1990. After the Green Revolution. Earthscan Press, London.
10. Conway, G. and Barbier, E. 1994. Plant, Genes and Agriculture. Jones and Bartlett Publishers, Boston.
11. Council of Scientific and Industrial Research 1986. The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.
12. Council of Scientific and Industrial Research (1943-1976). The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products. New Delhi. Raw Materials I-XII. Revised Vol. I-III (1985-1992) Supplement (2000)
13. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York, USA.
14. Directory of Indian Wetlands, 1993, WWFINDIA, New Delhi and AWB Kuala Lumpur
15. Falk, D.A., Olwel, M. and Millan, C. 1996. Restoring Diversity. Island Press, Columbia, USA.
16. FAO/IBPGR 1989. Technical Guidelines for the Safe Movement of Germplasm. FAO/IBPGR, Rome.
17. Frankel, O.H., Brown, A.H.D. and Burdon, J.J. 1995. The Conservation of Plant Diversity. Cambridge University Press, Cambridge, U.K.
18. Gadgil, M. and Guha, R. 1996. Ecology and Equity: Use and Abuse of Nature in Contemporary India. Penguin, New Delhi.
19. Gaston, K.J. (Ed.) Biodiversity: A Biology of Numbers and Differences. Blackwell Science Ltd., Oxford, U.K.
20. Heywood, (Ed.) 1995. Global Biodiversity Assessment. United Nations Environment Programme. Cambridge University Press, Cambridge, U.K.
21. Heywood, H. and Wiersback, P.S. (Eds) 1991. Tropical Botanical Gardens. Their Role in Conservation and Development. Academic Press, San Diego.
22. Kocchar, S.L. 1998. Economic Botany of the Tropics, 2nd edition. Macmillan India Ltd., Delhi.
23. Kotbari, A. 1997. Understanding Biodiversity: Life Sustainability and Equity. Orient Longman.
24. Kohli, R., Arya, K.S., Singh, P.H. and Dhillon, H.S. 1994. Tree Directory of Chandigarh. Lovdlat Educational, New Delhi.

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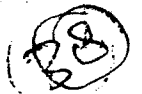
37

- Neir, M.N.B. et al. (Eds.) 1988. Sustainable Management of Non-Wood Forest Products. Faculty of Forestry, University Putra Malaysia, 43004 UPM Serdang, Selangor, Malaysia.
- Paroda, R.S. and Arora, R.K. 1991. Plant Genetic Resources: Conservation and Management. IPGRI (Publication) South Asia Office, C/o NBPG, Pusa Campus, New Delhi.
- Pimentel, D. and Hill, C.W. (Eds.) 1989. Food and Natural Resources. Academic Press, London, New York.
- Pinstrup-Andersen, P. et al. 1999. Wood Food Prospects: Critical Issues for the Early 21st Century. International Food Policy Research Institute, Washington, D.C., USA.
- Plant Wealth of India 1997. Special Issue of Proceedings Indian National Science Academy B-63.
- Pivchen, D.L., Smith, N.J.H., William, J.T. and Murti Anniswaty, N. 1987. Gene Banks and World's Food. Princeton University Press, Princeton, New Jersey, USA.
- Rodgers, N.A. and Parwar, M.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. I The Report. Wildlife Institute of India, Dehradun.
- Sahni, K.C. 2000. The Book of Indian Trees. 2nd edition. Oxford University Press, Mumbai.
- Schery, R.W. 1972. Plants for Man. 2nd ed. Englewood Cliffs, New Jersey: Prentice Hall.
- Sharma, O.P. 1996. Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co., Ltd., New Delhi.
- Swaminathan, M.S. and Kocchar, S.L. (Eds.) 1989. Plants and Society. Macmillan Publication Ltd, London.
- Thakur, R.S., Puri, H.S. and Huttain, A. 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow.
- Thomas, P. 2000. Trees - Their National History. Cambridge University Press, Cambridge.
- Wanger, H., Hikita, H. and Farnsworth, N. 1989. Economic and Medicinal Plant Research. Vols. 1-3. Academic Press, London.
- Water, K.S. and Gillett, H.J. 1998. IUCN Red List of Threatened Plant. IUCN, the World Conservation Union. IUCN, Gland, Switzerland and Cambridge, U.K.

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Suggested Laboratory Exercises

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

Laboratory Work

Food Crops: Wheat, rice, maize, chickpea (Bengal gram), potato, tapioca, sweet potato, sugarcane, morphology, anatomy, microchemical tests for stored food materials.

