UNIVERSITY OF RAJASTHAN

JAIPUR

SYLLABUS

M.Sc. BOTANY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination 2019

M.Sc. (Final) Examination 2020

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University of Rajasthan
JAIPUR

M.Sc. (BOTANY)

M. Sc. (ANNUAL PATTERN)

M. Sc. Previous

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

M.Sc. Final

Paper VII	Plant Morphology, Developmental Anatomy and Reproductive Biology
Paper VIII	Plant Ecology
Paper IX	Plant Resource Utilization & Conservation
Paper X	Biotechnology & Genetic Engineering of Plants & Microbes
Paper XI	Elective I
Paper XII	Elective II

Elective Papers XI & XII

Papers XI (a) :	Advanced Plant Pathology I
Paper XII (a) :	Advance Plant Pathology II

OR

Papers XI (b)	Seed Science and technology I
Paper XII (b)	Seed Science and technology II

OR

Papers XI (c) :	Ecosystem Ecology

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[illegible]

(1+1)

Paper XII : [illegible] Biology)

OR

Papers XI (d) : Advanced Plant Physiology I

Paper XII (d) : Advanced Plant Physiology II

OR

Papers XI (e) : Advanced Morphology and Morphogenesis- I

Paper XII (e) : Advanced Morphology and Morphogenesis- II

OR

Papers XI (f) : Biosystematics of Angiosperms I

Paper XII (f) : Biosystematics of Angiosperms II

OR

Papers XI (g) : Biotechnology- I

Paper XII (g) : Biotechnology- II

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(2)

M.Sc. (Previous)

There will be six papers in theory, each of three hours duration, 100 marks each and two practical's carrying 150 marks each (10% marks are reserved for viva and 15% records in each examination). Each practical examination will be of 6 hours duration to be completed in one day.

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

M.Sc. (Final)

There will be six papers, four compulsory and two elective in theory of 3 hours duration carrying 100 marks each and two practicals each as follows:

i. Practical for compulsory papers of 200 marks of 8 hours duration to be completed in two days.
ii. Practical for elective papers-100 marks of 4 hours duration to be completed in one day.

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

M.Sc. Botany

Scheme of Examination

M.Sc. (Prev.)

There will be six papers in theory, each of three hours duration, 100 marks each and two practicals carrying 150 marks each (100 marks for practicals and 50 for records in each examination). Each practical examination will be of 5 hours duration to be completed in one day.

Each theory 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 essential short objective type of questions which will include multiple choice type, one line answer type, one word type and fill in the blanks type.

M.Sc. (Final)

There will be six papers, four compulsory and two elective, all theory of 3 hours duration carrying 100 marks each and two practicals each as follows :

(i) Practical for compulsory papers of 200 marks of 5 hours duration to be completed in two days.

(ii) Practical for elective papers : 100 marks of 5 hours duration to be completed in one day.

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

M.Sc. Botany

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

Paper-I : Cell and Molecular Biology of Plants

Scheme of Examination **Max Marks : 100**

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

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(4)

pulsory. 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 blank type.

Unit—I

The dynamic cell : Structural organization of the plant cell, specialized plant cell types, chemical foundation, biochemical energetics.

Cell wall : Structure and function, biogenesis, growth.

Plasma membrane : Structure, models and functions, sites for ATPases, ion carriers, channels and pumps, receptors.

Plasmodesmata : Structure, role in movement of molecules and macromolecules, communication with the cell junctions.

Unit—II

Chloroplast : Structure, genome organization, gene expression, RNA editing, microchloroplasts and functions.

Mitochondria : Structure, genome organization, biogenesis.

Plant vacuoles : Tonoplast membrane, ATPases and transporters, as storage organelle.

Nucleus : Structure, nuclear pores, nucleosome organization, DNA synthesis, DNA repair, recombination, plant promoters and transcription factors, splicing, mRNA transport, nucleolus, rDNA, ribosome biogenesis.

Restriction enzymes : Classification, properties and uses in gene manipulation, construction of genomic and cDNA libraries, restriction sites as genetic markers, RFLP and their use in plant breeding.

Unit—III

Ribosomes : Structure, site of protein synthesis, mechanism of translation, initiation, elongation and termination factors and role of tRNA.

Protein sorting : Targeting of proteins to organelles.

Cell shape and motility : The cytoskeleton, distribution and role of microtubules and microfilaments, their biogenesis, implications in flagellar and other movements.

Unit—IV

Cell cycle and apoptosis : Control mechanisms, role of cyclins and cyclin-dependent kinases, retinoblastoma and p53 proteins, cytokinesis and cell plate formation, mechanism of programmed cell death.

Other Cellular organelles : Structure and functions of microbodies, Golgi apparatus, lysosomes, endoplasmic reticulum.

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(5)

Techniques in cell biology - Immunotechniques, in situ hybridization to locate transcripts in cell types, FISH, GISH, confocal microscopy.

Suggested Readings:

1. Lewin, B. 200. Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J., 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing USA.
4. Raven, T. *et al.* 1998. Plant Biology. Wadsworth Publishing Co., California USA.
5. Krishnamurthy, K.V. 2000. Methods in Cell Wall Cytochemistry, CRC Press, Boca Raton, Florida.
6. Buchanan, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
7. De, D.N. 2000. Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
8. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology, 2nd Edition). Harper Collins College Publishers, New York, USA.
9. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D., and Darnell, J. 2000. Molecular Cell Biology (5th Edition). W.H. Freeman and Co., New York, USA.

See the following Review Journals:

Annual Review of Plant Physiology and Molecular Biology.
Current Advances in Plant Sciences.
Trends in Plant Sciences.
Nature Reviews : Molecular and Cell Biology.

Suggested laboratory Exercises:

1. Isolation of mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
2. Isolation of chloroplasts and SDS-PAGE profile of proteins to demarcate the two subunits of Rubisco.
3. Isolation of nuclei and identification of histones by SDS-PAGE.
4. Isolation of plant DNA and its quantitation by a spectrophotometric method.
5. Isolation of DNA and preparation of 'cot' curve.

Dy. Registrar
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Jaipur

6. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
7. Isolation of RNA and quantitation by a spectrophotometric method.
8. Separation of plant RNA by agarose gel electrophoresis and visualization by EtBr staining.
9. Southern blot analysis using a gene specific probe.
10. Northern blot analysis using a gene specific probe.
11. Immunological techniques : Ouchterlony method, ELISA and Western blotting.
12. Viability staining with FDA for cell viability and cell wall staining with calcofluor.
13. Quantification of SPM and TBM.

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

Suggested Reading (for laboratory exercises):

1. Old, R.W. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
2. Glover, D.M. and Hames, B.D. (Eds.) 1995. DNA Cloning : A Practical Approach. Core techniques. 2nd edition. IRL Press at Oxford University Press, Oxford.
3. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology : Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.
4. Hoisington, D., Fuchs, R., and Messing, J.W. 1992. Methods for Recombinant DNA Techniques : Basic Procedures for Gene Manipulation. The Benjamin Cummings Publishing Co. Inc., Menlo Park, California.
5. Hall, J.L. and Moore, A.L. 1983. Isolation of Membranes and Organelles from Plant Cells. Academic Press, London, UK.
6. Harris, N. and Oparka, K.J. 1994. Plant Cell Biology : A Practical Approach. IRL Press, at Oxford University Press, Oxford, U.K.
7. Shaw, C.H. (Ed.). 1988. Plant Molecular Biology : A Practical

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Approach: IRL Press, Oxford

Paper-II : Cytology, Genetics and Cytogenetics

Scheme of Examination: Max. Marks : 100

Each paper will have questions out of which the candidate 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, true or false type and fill in the blanks type.

