MAHARSHI DAYANAND SARASWATI UNIVERSI'

AJMER

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MAHARSHI DAYANAND SARASWATI UNIVERSITY
AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. BOTANY

M.Sc. Previous Examination
(Semester I & II)
(w.e.f. 2015-16)
M.Sc. Final Examination
(Semester III & IV)
(w.e.f. 2016-17)

संस्करण
2017

मूल्य : 12/-

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

NOTICE

1. Change in Statutes/Ordinances/Rules/ Regulations Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

सूचना

1. समय-समय पर संशोधन या पुन: निर्माण कर परिनियमों/ अध्यादेशों/नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। **विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।**

MDS UNIVERSITY, AJMER

SCHEME OF EXAMINATION

M.SC. BOTANY SEMESTER SCHEME

FIRST SEMESTER

FOUR THEORY PAPERS [TIME: 3 HOURS DURATION, EACH]

S.NO.	COURSE	PAPER	MARKS
1.	I - PAPER	CELL AND MOLECULAR BIOLOGY	100
2.	II - PAPER	MICROBIOLOGY AND MYCOLOGY	100
3.	III - PAPER	ALGAE, BRYOPHYTES AND PTERIDOPHYTES	100
4.	IV - PAPER	PLANT PHYSIOLOGY	100

SECOND SEMESTER

FOUR THEORY PAPERS [TIME: 3 HOURS DURATION, EACH]

S.NO.	COURSE	PAPER	MARKS
1.	V- PAPER	GENETICS AND CYTOGENETICS	100
2.	VI - PAPER	GYMNOSPERMS AND PALEOBOTANY	100
3.	VII - PAPER	TAXONOMY OF ANGIOSPERMS	100
4.	VIII - PAPER	PLANT BIOCHEMISTRY AND GROWTH PHYSIOLOGY	100

COMBINED PRACTICAL FOR FIRST AND SECOND SEMESTERS = 400 MARKS*

{* Exercises based on Experimental work — 250 marks
Seminar and Project work based on field studies — 90 marks
Record — 30 marks
Viva-voce — 30 marks}

GRAND TOTAL OF MARKS FOR FIRST AND SECOND SEMESTERS = [400 + 400 + 400 = 1200]

THIRD SEMESTER

FOUR THEORY PAPERS {THREE CORE AND ONE ELECTIVE} [TIME: 3 HOURS DURATION, EACH]

S.NO.	COURSE	PAPER	MARKS
1.	IX- PAPER	PLANT DEVELOPMENT	100
2.	X - PAPER	ENVIRONMENTAL BIOLOGY	100
3.	XI- PAPER	PLANT BIOTECHNOLOGY	100
4.	XII - PAPER	(A) ADVANCED PLANT PATHOLOGY: PRINCIPLES AND TECHNIQUES (B) ADVANCED PLANT PHYSIOLOGY: SECONDARY METABOLITES (C) ADVANCED PLANT ECOLOGY: ENVIRONMENT AND ARID ZONE ECOLOGY	100

FOURTH SEMESTER

FOUR THEORY PAPERS {THREE CORE AND ONE ELECTIVE}

[TIME: 3 HOURS DURATION, EACH]

S.NO.	COURSE	PAPER	MARKS
1.	XIII- PAPER	PLANT REPRODUCTION	10(
2.	XIV - PAPER	PLANT RESOURCES: CONSERVATION AND UTILISATION	10(
3.	XV- PAPER	GENETIC ENGINEERING OF PLANTS AND MICROBES	10(
4.	XVI - PAPER	(A) ADVANCED PLANT PATHOLOGY: PLANT DISEASES (B) ADVANCED PLANT PHYSIOLOGY: GROWTH PHYSIOLOGY (C) ADVANCED PLANT ECOLOGY: ECOSYSTEM AND ECOSYSTEM ANALYSIS	10(

COMBINED PRACTICAL FOR THIRD AND FOURTH SEMESTERS = 40(MARKS*

{* Exercises based on Experimental work — 250 marks
Seminar and Project work based on field studies — 90 marks
Record — 30 marks
Viva-voce — 30 marks}

GRAND TOTAL OF MARKS FOR FIRST AND SECOND SEMESTERS = [400 + 400 + 400 = 1200]

NOTE ON THEORY EXAMINATION SCHEME (M. SC. BOTANY):

Syllabus of each question paper is divided into three units. The paper is divide into three parts: Part –A, Part –B and Part – C. (Total 100 marks; Duration hours).

PART – A (30 Marks) is compulsory and contains 10 Questions (50 words each). A least three questions will be set from each unit and each question is of 3 marks. PART – B (25 Marks) 9 questions (100 words each) will be set taking 3 from eacl unit and candidate is required to attempt 5 questions taking at least one questio from each unit but not more than 2 from any unit. Each question carries 5 marks PART – C (45 Marks) contains 6 questions two from each unit. Candidate i required to attempt three questions taking one from each unit. Each questio carries 15 marks (400 words).