Forage/food crops : Study of any five important crops of the locality (for example fodder sorghum, bajra, berseem, lentil, guar bean, gram, Ficus sp.)

Plant fibres :

(a) Textile fibres : cotton, jute, linen, sun hemp, Ramie

(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, Cathartus fuscus, Adiantum ceylanica (syn A. yucca), Allium sativum, Calophylla serpentina, Withania somnifera, Phyllanthus niruri, (P. fraternus), Andropogon paniculatus, Acorus calamus, Mentha arvensis, Rosy sp., Pogostemon cablin, Ocimum sanctum, Veriveria zizanioides, Jasminum grandiflorum, Coriaria sp., Pandanus odoratissimus.

Study of live or herbarium specimens or other available materials to become familiar with these resources.

Vegetable Oils : Mustard, groundnut, soybean, coccol, sunflower, castor, Morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.

Gums, resins, tannins, dyes : Perform simple tests for gums and resins. Prepare a water extract of vegetable dyes (Albizia, Terminalia, mangroves, tea, Cassia spp., Myrica) and dyes (turmeric, Bixa orellana, indigo, Bates madder, Lawsonia inermis) and perform tests to understand their chemical nature.

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39

4. Survey

Firewood and timber yielding plants and NTFPs :

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.

Prepare an inventory of the bamboos and rattans of your area giving their scientific and local names and their various uses with appropriate illustrations.

A survey of a part of the town or city should be carried out by the entire class, in batches. Individual students will select one 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 whether or not the conditions in which they are surviving are satisfactory. The individual reports will be combined to prepare a large map of the area, which can be used for subsequent monitoring either by the next batch of students/teachers/local communities/NGOs or civic 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 :

- A protected area (biosphere reserve, national park, or a sanctuary)
- A wetland
- A mangrove
- National Bureau of Plant Genetic Resources, New Delhi-110012 or one of its field stations.
- Head Quarters of the Botanical Survey of India or one of its Regional Circles.
- A CSIR Laboratory doing research on plants and their utilization.
- An ICAR Research Institute or a field station dealing with one major crop or crops.
- A recognised botanical garden or a museum (such as those at the Forest Research Institute, Dehradun, National Botanical

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(40)

Institute, Lucknow, Tropical Botanical Garden and Research Institute, Trivandrum), 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

Schemes of Examination

Max. Marks : 100

Each 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 of questions such as multiple choice type, one line answer type, one word type and fill in the blank type with a limit of 20 words.

Unit-I

Biotechnology : Basic concepts, principles and scope.

Plant Cell and tissue culture : General introduction, history, scope, concept of cellular differentiation, totipotency.

Organogenesis and adventive embryogenesis : Fundamental aspects of morphogenesis : somatic embryogenesis and androgenesis, mechanisms, techniques, and utility.

Unit-II

Somatic hybridization : Protoplast isolation, Fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplasts research.

Applications of plant tissue culture : Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and germplasm storage.

Recombinant DNA technology : Gene cloning principles and techniques, construction of genomic DNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA finger printing.

Unit-III

Genetic engineering of plants : Aims strategies for development of transgenics (with suitable examples), *Agrobacterium* - natural genetic engineer, T-DNA and transposon mediated gene targeting, chloroplast transformation and its utility, intellectual property.

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(41)

rights, possible ecological risks and ethical concerns.
Microbial genetic engineering: gene transformation, selection of recombinants and their characterization. Improvement of industrial microbes and microbial processes in biotechnology.

Genetics and protoplasts: Genetic engineering: mapping of genes, molecular markers for mapping, DNA libraries, artificial chromosomes, high throughput screening, transgenic plants; plant genome, microbial genomes, mutagenesis, gene cloning and expression.

Bioprocesses: Compounds, production, purification, downstream processing.

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11. J. L. Grant and J. H. H. (eds) (1970) *Plant Cell Culture*. London: George Allen and Unwin.
12. P. M. (ed) (1971) *Plant Cell Culture*. London: George Allen and Unwin.
13. Old, R. and P. (eds) (1971) *Plant Cell Culture*. London: George Allen and Unwin.
14. Primrose, S. B. (1975) *Principles of Genetical Analysis*. Blackwell Scientific Publications, Oxford, UK.
15. R. (ed) (1976) *Plant Cell Culture*. London: George Allen and Unwin.
16. R. (ed) (1977) *Plant Cell Culture*. London: George Allen and Unwin.
17. S. and M. (eds) (1978) *Plant Cell Culture*. London: George Allen and Unwin.
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Exercises

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43

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Unit-I

Plant Pathology : History & Scope. Nature, Origin. & Evolution of parasitism. Biotic and abiotic pathogens, Pathogen factors in disease development. Penetration, infection and pathogenesis. Physiological specialisation 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 plants.