Unit I

CYTOLOGY:

Chromatin organization : Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotype analysis, banding, [illegible] evolution, specialized types of chromosomes, polytene chromosomes, B-chromosomes and sex chromosomes, molecular basis of chromosome pairing.

Structural and numerical alterations of chromosomes, [illegible] aneuploidy and deficiencies, duplications, inversion and translocations, [illegible] fusion and meiosis of [illegible], recombination and [illegible] production of [illegible] and [illegible] tion, allopolyploids, [illegible] tion of major crop plants, [illegible] and monosomics.

Unit II

Genetics :

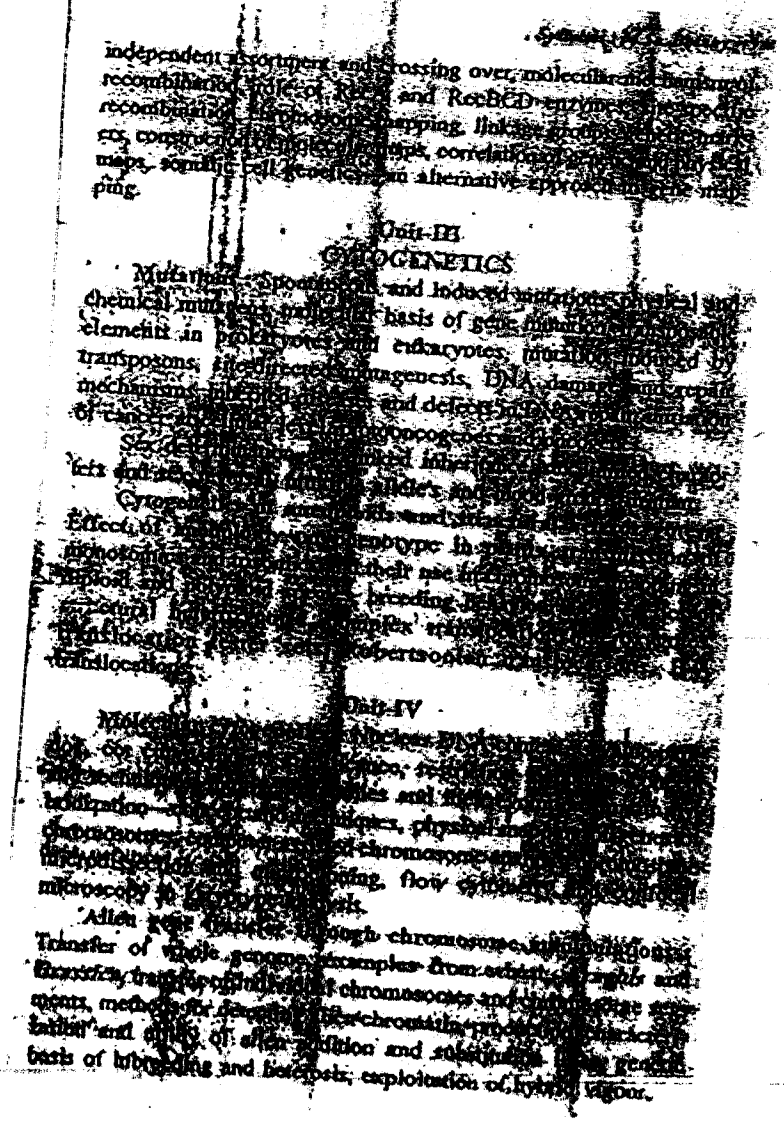
Genetics of prokaryotes and [illegible] plasmids, [illegible] ping, the bacteriophages and phage [illegible] nation in phage, genetic transformation, conjugation and transduction in bacteria, genetics of mitochondria and chloroplasts, cytoplasmic male sterility.

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

Genetic recombination and genetic mapping : Recombination

Dy. [illegible]

(8)



independent assortment and crossing over, molecular [illegible] of recombination, role of RecA and RecBCD enzymes, [illegible] recombination, [illegible] mapping, linkage groups, [illegible] construction of [illegible] maps, correlation of [illegible] maps, somatic cell [illegible] an alternative approach to gene mapping.

Unit-III

CYTOGENETICS

Mutations – Spontaneous and induced mutations; physical and chemical mutagens, molecular basis of gene mutations, [illegible] elements in prokaryotes and eukaryotes, mutations induced by transposons, site-directed mutagenesis, DNA damage and repair mechanisms, [illegible] and defects in DNA [illegible] of cancer [illegible] oncogenes [illegible]

Sex [illegible] linked inheritance [illegible] lets and [illegible] alleles and [illegible]

Cytogenetics [illegible] and [illegible] Effect of [illegible] phenotype in [illegible] monosomics [illegible] their use in [illegible] haploid and polyploid [illegible] breeding [illegible] structural [illegible] complex [illegible] translocation [illegible] Robertsonian [illegible] translocations.

Unit-IV

Molecular [illegible] Nuclear DNA [illegible] [illegible] hybridization [illegible] techniques, physical [illegible] chromosome [illegible] chromosome [illegible] microdissection and [illegible] sorting, flow cytometry [illegible] microscopy in [illegible].

Alien gene transfer through chromosome manipulations: Transfer of whole genome, examples from wheat, [illegible] and Brassica, transfer of individual chromosomes and chromosome segments, methods for detecting alien chromatin, production, characteristics and utility of alien addition and substitution [illegible] genetic basis of inbreeding and heterosis, exploitation of hybrid vigour.

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Suggested Readings :

1. Alberts B, Bray, D., Lewis, J., Raff, M., Robert, K. and Watson, J.D. 1989. Molecular Biology of the Cell (2nd edition). Garland Publishing Inc., New York.
2. Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
3. Burnham, C.R. 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minneapolis.
4. Busch, H. and Rothblum, L. 1982. Volume 2. The Cell Nucleus rDNA Part A. Academic Press.
5. Hartl, D.L. and Jones, E.W. 1998. Genetics : Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts, USA.
6. Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
7. Karp, G. 1999. Cell and Molecular Biology : Concepts and Experiments. John Wiley & Sons, Inc., USA.
8. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
9. Lewis, R. 1997. Human Genetics : Concepts and Applications (2nd edition). WCB McGraw Hill, USA.
10. Malacinski, G.M. and Freifelder, D. 1998. Essentials of Molecular Biology (3rd Edition). Jones and B. Antlet Publishers, Inc., London.
11. Russel, P.J. 1998. Genetics (5th edition). The Benjamin/Cummings Publishing Company Itd., USA.
12. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2nd edition). John Wiley & Sons, Inc., USA.

Suggested Laboratory Exercises

1. Linear differentiation of chromosomes through banding techniques, such as G-banding, C-banding and Q-banding.
2. Silver banding for staining nucleolus organizing region, where 18S and 28srDNA are transcribed.
3. Orcein and Feulgen. Staining of the salivary gland chromosomes of Chironomas and Drosophila.
4. Characteristics and behaviour of B chromosomes using maize or any other appropriate material.
5. Working out the effect of mono- and tri-somy on plant pheno-

(10)

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type, fertility and meiotic behaviour.

6. Induction of polyploidy using colchicines, different methods of the application of Colchicines.

7. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.

8. Effect of translocation heterozygosity on plant phenotype, chromosome pairing and chromosome disjunction and pollen and seed fertility.

9. Meiosis of complex translocation heterozygotes.

10. Isolation of chlorophyll mutants, following irradiation and treatment with chemical mutagens.

11. Estimation of nuclear DNA content through microdensitometry and flow cytometry.

12. Fractionation and estimation of repetitive and unique DNA sequences of nuclear DNA.

Suggested Readings :

1. Fukui, K. and Nakayama, S. 1996 : Plant Chromosomes : Laboratory Methods, CRC Press, Boca raton, Florida.

2. [illegible] and Sharma, A. 1999. Plant Chromosome Analysis, Manipulation and Engineering. Harwood Academic Pub., [illegible] Australia.