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, molecular manipulation of resistance. Non-parasitic diseases and control measures.

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.

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

Scheme of Examination

Max.Marks : 100

Each 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 of questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

with a limit of 20 words.

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.

Unit-II

Bacteria : Classification and nomenclature of bacterial plant

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115

pathogens. Methods of identification of bacterial pathogens (Morphology, physiology, serology and pathogenicity).
bacterial diseases : Brown rot of potato, blight of rice, soft rot of vegetables, Crown gall disease, angular leaf spot of cotton.

Unit-III

Virus, viroid and phytoplasma disease : Symptomatology and transmission of viral diseases; Potato virus X & Y, Tomato ring disease, mosaic, bunchy top of banana; viroids and important viroid diseases. Phytoplasma General account; Sesame phyllody, Spike disease of rice.

Unit-IV

Nematology : Brief history, classification and identification of important pathogenic nematodes. Morphology and anatomy of nematodes. Methods used in Nematology.
Control of plant parasitic nematodes. Nematode Disease : Root-knot disease of wheat & barley, ear cockle of wheat, root-knot of cotton.

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46

Unit I

History of seed testing and its importance to agriculture, aims of seed testing, Seed- definition and its types. Sampling of seeds, purity analysis (physical and genetical), seed moisture content, germination test, rapid test of viability and evaluation, seedling evaluation, various methods of seed separation, cleaning, drying and Seed processing plant and its process.

Unit II

Gross architecture of seed structure of angiosperms, identification and structure of seeds of important crop plants with special reference to Rajasthan (wheat, pearl millet, mustard, gram, pea) and Identification of designated objectionable weeds at seed level. Physiology of seed germination; seed and seedling vigour.

Unit III

Principles of seed production, seed production in self and cross pollinated crops; hybrid seed production. Production of foundation and certified seeds; synthetic seed, terminator seed technology, Seed storage methods, principles for safe seed storage, effects of storage, mycotoxins- major groups, detection and detoxification, Deterioration of seeds in storage by micro-organisms, insects and rodents; control of seed deterioration.

Unit IV

Seed certification standards and quarantine regulations. International cooperation, International Seed Testing Association - Rules and recommendations, Certificates, other seed certificates; Indian Seeds Act and recent amendments, National and Regional Seed Corporations of India - their organisation, aims and functions. National and International Co-operation in Seed Pathology. Sanitary and phytosanitary (SPS) agreements of WTO.

List of suggested Practical exercises:

1. Structure of seeds of some crop plants (wheat, pearl millet, mustard, gram, and pea).
2. Preparation of inventory of designated objectionable weeds at seed level and identification.
3. Identification of seed coat cracking.
4. Study of physical purity of seed sample.

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47

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5. Study of seed germination, seedling abnormality and seedling index.
6. Determination of moisture content of seeds.
7. TZ test for seed viability
8. Assay of enzymes in crop seeds.
9. Preparation of synthetic seeds.
10. Localization of starch, protein, lipids, tannins, phenols and lignin in seed sections.
11. Isolation and identification of storage fungi.
12. Preparation of phytosanitary certificate etc. of seed lot.

Suggested Readings:

Agarwal, V.K. and Sinclair, J.B. (1987). Principles of Seed-pathology, II edition CRC Lewis Publishers, Boca Raton, New York, London.

1. Agrawal, R.L. 1980. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Anonymous (1985, 2014). International rules for seed testing. International Seed Testing Association (ISTA). <http://www.seedtest.org/en/home.html>; <http://www.seedtest.org/en/international-rules-content--1--1083.html>
3. Bewley, J.D. and Black, M. 1983. Physiology and Biochemistry of Seeds in Relation to Germination. Volume I & II. Springer-Verlag, Berlin, Heidelberg, New York.
4. Copeland, L.O. 1976. Principles of Seed Sci. and Technology Minnesota, USA.
5. Khare, D. and Bhale, M.S. (2014). Seed Technology. Scientific Publishers (India), Jodhpur. Revised 2nd Ed.
6. Kulkarni, G.N. 2002. Principles of Seed Technology. Kalyani Publishers, New Delhi.
7. Neergaard, P. 1986. Seed- A horse of hunger or a source of life. Revised print of Danish Government Institute of Seed Pathology for Developing Countries. Hellerup, Denmark.
8. Winton, A. I and Winton, K. B. (1932-1939): The structure and composition of foods. Vol I and II: John Wiley and Sons, Inc., New York.