Paper III : Biology and Diversity of Lower Plants : Cryptogams

Scheme of Examination

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 have [illegible] parts of question each [illegible] Units.

Phycology : Algae in diversified habitats (terrestrial, freshwater, marine), thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual) criteria for classification of algae, pigments, reserve food, flagella, classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta : with special reference to *Micractinium, Hydrodictyon, Draparnaldiopsis, Cosmarium*, algal blooms, algal biofertilizers : algae as food, feed and use in industry.

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11

Unit—II

Mycology : General characters of fungi, substrate relationship in fungi, cell ultrastructure, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic, symbiotic), heterothallism, heterokaryosis, parasexuality, recent trends in classification. Phylogeny of fungi, general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, deuteromycotina, with special reference to *Albugo*, *Chaetocnium*, *Monoblepharella*, *Melampsora*, *Polyporus*, *Drechslera* & *Phoma*, fungi in industry, medicine and as food, fungal diseases in plants and humans, Mycorrhizae, fungi as biocontrol agents.

Unit—III

Bryophyta : Morphology, structure, reproduction and life history, distribution, classification, general account of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales, with special reference to *Pellia*, *Cyathodium*, *Notothylas* and *Polytrichum*, economic and ecological importance.

Unit—IV

Pteridophyta : Morphology, anatomy and reproduction, classification, evolution of stele, heterospory and origin of seed habit, general account of fossil pteridophytes, introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida, with special reference to *Lycopodium*, *Selaginella*, *Pteris*, *Equisetum*, Telome theory.

Suggested Reading

Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology, John Wiley & Sons, Inc.

Gilman, A. 1958. Introduction to the Fungi. McGraw-Hill Book Co., New York.

Kumar, H.D. 1988. Introductory Phycology. Affiliate East-West Press Ltd., New Delhi.

Mandahar, C.L. 1978. Introduction to Plant Viruses. Chand & Co. Ltd., Delhi.

Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology. New Age International Press.

Morris, I.1986. An Introduction to the Algae. Cambridge University Press, U.K.

Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad.

Parihar, N.S. 1996. Biology & Morphology of Pteridophytes.

Dy. Registrar
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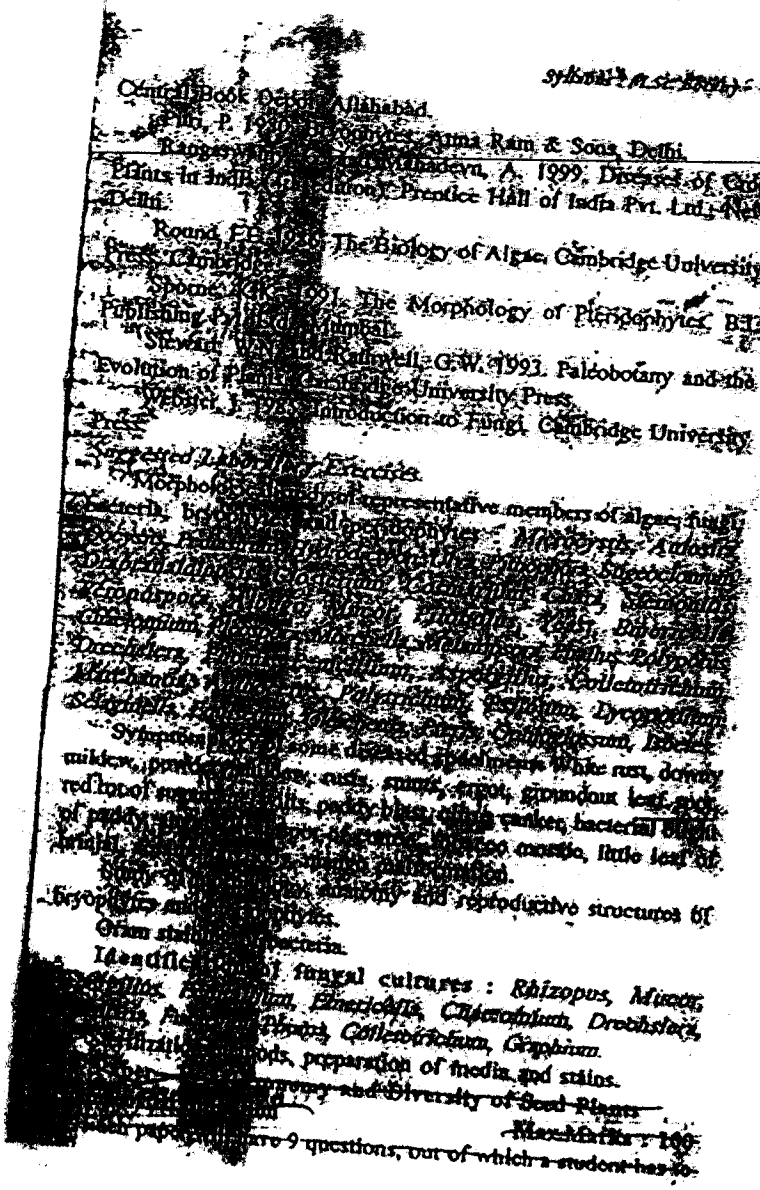
12



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(13)

PAPER IV : TAXONOMY AND DIVERSITY OF SEED PLANTS

Gymnosperms

Unit I

Introduction Gymnosperms, the vessel-less and fruitless seed plants varying in the structure of their sperms, pollen grains, pollen germination and the complexity of their female gametophyte; Evolution of Gymnosperms. Classification of Gymnosperms and their distribution in India. Brief account of the families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). General account of Cycadeoidales and Cordaitales Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

Unit II

TAXONOMY OF ANGIOSPERMS

1. Aims, components, and principles of Taxonomy; Alpha and Omega Taxonomy, documentation and scope.
2. Systems of Angiosperm classification: Cronquist, Dahlgren, Thorne and APG-II.
3. International Code of Botanical Nomenclature: Principles, rules and recommendations; Taxonomic concept: Hierarchy, species, genus, family and other categories.

Unit III

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

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

Taxonomic tools and techniques: Herbarium, serological, Molecular technique, GIS and Mapping biodiversity

(14)

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Unit IV

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

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

Suggested Readings

Bhatnagar, S.P. and Moitra, A. 1996. Gymnosprms. New Age International Pvt. Ltd., New Delhi.

Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London,

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

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

Grant, W.F. 1984. Plant Biosystematics. Academic Press London.

Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd., London.

Heslop-Harrison, J. 1967. Plant Taxonomy - English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.

Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.

Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd., London.

Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.

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

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

Singh, H. 1978, Embryology of Gymnosprms. Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.

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

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

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

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

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

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

Suggested Laboratory Exercises

Gymnosperms

1. Comparative study of the anatomy of vegetative and reproductive pans of cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria, Cryptomeria, Taxodium, Podocarpus, Agathis, Taxus, Ephedra and Genetum.

2. Study of important fossil gymnosperms from prepared slides and specimens.

Angiosperms

3. Description of a specimen from representative, locally available families List of Locally Available Families :

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

4. Description of a species based on various specimens to study intraspecific variation: a collective exercise.

5. Description of various species of a genus; location of key characters and preparation of keys at generic level.

6. Location of key characters and use of keys at family level.

7. Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.

8. Training in using floras and herbaria for identification of specimens described in the class.

9. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

10. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

(17)

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Paper – V : Plant Physiology and Metabolism

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

Unit–I

Water relation of plants : Unique physicochemical properties of water, chemical potential, water potential, apparent free space, movement of water, Soil Plant Atmosphere Continuum (SPAC), stomatal regulation of transpiration, signal transduction in guard cell.

Membrane Transport : Passive - non-mediated transport and facilitated, Pathway-mediated transport, ATP-driven active transport, Symport, Antiport Ion channels.

Amino acids, Proteins and Enzymes : Nod factor, root nodules and nitrogen fixation, structure of amino acids, stereochemistry, Amphoteric properties, synthesis of amino acids by reductive amination, GS-GOGAT system and transamination.

Structure of proteins : Primary, secondary, tertiary, quaternary and domain structure, reverse turn and Ramchandran Plot, protein stability : electrostatic forces, hydrogen bonding, disulfide bonding and hydrophobic interaction.

Enzymes : Structure and properties, substrate specificity, classification and mechanism of enzyme action.

Unit–II

Carbohydrates : Classification, structure and function of monosaccharides, polysaccharides and glycoproteins including starch, cellulose and pectins.

Photosynthesis : Photosynthetic pigments, absorption and transformation of plant energy, photo-oxidation, light complexes of

(18)

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thylakoid membranes : photosystem I, cytochrome b- f complex, photosystem II and coupling factors, [illegible] water and O_2 evolution, non-cyclic and cyclic photophosphorylations, water-water cycle, proton gradient and photophosphorylation, Calvin cycle, regulation of RUBISCO activity, control of photosynthetic cycle, C_4 pathway and its adaptive significance, CAM pathway, differences between C_3 and C_4 plants, glycolate pathway and photorespiration, chlororespiration and CO_2 concentrating mechanism in micro-organism.

Unit-III

Respiration : Anaerobic and aerobic respiration, amphibolic nature of TCA cycle, pentose phosphate pathway, glyoxylate pathway, oxidative phosphorylation, mitochondrial electron transport, high energy compounds : their synthesis and utilization.

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

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

Unit-IV

Plant growth regulators : Auxins - chemical nature, bioassay, physiological effects and mode of action.

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

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

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

Physiology of flowering : Photoperiodism and vernalization.

Suggested Readings :

1. Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library. Springer-Verlag, New York, USA.

19

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4. Hooykaas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier Amsterdam The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira P., Baltimore D. and Darnell J., 2000. Molecular Cell Biology (fourth edition). W.H. Freeman and Company, New York, USA.
7. Moore, T.C. Biochemistry and Physiology of Plant Hormones. Springer-Verlag, New York, USA.
8. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
9. Salisbury, F.B. and Ross, C.W., 1992. Plant Physiology (fourth edition). Wadsworth Publishing Co., California, USA.
10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee, 1999. Concepts in Photobiology : Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L. and Zeiger, E., 1998. Plant Physiology (second edition). Sinauer Associates Inc. Publishers, Massachusetts, USA.
12. Thomas, H. and Grierson, D. (eds) Plant Biotechnology. Academic Press, San Diego, USA.
13. Wareing, P.F. and Phillips, I.D.J. 1981. Growth and Differentiation in Plants (third edition). Pergamon Press, Oxford, UK.

1. Effect of [illegible] concentration on the [illegible]
2. [illegible] on activity of [illegible]
3. [illegible] inhibitory of its [illegible]
4. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.
5. To determine the chlorophyll a, chlorophyll b. ratio in C_3 and C_4 plants.
6. Isolation of intact chloroplasts and estimation of chloroplast protein by any one assay.
7. To demonstrate [illegible] phosphorylation in intact chloroplasts, resolve the [illegible] by SDS-PAGE and perform autoradiography.

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20

8. Extraction of seed proteins depending upon the solubility.
9. Determination of succinate dehydrogenase activity, its kinetics and sensitivity against [illegible].
10. Desalting of proteins by gel filtration chromatography employing Sephadex.
11. Preparation of the standard curve of protein (BSA) and estimation of the protein content in the extract of plant material by Lowry's or Bradford's method.
12. Fractionation of proteins using gel filtration chromatography by Sephadex (G100 or [illegible]).
13. SDS-PAGE for soluble proteins extracted from the given plant materials and comparison of their profile by staining with Coomassie Brilliant Blue or silver nitrate.
14. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoresis.
15. Radioisotope methods [illegible] chromatography, instrumentation (GM count and Scintillation counter) and principles involved.
16. Principles of colorimetry, spectrophotometry and fluorimetry.

Suggested Readings (for the above practicals)

1. bajracharya, D. 1999. [illegible] in Plant Physiology : A Laboratory Manual. [illegible] New Delhi.
2. Copper, T.G. 1977. [illegible] John Wiley, New York, USA.
3. Copeland, R.A. 2000. [illegible] Practical Introduction to Structure, Mechanism and [illegible] Wiley Publishers, New York.
4. Dennison, C. 1999. A [illegible] Kluwer Academic Publishers, [illegible].
5. Devi, P. 2000. Principles [illegible] Plant Molecular Biology. Biochemistry and [illegible] Publishers, Jodhpur, India.
6. Dryer, R.L. and Lata, [illegible] Experimental Biochemistry. Oxford University Press, [illegible].
7. Haines B.D. (Ed.) 1998. [illegible] Electrophoresis of Proteins : A Practical Approach, 3rd edition, [illegible]. Oxford University Press, Oxford, U.K.
8. Harborne, T.C. 1981. Phytochemical Methods : A Guide to Modern Techniques of Plant Analysis. Chapman & Hall, London

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21

Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.

Nimse, S.B. and Sahoo, D.P. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc. Maryland, USA.

Plummer, D.T. 1991. An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi.

Scopes, R.K. 1993. Techniques and Practice of Chromatography. Springer-Verlag New York, Inc. New York.

Wilson, K. and Goulding, K.H. (Eds). 1986. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, U.K.

Wilson, K. and Walker, J. 1994. Practical Biochemistry : Principles and Techniques. 4th edition. Cambridge University Press

Max. Marks: 100

Time: 3 hours

Note: There are 9 questions, out of which 5 questions are to be attempted including the question No.1 which is compulsory. Question No.1 will carry 20 marks and rest of the questions will carry 16 marks each.

Unit - I

1. Microbiology

2. Microbiology and Plant Pathology

3. Bacteria : General account, ultrastructure, reproduction, classification, habit and economic importance.

4. Viruses and Mycoplasma : Discovery, characteristics, ultrastructure of TMV, classification of viruses, chemical nature, replication, transmission, cyanophages, ecological importance.

5. Phytoplasma : General characteristics and role in causing plant diseases.

Unit-II

4. Scope and application of microbes in agriculture, industry, food, pollution and biological control of pests.

5. General account of immunity, allergy, properties of antigens and antibodies, antibody structure and function, affinity and anti-

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(22)

body specificity. Monoclonal antibodies and their uses, antibody engineering, vaccines, types of vaccines. Preliminary account of Biofilms, biochips, biosensors and biopesticants.

Unit– III

Plant Pathology

6. History and scope of plant pathology : General account of diseases caused by plant pathogens. Pathogen attack and defence mechanism: Physical, physiological, biochemical and molecular aspects.

Plant disease management : Chemical, biological, IPM systems, development of transgenics, biopesticides, plant disease clinics. Preliminary account of application of biotechnology in plant pathology.

Unit-IV

Symptomology, identification and control of following plant diseases.

Fungal diseases : Wheat (Rust, Smut, Bunt), Paddy (Grain discolouration, ergot and sheath rot), Cotton (Wilt), Grapes (Downy mildew and powdery mildew).

Bacterial diseases : Wheat (Tundu), Citrus canker.