48

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Paper XII (b): SEED SCIENCE & TECHNOLOGY -II

Unit I

Introduction and importance of Seed Pathology in modern agriculture. History of Seed Pathology. Various methods for testing seed borne fungi, bacteria and viruses (Dry seed examination, seed washing test, incubation methods, cultural, biochemical, serological, nucleic acid based methods).

Unit II

Mechanism of seed infection and its types, environment influencing seed infection, infected/contaminated part of seed, morphology and anatomy of seeds in relation to invasion, location of inoculum of the pathogen in seed- seed coat and pericarp, endosperm and perisperm and embryo.

Seed-borne diseases of some important crops with particular reference to the state of Rajasthan and India. Typical case of infection by: fungi (wheat- smuts and bunts, Sesame-charcoal rot; bacteria (Brassicas- black rot, cluster bean- bacterial blight); viruses (tomato mosaic virus, pea seed borne mosaic virus,) and nematodes (wheat- ear cockle, rice- white tip).

Unit III

Seed-borne inoculum, inoculum density and assessment of seed borne inoculum in relation to plant infection, epiphytotics due to seed borne inoculum, disease forecast based on infected seed samples, tolerance limits of seed borne pathogens.

Transmission of seed borne disease: Systemic and non- systemic seed transmission, types of disease transmission, mode of establishment and course of disease from seed to seedling and plant, factors affecting seed transmission.

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619

Unit IV

Management of seed-borne disease, principles of control, seed treatments (physical, chemical and biological), mechanism of action of seed treatments, major seed treatments for important seed borne pathogens and their methods of application.

List of suggested Practical exercises:

1. Dry seed examination of seed lots.
2. Isolation and identification of seed-borne mycoflora by standard blotter method.
3. Preparation of culture media (PDA and NA).
4. Plating seeds on PDA/NA for identification of seed borne fungi and bacteria.
5. Other methods of plating e.g. deep freezing; 2,4D- blotter method.
6. Water agar test tube seedling symptom test.
7. Study of any seed borne nematode disease.
8. Detection of bacterial and viral pathogens in seeds.
9. LOPAT tests for detection of seed- borne bacteria.
10. Nucleic acid based detection of seed borne pathogens.
11. Histopathology of infected seed samples.
12. Physical control of seed-borne pathogens.
13. Antibiotic/fungicidal assay against seed-borne pathogens
14. Biological control of seed borne pathogens.
15. Field visits: Crop fields, FCI, NSC, Seed testing Labs., quarantine station (e.g. NBPGR) etc.

Suggested Readings:

1. Agarwal, P. C., Mortensen, C. N. and Mathur, S. B. (1989). Seed-borne diseases and seed health testing of rice. Technical Bull. No.3, Danish government institute of seed Pathology for Developing Countries (DGISP), Copenhagen and CAB International Mycological Institute, (CMI) UK.
2. Agarwal, V.K. 2006. Seed Health. International Book Distributing Company. Charbagh, Lucknow, India.
3. Agarwal, V.K. and Sinclair, J.B. (1987). Principles of Seed-pathology, II edition CRC Lewis Publishers, Boca Raton, New York, London.
4. Agrawal, R.L. 1980. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Agrios, G.N. 2005. Plant Pathology. Academic Press, London., New York

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50

6. Anonymous (1985, 2014). International rules for seed testing. International Seed Testing Association (ISTA). <http://www.seedtest.org/en/home.html>; <http://www.seedtest.org/en/international-rules-content--1--1083.html>
7. Clifton, A. 1958. Introduction to the Bacteria. McGraw Hill Book Co., New York.
8. Khare, D. and Bhale, M.S. (2014). Seed Technology. Scientific Publishers (India), Jodhpur. Revised 2nd Ed.
9. Mandahar, C.L. 1978. Introduction to plant viruses. S. Chand & Co. Ltd., Delhi.
10. Mathur, S.B. and Cunfer, B.M. 1993. Seed-borne diseases and Seed health Testing of Wheat. Danish Government Institute of Seed Pathology, for Developing Countries. Hellerup, Denmark.
11. Neergaard, P. (1977). Seed Pathology. Vol. I & II. The Mac Millan Press Ltd., London.
12. Rangaswamy, G. & Mahadevan, A. 1999. Diseases of crop plants in India (4th edition). Prentice Hill of India, Pvt. New Delhi.
13. Richardson, M. J. (1990). An annotated list of seed borne diseases 4th edn. Proc. Int Seed Test Assoc. Zurich, Switzerland.
14. Schaad, N. W. (1980). Laboratory guide for identification of plant pathogenic bacteria (edt.). Bacteriology Committee of American Phytopathological Society, St. Paul, Minnesota.
15. Schaad, N. W. (1988). Laboratory guide for identification of plant pathogenic bacteria (2nd eds.). APS Press (The American Phytopathological Society), St. Paul, Minnesota.
16. Singh, D. and Mathur, S. B. (2004). Histopathology of seed-borne infections. CRC Press, Boca Raton, London, New York, Washington DC, pp 296.
17. Singn, K.G. and Manalo, P.L. 1986. Plant Quarantine and Phytosanitary Barriers in the Asean. Asean Plant Quarantine Centre and Training Institute, Malaysia.