Viral diseases : Tobacco mosaic, Bhindi yellow mosaic.

Phytoplasmal diseases : Little leaf of brinjal.

Nematode disease : Root-knot of vegetables.

Suggested Readings

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. John Wiley & Sons Inc.
2. Agrios, [illegible]. Plant Pathology. Academic Press, London.
3. Albajes, R., Gullino, M.L., Van Lenteren, J.C. and Elad, Y. 2000. Integrated Pest and Disease Management in Greenhouse Crops. Kluwer Academic Publishers.
4. Bridge, P., Moore, D.R. & Scott, P.R. 1998. Information Technology, Plant Pathology and Biodiversity. CAB International, U.K.
5. Clifton, A. 1958. Introduction to the Bacteria. McGraw Hill Book Co. New York.
6. Mandahar, C.L. 1978. Introduction to plant viruses. Chand & Co Ltd. Delhi.

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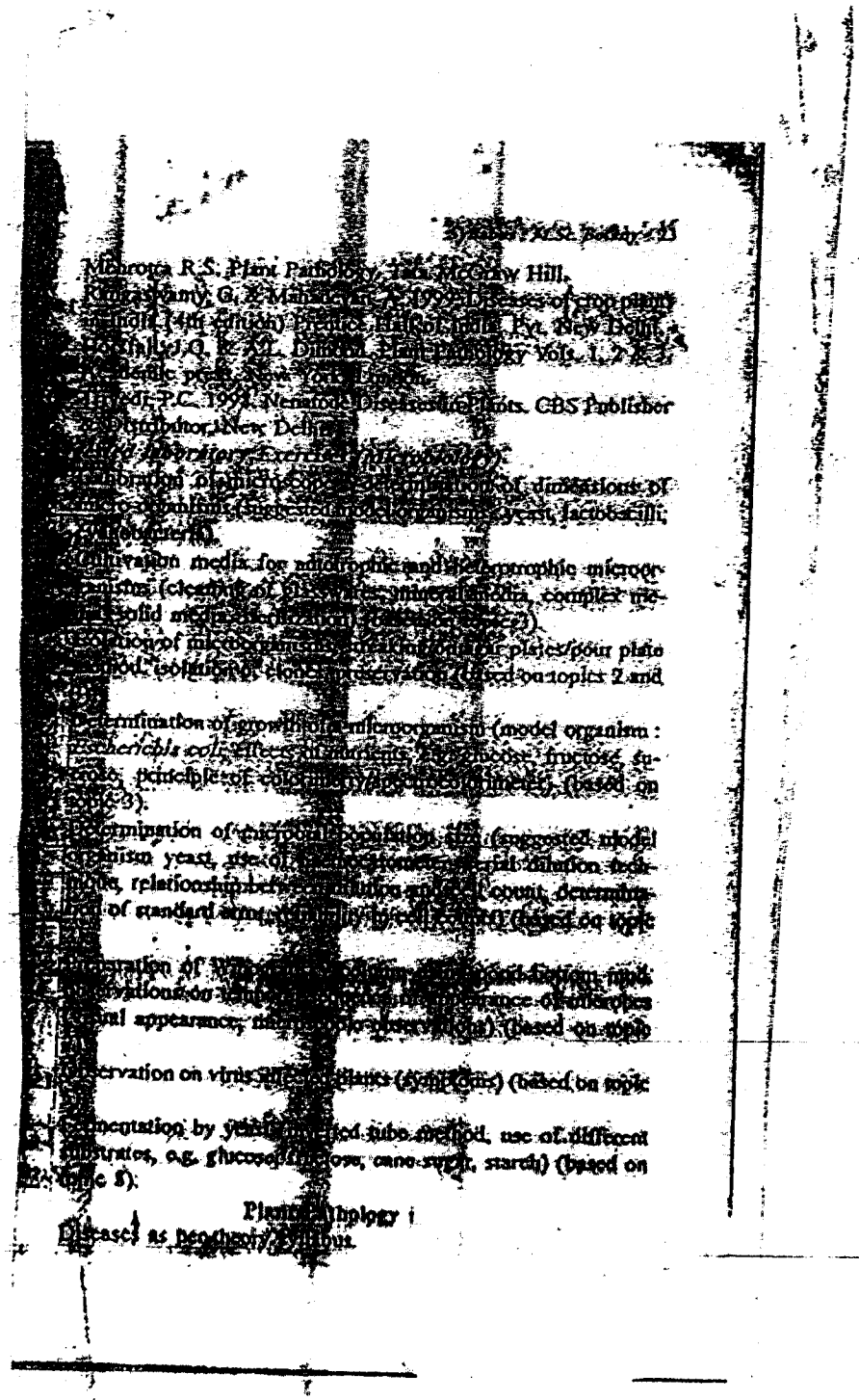

Mehrotra R.S. Plant Pathology, Tata McGraw Hill.

Rangaswamy, G. & Mahadevan, A. 1999. Diseases of crop plants in India (4th edition) Prentice Hall of India Pvt. New Delhi.

Horsfall, J.G. & A.E. Dimond. Plant Pathology Vols. 1, 2 & 3. Academic press, New York.

Agrios, G.N. 1988. Plant Pathology.

Alexopoulos, C.J. & C.W. Mims. Introductory Mycology.

Singh, R.S. 1994. Plant Pathology.

Sharma, P.C. 1994. Nematode Biotechnology. Tata McGraw Hill Publishing Co. Ltd. New Delhi.

Sharma, P.D. 1997. Plant Pathology. Rastogi Publications, Meerut.

Vidyarthi, R.D. & Sunder Kaushal. Plant Pathology.

Practical Mycology:

Calibration, Microscopy and measurement of dimensions of fungi, bacteria, actinomycetes (bacteria, yeast, lactobacilli; rhizobium).

Cultivation media for microbial and phytopathogenic microorganisms (classification of culture media, complex media, synthetic media, solid media, maintenance of cultures).

Isolation of microorganisms from soil, water, plant parts/pour plate method, isolation from diseased plant parts (based on topics 2 and 3).

Determination of growth of microorganisms (model organism : *Escherichia coli*, effects of nutrients, temperature, fructose, sucrose, principle of colorimetry, turbidimetry, (based on topic 3).

Determination of microbial population size (suggested model organism yeast, use of haemocytometer, serial dilution technique, relationship between dilution and cell count, determination of standard curve, viability by dye exclusion (based on topic 4).

Demonstration of [illegible] (based on topic 5).

Observations on [illegible] (based on topic 6).

Observation on virus infected plants (symptoms) (based on topic 7).

Fermentation by yeast, closed tube method, use of different substrates, e.g. glucose, sucrose, cane sugar, starch) (based on topic 8).

Plant Pathology I

Diseases of [illegible]

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24

Skeleton Paper

B.Sc. (Previous) Group-I Practical Examination

Time :-6 Hours

Q.No.	Questions	Marks Allotted
1.	(a) Perform the given molecular biology exercise.	16
	(b) Perform the given exercise of cell biology/ molecular biology.	15
2.	(a) Perform the given exercise of Genetics/ Mendelism.	16
	(b) Perform the given exercise of Cytogenetics/ Polyploidy/ chromosome	16
3	(i) Identify two algae from the given specimens. Draw labelled diagrams. Comment upon their significant characters and systematic.	8
	(ii) Make a suitable preparation of material provided to show reproductive parts of the fungus.	8
	(iii) Draw well labelled diagrams. Identify the fungus giving reasons.	8
	(iv) Make a suitable preparation of vegetative/ reproductive parts of the angiosperm provided. Draw labelled sketches. Write features of the material provided. Identify giving reasons.	8
4.	Identify the specimens/slides (6-9)	18
5.	Spotting	9
6.	Viva-voce	15

Skeleton Paper

B.Sc. (Previous) Group-II Practical Examination

Time :-6 Hours

Q.No.	Questions	Marks Allotted
1.	(a) Describe the material in scientific language. Assign it to the relevant family with reasons. Draw floral diagram.	9

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25

(b) Prepare an artificial key of the given plant materials (A, B & C). 6

(c) Make a suitable preparation of material 'D'

special interest, if any. 10

(d) Make a suitable preparation of given material 'E' (reproductive part only) Draw labelled diagram, identify it giving reasons. 6

2. Perform the physiology experiments as assigned to you. Describe the methodology and record your observations.

Exercise 'a' 20

Exercise 'b' 10

3. (i) Perform the microbiological exercise given to you. Draw suitable diagram describe methodology and record your observations. 10

(ii) Prepare a suitable slide of the given microbiological exercise. Draw diagram, describe methodology and record your results. 7

(iii) Prepare a suitable slide of the given material 'D' for histological study. Draw labelled diagram, identify the pathogen, give reasons. 12

Spotting 10

Herbarium 5

Sessional Marks 25

Viva voce 10

Plant Morphology, Development and Reproduction

Paper-VII : Plant Diversity-Algae and Reproduction

Paper-VIII : Plant Ecology

Paper-IX : Plant Resource Utilization and Conservation

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

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

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

Paper-XI(b) : Seed Science and Technology-I

Paper-XII(b) : Seed Science and Technology-II

Ecosystem Services

Paper-XI(c) : Environmental Biology-I

Paper-XII(c) : Agro-Forest Ecosystem

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

Paper-XII(d) : Advanced Plant Physiology-II

Paper-XI(e) : Advanced Morphology and Microtechnique-I

Paper-XII(e) : Advanced Morphology and Microtechnique-II

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

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

Paper-XI(g) : Biotechnology-I

Paper-XII(g) : Biotechnology-II

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26

& REPRODUCTIVE BIOLOGY

Unit I

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

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

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

Unit II

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

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

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

Unit III

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

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27

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

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

Pollination, pollen-pistil interaction and fertilization : Floral characteristics, pollination mechanisms and vectors, ,structure of the pistil, pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, bio'chemical and molecular aspects), double fertilization, in vitro fertilization.

Unit IV

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

Polyembryony, apomixis, embryo culture, dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

Latent life - dormancy: importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy.

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

Suggested Readings:

2. Bewley. J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press. New York.

3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.

4. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford. New York.

10. Raven, P.H., Evrt, R.F. and Eichhorn, S. 1992. Biology of Plants (5th edition). Worth, New York

11. Salisbury, P.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing, Belmont, California

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Cambridge University Press, Cambridge.

13. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.

14. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.

15. Howell, S.H. 1998. Molecular Genetics of Plant Developmem. Cambridge University press, Cambridge.

16. Leins, P., TucKer, S.C. and Endress, P.K. 1988. Aspects of Floral Development, J. Cramer, Germany.

17. Lyndon, R.F. 1990. Plant Development. The Cellular Basis, Unnin Byman, London.

18. Murphy, T.M. and Thompson, W.E, 1988. Molecular Plant Development. Prentice Hall, New Jersey.

19. Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons,London.

20. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.

20. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.

20. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.

21. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.

22. Sdgely, M. and Griffin, A.R. 1989. Sexual Reproduction to Tree Crops. Academic Press, London.

23. Shivanna, K.R. and Sawhney, VK. (eds.) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.

24. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology : A Laboratory Manual. Springer-Verlag. Berlin.

25. Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen : Structure and Function. Wiley Eastern Ltd., New York.

26. The Plant Cell Special Issue on Reproductive Biology of Plants. Vol. 5(10) 1993.

Suggested Laboratory/Field Exercises

1. Study of living shoot apices by dissections using plants such as *Tabernaemontana, Albizia*

2. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant . Examination of shoot apices in a monocotyledon in both T.S. and L.S to show the origin and arrangement of leaf primordia.

3. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement. Examination of rosette plants (*Launaea, Mollugo, Raphanus, Hyoscyamus etc.*) and induction of bolting under natural conditions as well as by GA treatment.

4. Microscopic examination of vertical sections of leaves such as *Eucalyptus, Ficus*, Mango, *Nerium*, maize, grass and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the leaf anatomy C3 and C4 of plants.

5. Study of epidermal peels of leaves such as *Coccinia, Tradescantia* etc. to study the development and final structure of stomata and prepare stomatal index.

6. Study of types of stomata in plants belonging to different families.

7. Study of whole roots in monocots and dicots.

8.Examinatian of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives. (use maize, aerial roots of banyan etc.)

9. Study of lateral root development.

10. Study of leguminous roots with different types of nodules.

11.Study of primary and secondary tissue differentiation in roots and shoots.

12.Study of seed coat types- *Pisum, Cucurbita*, wheat.

13. Study of vascular tissues by clearing technique

14. Study of microsporogenesis and gametogenesis in sections of anthers of different ages.

15. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotoloria, Tradescantia, Brassica. Petunia, Solanum melongena*, etc.)

16. Study of wall layers of anther.

17. Tests for pollen viability using stains and in vitro germination.

18. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.

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30

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 Mannual, 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

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. Ecosystem services

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, Environment impact assessment, ecosystem restoration

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32

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.L. and Reiss, M.J. 1988. Ecology, Principles and Applications. Cambridge University Press. Cambridge, U.K.
10. Molan, B. and Billharz, S. 1997. Sustainability Indicators. John Wily Sons, New York.

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Unit IX

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. Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, New York.
2. Mueller-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. Odum, E.P. and Barrett, G.W. 1988. Ecology, Principles and Applications. Cambridge University Press, Cambridge, U.K.
10. [illegible] Statistical Ecology. John Wiley & Sons, New York.

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[illegible]

[illegible]

[illegible] Delhi

[illegible] Manual 2002. Handbook of Methods in Environmental Studies Vol. 1 &2. ABD Publisher, Jaipur.

[illegible] Chapman and M. J. Reiss. 1995. Ecology principles and applications. Cambridge University Press.

[illegible] Faune, C. Ferra, P. Medori and J. Devaux. 2001. Ecology Science & Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

G. T. 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 stands using community coefficients (similarity indices).
3. To estimate IVI of the species in a grassland/woodland using quadrat method.
4. To determine gross and net phytoplankton productivity by light and dark bottle method.
5. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
6. To determine the Water holding capacity of soils collected from different locations.
7. To determine percent organic carbon 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 azide modification of Winkler's method.
9. To estimate chlorophyll content in SO_2 fumigated and unfumigated plants leaves.
10. To estimate rate of carbon dioxide evolution from different soils using soda lime-soil alkali method.
11. To estimate [illegible] in soil samples using [illegible]

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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 the parts such as multiple choice type, one line answer type, one word type and fill in the blanks type. Limit of 20 words.

Unit-I

Plant Biodiversity : Concept, status in India, utilization and concerns.

Sustainable development : Basic Concepts. Origins of agriculture

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

Unit-II

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

Unit-III

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

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

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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 Indian initiatives, protected areas in India—sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs, conservation of wild biodiversity.

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

Recommended Readings

Anonymous 1993. 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.

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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.

Chrispeels, M.J. and Sadava, D. 1977. Plants, Food and People. W.H. Freeman and Co., San Francisco.

Cristi, B.R. (ed.) 1999. CRC Handbook of Plant Sciences and Agriculture. Vol. I. 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.