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Paper XI (C): Ecosystem Ecology

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: Springs, 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, roads, waste disposal.

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

(52)

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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 arid zones (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. Wadhvani and N.N. Chhabra (Eds.). 1983. Desertification and its Control. ICAR, New Delhi.
2. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York.
3. Subrahmanyam, N.S. and A.V.S.S. Sambamurty 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.
- Study of trichomes of xerophytes (Zizyphus, Lantana, Calotropis, Aerva) growing in your locality.
- Study spread of root system of a perennial species in the soil
- Study ecological adaptations of halophytes in your nearby area.

(53)

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5. Seed Viability by T.T.C. method
6. Dormancy in seeds
7. Soil moisture and temperature at different depths
8. Salinity of soil sample.
9. Study of Canopy and Basal Cover of trees in your study area
10. Estimate primary productivity of a water body by light and dark bottle method
11. Mean leaf area of 2 plant Species growing in your area by graph method
12. Relative humidity by hair hygrometer
13. Light intensity by lux meter

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54

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Unit I

Unit I

Air Pollution: Important Primary (CO, CO₂, Particulates, Odour Producing compounds), Primary Photochemical reaction, Formation of air pollutants on Buildings & Monuments, pollution control (particulates and gaseous pollutants), depletion, control strategies;

Oxides of Sulphur & Nitrogen, H₂S, Chlorine & Secondary Air Pollutants (Smog, Acid rain, ozone and peroxyacetyl nitrate in air), Effects on plants, man and animals; Biomonitoring, Air pollutants), Green belt, Ozone depletion, mechanism

Unit II

Unit II

Water Pollution: Eutrophication- Process and Control; metal Pollution, Treatment, Disposal & Recycling Minimum National Standards

Control; Oil Pollution, Thermal Pollution, Heavy metal Pollution, drinking water standards

Solid & Hazardous waste management & collection, Shrinking waste streams: 3Rs (Reduce, Reuse & Recycle) from waste, demanufacturing; Methods of disposal; Hazardous waste: Definition, disposal and management

Resource Recovery: Solid wastes, Types, Management, Reduction, Recycle & Reuse), composting, energy recovery; disposal: Land fill, Open dumps, Exporting waste; Resource Recovery

Unit III

Unit III

Climate Issues: Greenhouse gases (CO₂, CH₄, CFCs), consequence of greenhouse effects (CO₂ feedback, Biodiversity erosion), Carbon footprints, Carbon sinks, Sensing technology in environmental studies, the future of planet earth.

N₂O, CFCs: sources, trends and role) and utilization, global warming, sea level rise, carbon sequestration, Applications of GIS and Remote Sensing, future of planet earth.

Raj Jas

55

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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. Brij Gopal, 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.Abrol and V.V. Dhruva Narayana (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 Applications. 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

56

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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 β -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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57

Paper-XI (d) : Advanced Plant Physiology-I

Scheme of Examination

Max.Marks : 100

Each 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 of questions 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

Proteins and Enzymes : Techniques of protein purification,

protein sequencing and proteomics, enzyme kinetics, Michaelis-Menten equation and significance of K_m value, negative and positive cooperativity, enzyme nomenclature and EC number, catalytic mechanisms, acid-base catalysis, covalent catalysis, metal ion catalysis, electrostatic catalysis, catalysis through proximity-orientation effect and catalysis through transition state bonding, lysozyme as model enzyme for catalytic mechanism, regulation of enzyme activity; feed back and allosteric regulation, active sites, coenzymes, activators and inhibitors, isoenzymes, ribozymes and abzymes.

Unit-II

Nucleotides : Biosynthesis of ribonucleotides (purines and pyrimidines), formation of deoxyribonucleotides, salvage purines, nucleotide degradation.