9. Conway, G. and Barbier, E. 1990. After the Green Revolution. Earthscan Press, London.
10. Conway, G. and Barbief, 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 (1948-1976). 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. Fall, 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 Difference. Blackwell Science Ltd., Oxford, U.K.
20. Heywood, V. (Ed). 1995. Global Biodiversity Assessment. United Nations Environment Programme. Cambridge University Press, Cambridge, U.K.
21. Heywood, V.H. and Wyselacki, P.S. (Eds) 1991. Tropical Botanical Gardens. Their Role in Conservation and Development. Academic Press, San Diego.
22. Kochhar, S.L. 1998. Economic Botany of the Tropics, 2nd edition. Macmillian India Ltd., Delhi.
23. Kothari, 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. Lovdale Educational, New Delhi.

Dy. Registrar
(Academic)
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JAIPUR

Nair, M.N.B. *et al.* (Eds.) 1988. Sustainable Management of Non-Atwood Forest Products. Faculty of Forestry, University Putra Malaysia, 43004 UPM Serdong, Selangor, Malaysia.

Parodá, R.S. and Arora, R.K. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Publication) South Asia Office, C/o NBPGR, Pusa Campus, New Delhi.

Pimentel, D. and Hall, C.W. (Eds.) 1989. Food and Natural Resources, Academic Press, London, New York.

Pinstrup-Anderson, P. *et al.* 1999. World 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.

Pluckhen, D.L., Smith, N.J.H., William, J.T. and Murti Anishetty, N. 1987. Gene Banks and World's Food. Princeton University Press, Princeton, New Jersey, USA.

Rodgrs, N.A. and Panwar, M.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. I. The Repoit. 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. Hills 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 Husain, 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., Hikino, H. and Farnswarth, 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

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, clover, guar bean, gram, *Ficus* sp.)
3. plant fibres :
   (a) Textile fibres : cotton, jute, linen, sunn hemp, Cannabis
   (b) Cordage fibres : coir
   (c) Fibres for stuffing : silk cotton or kapok
   Morphology, anatomy, (microscopic) study of whole fibres using appropriate staining procedures.
4. 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, Catharanthus roseus, Adhatoda cylanica (syn A. vasica) Allium sativum, Rauwolfia serpentina, Withania somnifera, Phyllanthus amarus, (P. fraternus), Andrographis paniculata, Aloe barbadensis, Mentha arvensis, Rosa sp., Pogostemon cablin, Origanum vulgare, Veiveria zizanioides, Jasminum grandiflorum, Cymbopogon sp., Pandanus odoratissimus.
   Study of live or herbarium specimens or other crystal materials, to become familiar with these resources.
4. Vegetable Oils : Mustard, groundnut, soybean, coconut, sunflower, castor, Morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.
5. Gums, resins, tannins, dyes : Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (*Acacia, Terminalia, mangroves, tea, Cassis* spp. Myrobalans) and dyes (turmeric, *Bixa orellana*, indigo, *Butea monosperma, Lawsonia inermis*) and perform tests to understand their chemical nature.

ield Survey

Firewood and timber yielding plants and NWFPs :

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 larger 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.

entific 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 graden or a mutseum (such as those at the Forest Research Institute, Dehradun, National Botanical

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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 blanks 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/cDNA 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* — the natural genetic engineer, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual prope

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rights, possible ecological risks and ethical problems.

Microbial genetic manipulation for improvement: Genetic transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Unit-IV

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

Bioactive Compounds: Alkaloids, glycosides, flavonoid, proteins and terpenoids.

Suggested Readings :

1. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture : Theory and Practice (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. 1998. Genomes. John Wiley & Sons (Asia) Pvt. Ltd, Singapore.
4. Collins, J.A., Boyd, J.W., Adam, [illegible], Eld, 1999, Biotechnology and Plant [illegible] Introduction and [illegible], CAB International, [illegible].
5. Christoph, M.J. and [illegible], Genetics and Agriculture, Roger le [illegible], [illegible], USA.
6. Collins, B.A. and [illegible], Essential Cell Biology, Bios Scientific Publishers, Oxford, [illegible].
7. Glick, B.R. and Pasternak, [illegible], Molecular Biotechnology: Principles and Applications of Recombinant DNA, ASM Press, Washington, USA.
8. Gustafson, J.P. 2000. Genetics, Kluwer Academic/Plenum Publishers New York, USA.
9. Hughes, R.J. 1990. Practical Approaches in Plant Molecular Biology, Chapman & Hall, London, UK.
10. Jain, S.M., Sopory, S.K. and Veilleux, R.E. 1996. In vitro Haploid Production in Higher Plants, Vols. 1-5, Fundamental Aspects and Methods, Kluwer Academic Publishers, Dordrecht, The Netherlands.

42

Dy. Registrar
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JAIPUR

11. Jölles, G and Jornvall, H. (eds.) 2000. Proteomics in Functional Genomics. Birkhäuser Verlag, Basel, Switzerland.
12. Karim, S.K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
13. Old, R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation : Blackwell Scientific Publications, Oxford, UK.
14. Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Scientific Ltd., Oxford, UK.
15. Raghavan, V. 1986. Embryogenesis in Angiosperms : A Developmental and Experimental Study, Cambridge University Press, New York, USA.
16. Raghavan V. 1997. Molecular Biology of Flowering Plants, Cambridge University Press, New York, USA.
17. Shaltiel, S. and Morgowicz, [illegible]. Biotechnology, Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
18. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, Dordrecht.

Suggested Laboratory Exercise:

1. [illegible] characteristics of *E. coli* [illegible]
2. [illegible] of plasmid from *E. coli* [illegible] its quantification spectrophotometrically.
3. Restriction digestion of the plasmid and [illegible] of the size of various DNA fragments.
4. Cloning of a DNA fragment in a [illegible] and screening of the clones in bacterial population.
5. Determination of DNA sequence [illegible]
6. Isolation of protoplasts from various plant tissues and testing their viability.
7. Effect of physical (*e.g.* temperature) and chemical (osmoticum) factors on protoplast yield.
8. Demonstration of protoplast fusion [illegible]
9. Organogenesis and somatic embryogenesis from protoplast culture and propagation of artificial seeds.
10. Demonstration of androgenesis in Datura.
11. Electroporation of protoplasts and [illegible] expression of the reporter gene.