Vitamins : Water and fat-soluble vitamins, biochemical function of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxin, ascorbic acid, vitamin B₁₂, ascorbic acid, vitamin A and Vitamin E.

Unit-III

Secondary Metabolites :

Coumarins and lignins : Structure and synthesis.

Insecticides : (pyrethrins and rotenoids) distribution, chemistry and function.

Tannins : distribution, synthesis and function.

Flavonoids and water-soluble pigments : Synthesis and function.

Hallucinogens : Distribution, chemistry and function.

Unit-IV

Alkaloids : Pyrrole, pyrrolidine, pyridine, polyacetylmorphine, tropane and indole alkaloids—their distribution, synthesis and function.

Saponins and saponinins : Sterols, steroids, steroidal alkaloids—their distribution, synthesis and function.

Cardiac glycosides : Their distribution, structure and function.

Paper XII (d) : Advanced Plant Physiology-II

Scheme of Examination

Max.Marks : 100

Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No.1 which will be compulsory.

Raj Jais

(58)

Registrar
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pulsory. The question No.1 will carry 20 marks and will be of several short objective-type of questions 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

Plant growth regulators : Natural and synthetic, biochemistry and physiological effects of brassinosteroids, jasmonic acid; salicylic acid, polyamines, morphactins and cyanogenic compounds.

Signal transduction in plants : Receptors and G-proteins, phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity of protein kinases and phosphatases, signal transduction mechanisms with special reference to: Gibberellin induced signal transduction, auxin induced signal transduction and cytokinin induced signal transduction.

Unit-II

Stress physiology : Plant responses to biotic and abiotic stresses, mechanism of biotic and abiotic stress resistance, plant defense mechanisms against water stress, salinity stress, metal toxicity, freezing and heat stress and oxidative stress.

Unit-III

Photobiology-Photoreceptors, Phytochrome : history, discovery, physiological properties, interaction between hormones, and phytochrome, role of different phytochromes in plant development and flowering, mechanism of phytochrome signal transduction. Physiology of flowering photo-periodism and vernalisation.

Circadian rhythms in plants-Nature of oscillator, rhythmic outputs, entrainments (inputs) and adaptive significance.

Unit-IV

Tools and Techniques : Principles and application of spectrophotometry, Principles of chromatography, partition chromatography, thin layer chromatography, ion-exchange chromatography, gas-liquid chromatography, high performance liquid chromatography, gel filtration, electrophoresis, isoelectric focusing, immobilized pH gradient, ultra centrifugation (velocity and density gradient), ELISA and RIA.

Paper-XI (c) : Advanced Morphology and Morphogenesis-I
Schemes of Examination **Max.Marks : 100**

Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question, No.1, which will be com-

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Jaipur

(59)

ulsory. The question No.1 will carry 20 marks and will be of several short objective type of questions such as multiple-choice type, one answer type, one word type and fill in the blanks type. with a limit of 20 words. Unit-I:

Floral anatomy and its role in explaining the morphology of the stamen and Carpel, Placentation : Inferior ovary, Taxonomic significance of floral anatomy. Anatomy of the seed and pericarp and their economic significance.

Unit-II

Anther-Organizational relationship of anther tissues; ultrastructure aspect of microsporogenesis : Pollen-sporoderm pattern. Pollen analysis, pollen fertility and sterility, allergy due to pollen. Pollen-pistil interaction, cytomorphology of style and stigma, ultrastructure of pollen ultrastructural studies on pollen tube growth in the style, chemotropism, fertilization. Viability, storage and germination of pollen.

Unit-III

Embryosac-Basic types and their interrelationships, ultrastructural aspects of embryosac development. Endosperm—Intraembryonic relationship of the major types of endosperms, morphology and role in embryo development, Embryo-Major types, embryogenetic laws; comparison of Soueges and Johansen's system; physiological factors controlling growth and differentiation of embryo;

Unit-IV

Apomixis—genogenesis, androgenesis, agri-horticultural importance. Embryological features of the following families : Santalaceae, Convolvulaceae, Podostemaceae, Cucurbitaceae, Scrophulariaceae, Ranunculaceae, Orobanchaceae, Lentibulariaceae.

Paper III (e) : Advanced Morphology and Morphogenesis-II
Schemes of Examination Max Marks : 100

Each paper will have 3 questions, out of which a student has to attempt 2 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 of questions such as multiple-choice type, one answer type, one word type and fill in the blanks type. with a limit of 20 words. Unit-I

Development and morphogenesis-shoot apex the apical cell,

60

Raj / Das
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meristem, the subcellular and biochemical structure of the meristem. The mechanism of primordium initiation transition to flowering, growth and formation of organs. Experimental work on apical meristem, meristem culture and virus free plant, histochemical studies on apical meristems.

Unit-II

The phenomenon of morphogenesis-correlation, polarity, symmetry, differentiation, regeneration.

Morphogenetic factors : Physical, mechanical, chemical and genetic factors. molecular basis of morphogenesis in plants with special reference to work done in Arabidopsis.

Unit-III

Somatic embryogenesis-survey of somatic embryogenesis in angiosperms, direct somatic embryogenesis and embryogenesis from callus and protoplasts, cytology, physiology and genesis of somatic embryogenesis nutritional factors, hormonal factors and embryo rescue in wide hybridization.

Micropropagation advances and synthetic seeds.

Cell plating technique and isolation of mutant cell lines; auxotrophic mutants.

Mechanism involved in cell culture mutants.

Suspension culture and growth studies.

Unit-IV

Microtechniques for plant cultures. Fixation (FAA and glutaraldehyde) and embedding in paraffin and GMA, equipment and histological procedures. *Transmission and scanning electron microscopy for plant protoplasts and cultured cells and tissues. Endosperm and ovary culture, control of fertilization; experimental work on embryology of parasitic plants. Role of plant tissue culture in crop improvement.

Paper-KI (f) : Biosystematics of Angiosperms-I

Schemes of Examination

Max. Marks : 100

Each 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 of questions such as multiple choice type, one line answer type, one word type and fill in the blanks type with a limit of 20 words.

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61

Unit-I

Aims, components and principles of taxonomy, Alpha and Omega taxonomy, documentation, scope, significance and relationship of experimental and orthodox taxonomy, Evolutionary taxonomic classification.

Unit-II

Botanical gardens and Arboreta, Information from plant geography, Indian plant geographical regions, Role of Herbaria in taxonomy, Taxonomic literature, Taxonomic resource information (Data analysis coding of characters, statistics).

Principles, rules, rank of plant nomenclature, ICBN—Principles and important rules, type method, Principle of priority and its limitation, Name of hybrids and cultivars, Concept of Biocode.

Unit-III

Biosystematics Procedures : Steps of biosystematic studies, Biosystematic categories—Palynology, Cytology, Embryology, Anatomy and Histochemistry.

Unit-IV

Numerical taxonomy : Principles, Serum diagnosis Concepts, Phytochemistry Operational taxonomic units (OTU), Data processing and taxonomic studies, Taxometric methods for study of Population variation and similarity—Coding, Cluster analysis, cladistics.

Paper-XII (f) : Biosystematics of Angiosperms, II

Schemes of Examination

Max. Marks : 100

Each 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 of questions 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

Experimental taxonomy—Scope and Significance, Experimental categories. Relationship in experimental and orthodox taxonomy, Synthetic theory of evolution.

Unit-II

Concept of species, speciation, species classification, Concept of characters—analytic versus synthetic character, qualitative versus quantitative characters, good and bad characters, Taxonomic charac-

(62)

Raj / Jav

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ter—Character weighing. Characters variation, its role in speciation and isolation.

Unit-III

Concept of population, its significance, pattern of phenetic variability, Geographical variability, Transplant experiments. Genotype—environmental interaction, Plasticity, Variation—cause of variation in population, Range of tolerance and phenotypic plasticity, Ecotypes—origin and differentiation, Taxonomic significance of ecotypes.

Unit-IV

Experimental taxonomy and hybridization, Role of hybridization in evolution, Stabilization of hybrids and amphidiploidy, introgression and segregation.

Method of analysis of hybrid complex, Introgressive hybridization, Taxonomic treatment of hybrid complex. Breeding barriers, epistasis pleiotropy. Biochemical systematics—method and principles. Systematic markers, chemotaxonomy.

Suggested Readings:

1. Lawrence, C. H. M. 1951. Taxonomy of Vascular Plants. MacMillan, New York.
2. Davis, P.M. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
3. Heywood, V.H. and Moore, D. H. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
4. Radford, A.H. 1986. Plant Fundamentals of Plant Systematics. Harper and Row, New York.
5. Stace, C.A. 1989. Plant Taxonomy and Biosystematics, Edward Arne London.
6. Woodland, D.W. 1991. Contemporary Plant Systematics, Prentice Hall New-Jersey.
7. Nordenstam, B., LT-Gazaly, G. and Kassar, M., 2000. Plant Systematics for 21st Century, Portland Press Ltd., London.
8. Nalk, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill, New Delhi.
9. Singh, G. 1999. Plant Systematics : Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi.
10. Sivarajan, V.V. 1991. [Reprinted 2001] Principles of Plant Taxonomy. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

(63)

Raj / Jay

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Paper-XI (g) : Biotechnology-I

Scheme of Examination Max.Marks : 100

Each 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 of questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

The concept of totipotency and history of development of plant tissue culture from Haberlandt to the present development of different PTC media and their nutritional components.