Dy. Registrar
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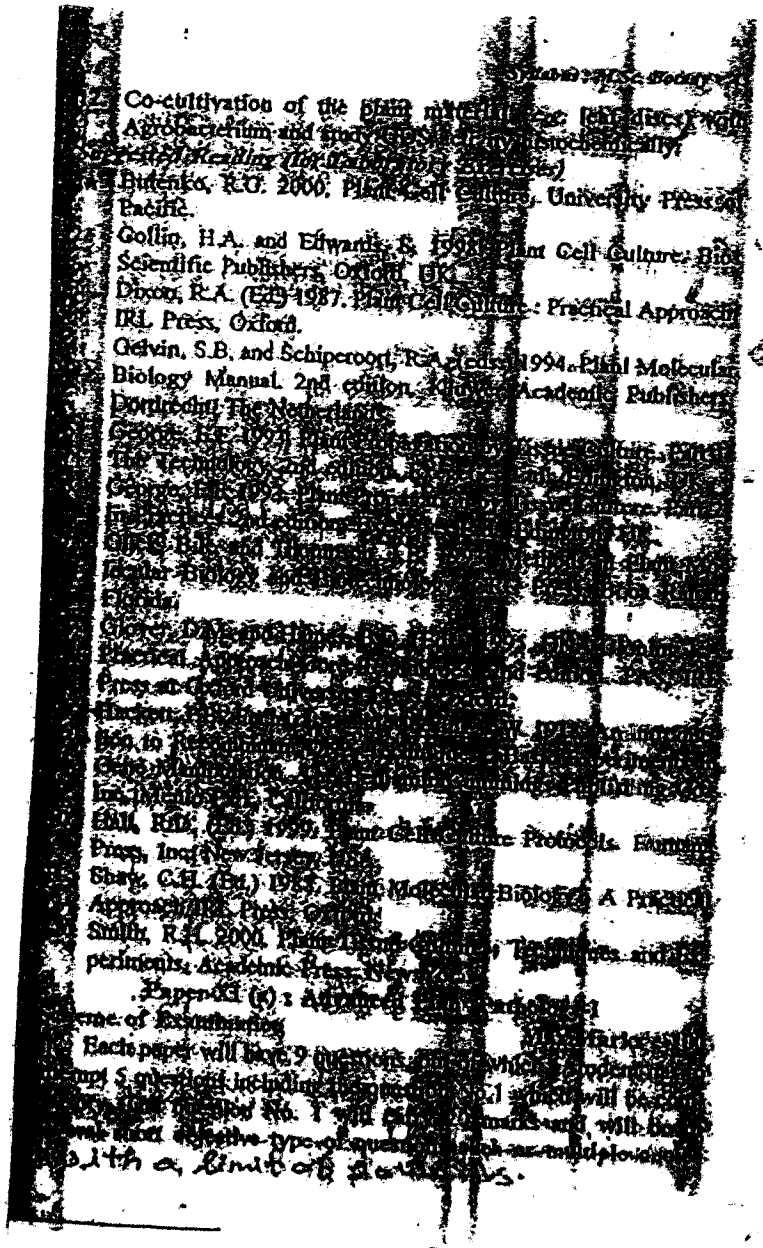
JAIPUR

(43)



Co-cultivation of the plant material [illegible] with Agrobacterium and study [illegible] genetically [illegible]

Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice, a revised edition. Elsevier Science Publishers, Amsterdam, The Netherlands.

Butenko, R.G. 2000. Plant Cell Culture. University Press of Pacific.

Gamborg, O.L. and Phillips, G.C. (Eds.) 1995. Plant Cell, Tissue and Organ Culture: Fundamental Methods. Springer-Verlag, Berlin, Heidelberg, New York.

Gamborg, O.L. and Shyluk, J.P. (Eds.) 1981. Nutrition, Media and Characteristics of Plant Cell and Tissue Cultures. In: Thorpe, T.A. (Ed.) Plant Tissue Culture: Methods and Applications in Agriculture. Academic Press, New York.

Gamborg, O.L., Miller, R.A. and Ojima, K. 1968. Nutrient Requirements of Suspension Cultures of Soybean Root Cells. Experimental Cell Research 50: 151-158.

Gamborg, O.L. and Wetter, L.R. (Eds.) 1975. Plant Tissue Culture Methods. National Research Council of Canada, Saskatoon, Saskatchewan, Canada.

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

George, E.F. 1993. Plant Propagation by Tissue Culture. Part 1. The Technology. 2nd edition. Exegetics Ltd., Edington, Wilts, England.

George, E.F. 1993. Plant Propagation by Tissue Culture. Part 2. In Practice. 2nd edition. Exegetics Ltd., Edington, Wilts, England.

Gill, R. and Thomas, [illegible]. Molecular Biology. [illegible] Florida.

Glick, [illegible]. Practical [illegible] Press, [illegible]

Hall, R.D. (Ed.) 1999. Plant Cell Culture Protocols. Humana Press, Inc., New Jersey, USA.

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

Smith, R.H. 2000. Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.

Paper-III (f) : Advanced [illegible]

Scheme of Examination

Each paper will have 9 questions [illegible] 5 questions including [illegible] will be [illegible] Question No. 1 will [illegible] and will be [illegible] with a limited [illegible]

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JAIPUR

44

~~type, one line answer type, one word type and fill in the blanks type.~~

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.

Unit-I

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

Unit-II

Bacteria : Classification and nomenclature of bacterial plant

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JAIPUR

145

athogens. Methods of identification of bacterial pa
phology, physiology, serology and pathogenicity).
bacterial diseases : Brown rot of potato, blight of rice, soft ro
of vegetables, Crown gall disease, angular leaf spot of cotton.

Unit-III

Virus, viroid and phytoplasma disease : Symptomatology and
ansmission of viral diseases; Potato virus X & Y, Tomato ring
osaic, bunchy top of banana; viroids and important viroid diseases.
ytoplasma General account; Sesame phyllody, Spike disease of
ital.

Unit-IV

Nematology : Brief history, classification and identification of
nt pathogenic nematodes. Morphology and anatomy of nematodes.
hods used in Nematology.
Control of plant parasitic nematodes. Nematode Disease :
a disease of wheat & barley, ear cockle of wheat, root-knot
se.

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46

Paper XI (b): SEED SCIENCE & TECHNOLOGY-I

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.

47

Dy. Registrar
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Jaipur

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.

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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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

(50)

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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. Cliffton. 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. Singh, K.G. and Manalo, P.L. 1986. Plant Quarantine and Phytosanitary Barriers in the Asean. Asean Plant Quarantine Centre and Training Institute, Malaysia.

51

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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

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

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

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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. Wadhwani 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

gested 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.

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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Paper XII (C): ENVIRONMENTAL BIOLOGY

Unit I

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

Unit II

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

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

Unit III

Climate Issues: Greenhouse gases (CO_2, CH_4, N_2O, CFCs: sources, trends and role) and consequence of greenhouse effects (CO_2 fertilization, global warming, sea level rise, Biodiversity erosion), Carbon footprints, Carbon sequestration, Applications of GIS and Remote Sensing technology in environmental studies, the future of planet earth.

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 amd 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.

ggested Laboratory Exercises

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

57

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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 Km value, nagative and positive cooperrativity, 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, coezymes, activators and inhibitors, isoenzymes, ribozymes and abzymes.

Unit-II

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

Vitamins : Water and fat-soluble vitamins, biochemical function of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxin, folic acid, vitamin B_{12} ascorbic acid, vitamin A and Vitamin

Unit-III

Secondary Metabolites :

Coumarins and lignins : Structure and synthesis.

Insecticides : (pyrethrins and rotenoids) distribution, chemistry 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, polyacetyl isoquinoline, tropane and indole alkaloids—their distribution, synthesis and function.

Saponins and sapogenins : 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 com-

58

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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 biotoic 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 chromatotgraphy, 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 (e) : 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-

59

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mulsory. 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

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 taxonomic significance.

Unit-II

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

Unit-III

Embryosac-Basic types, and their interrelationships, Ultrastructural aspects of embryosac development. Endosperm—Interrelationship of the major types of endosperms, cytology and role. Embryo development, Embryo-Major types, embryogenic 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, Acanthaceae, Plodostemaceae, Cucurbitaceae, Scrophulariaceae, Gesneriaceae, Orobanchaceae, Lentibulariaceae.

Paper XII (e) : Advanced Morphology and Morphogenesis-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

Development and morphogenesis-shoot apex the apical cell,

60

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meristem, the subcelluar 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 ofmorphogenesis-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-XI (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.

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

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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, Ci. II. 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. Radrord, A.H. 1986. Plant Fundamentals of Plant Systematics. Harper and Row, New York.
5. Stace, C.A. 1989. Plant Taxonomy and Biosystematics, Edward Arme 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. Naik, 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

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 auxillary 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 referencte to rice, wheat and maize.

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

Microrpropagation advances and synthetics 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.

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 developements 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
1.	(a) Study the diseased plant material 'A' provided; make histopathological investigations.	

65

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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 tranmission of pathogen in infected seedling.	10

66

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