Plant tissue culture laboratory—facilities, operation and management, media preparation and handling; Sterile techniques.

Unit-II

Pathways of plant regeneration—proliferation of axillary buds, adventitious shoot bud proliferation, organogenesis and somatic embryogenesis from callus and suspension cultures.

Somatic embryogenesis—Survey of somatic embryogenesis in angiosperms. Zygotic versus somatic embryogenesis in monocots and dicots. Conifer somatic embryogenesis.

Unit-III

Pollen embryogenesis—Discovery of anther culture, survey of anther and pollen culture in dicots and monocots, pathways of pollen embryogenesis, cytology and of pollen embryogenesis, stages of pollen development. Haploids for breeding and selection of mutants.

Isolation and culture of protoplasts of grasses review of work done with special reference to rice, wheat and maize.

Propagation of ornamental plants by tissue culture. Application of tissue culture in forestry.

Micropropagation advances and synthetic seeds, use of ELISA methods to certify pathogen free plants.

Unit-IV

Quantification of tissue culture procedures : fresh and dry weight culture density by cell count, packed cell volume mitotic index.

Microtechniques for plant cultures—fixation (FAA and glutaraldehyde) and embedding in paraffin and GMA, equipment and histological procedures. Transmission and scanning electron microscopy for plant protoplasts, cells and tissues.

Staining procedures for chromosome analysis.

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64

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Paper-XII (g) : Biotechnology-II

Scheme of Examination

Max.Marks : 100

Each 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 of questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Transgenic plants—the concept and history of developments of transgenesis in plants.

Agrobacterium—mediated transformation.

Unit-II

Direct DNA transfer into intact plants cells—microprojectile, bombardment and chemical uptake of DNA by plant protoplasts.

Tools for genetic transformation—Transformation vectors, promoters, terminators and markers and reporter genes.

Unit-III

Regulation of heterologous gene expression—factors affecting gene expression, introns, plants transcriptional factors, gene silencing, antisense RNA.

Transgenic approaches to crop improvement—protection against biotic (virus, fungi, bacteria, nematode, insect, weed) and abiotic stress (salinity, drought, cold, metals), Nutritional quality improvement—golden rice and other developments. Extension of flower life, pigmentation and fragrance.

Unit-IV

Manufacture of valuable products—antigens, antibodies, edible vaccines, enzymes, proteins.

Benefits and risks of producing transgenic plants—IPR and regulatory requirements, field testing and regulations to release transgenic plants in India.

Skeleton Paper

M.Sc. (Final) Special Paper Adv. Plant Pathology

Practical Examination

Time : 4 hours

M.M. : 100

Q.No.	Questions	Marks allotted
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1. (a) Study the diseased plant material 'A' provided; make histopathological investigations.

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	Draw labelled drawing and identify the pathogen giving reasons.	10
(b)	Study and identify the mycoflora from the given material.	5
2.	Give suitable drawings make a suitable preparation so as to study the given material 'C' identify giving reasons.	10
3.	Study the external morphology, histopathology and development stages of given material 'D'. Draw labelled diagrams. Identify the causal organism.	10
4.	Caliberate your microscope with the help of micrometers and measure spores and determine the mean size.	10
5.	From given plant material isolate virus free plantlet through apical meristem culture. Briefly describe the procedure.	8
6.	Stain the given bacterial sample and identify it as gram positive or negative. Write in brief the procedure adopted.	10
7.	Viva-Voce.	10
8.	Spots (Four)	12
9.	Practical record.	15

Skeleton Paper


M.Sc. (Final) Special Paper-Seed
Technology and Seed Pathology

Practical Examination

Time : 4 hours

M.M. : 100

Q.No.	Questions	Marks allotted
1.	Study the morphological and anatomical features of given seeds.	20
2.	Study the seed-borne mycoflora of given seed sample	25
3.	Determine the location of pathogen in different components of given symptomatic seeds. or Estimate the spore load in given seed sample.	10
4.	Examine the viability of seed lot. or Study the transmission of pathogen in infected seedling.	10


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66