NOTE ON PRACTICAL EXAMINATION SCHEME (M. SC. BOTANY):

I. Combined Practical examination shall be of 10 hours duration In two day time period of 5 hours each day for M.Sc. Semester (I and II)and (III an IV) separately.

II. Regarding seminars assessment, each student shall orally present 2 semi nars of 30 minutes duration each per session in the presence of Head o the Department or Faculty members appointed by him and also submit

write up for each seminar. The seminar evaluation record and project work record be placed by the H.O.D. before the external and internal practical examiners for the purpose of final evaluation by them at the time of practical examination.

WORKLOAD

Each theory paper must be given 4 hours per week for theory. Practicals must be given 20 hrs. per week per batch. Each laboratory batch for practicals must not be of more than10 students.

Criteria to pass: The number of papers and the maximum marks for each paper/ practical are shown in the scheme above. It will be necessary for a candidate to pass in theory and practicalpart of a paper/subject separately.

In order to pass, a candidate, shall be required to obtain in each semester examination:

i. At least 36% marks in the aggregate of all the papers prescribed for the examination* and

ii. At least 36% marks in combined practical examination each year* provided that if a candidate fails to secure at least 25 % marks in each individual paper at the examination and also the project work/seminar, where ever prescribed, he/she shall be deemed to have failed at the examination, not withstanding his/her having obtained the minimum percentage of marks required in the aggregate for the examination.

iii. Division shall be awarded only at the end of the examination of the final semester on the combined marks obtained in all semesters, taken together, as noted below:

a. First Division : on >60% marks and

b. Second Division : on >48% marks

iv. Due Paper: if a candidate passes only in 2 papers in Semester I or III or in 3 papers in Semester II or IV, he/she will be allowed to appear in the due paper only with the students appearing in the same paper next year.

v. Division after Due Paper: If a candidateclears any paper(s), prescribed for a semester's examination after a continuous period of three years, then for the purpose of working out his/her division the minimum passing marks only viz. 25% (365 in case of practicals) shall be taken into account in respect of such paper(s)/practical(s) cleared after expiry of the afore said period of three years; provided that in case where a candidate requires more than 25% marks in order to reach the minimum aggregate asmany marks out of those actually secured by him/her will be taken into account as would enable him/her to make up the deficiency in the requisite minimum aggregate.

Note: Non collegiate candidates are not eligible to appear in the examination, where practical is involved.

COURSE DETAILS: FIRST SEMESTER

PAPER - I: CELL AND MOLECULAR BIOLOGY

UNIT I

Cell organelles: Ultra structure and functions of Mitochondria, Plastid, Golg body, Vacuole,Introsome, Microbodies and Ribosome.

Techniques in cell biology: Immuno-techniques; in situ hybridization to locate transcripts in cell types; FISH, GISH; confocal microscopy.

UNIT II

Chromatin Organization: Chromosome structure and packaging of DNA,molecula organization of centromere and telomere; nucleolus and ribosomal RNA genes; eu chromatin and heterochromatin; karyotype analysis; banding patterns; karyotyp evolution; specialized types of chromosomes; polytene, lampbrush, B-chromosome and sex chromosomes; molecular basis of chromosome pairing.

UNIT III

Structural and numerical alterations in chromosomes: Origin, meiosis and breedin behavior of duplication, deficiency, inversion and translocation; structural heterozy gotes; complex translocation heterozygotes; translocation tester sets; Robertsonia translocations; B-A translocations.

Mutation: Spontaneous and induced mutation; physical and chemical mutagens molecular basis of gene mutations; transposable elements in prokaryotes and eu karyotes; mutations induced by transposons; site-directed mutagenesis; DNA dam age and repair mechanisms; inherited human diseases and defects in DNA repair initiation of cancer at cellular level; protooncogenes and oncogenes.

Suggested Laboratory Exercises

1. Isolation and purification of nuclei and their staining with Feulgen stain o DAPI.
2. Isolation of mitochondria and their visualization with Janus green B an mitotracker.
3. Isolation of chloroplasts and determination of number of chlorophyll mol ecules per chloroplast.
4. To study the effect of inhibitors and uncouplers on the activity of succini dehydrogenase, a marker enzyme of mitochondria.
5. In situ visualization of microfilaments and microtubules by fluorescent la beling.
6. Isolation of plant DNA and its quantization by a spectrophotometri method.
7. Isolation of DNA and preparation of cot curve.
8. Restriction digestion of plant DNA, its separation by agarose gel electro

phoresis and visualization by ethidium bromide staining.

9. Isolation of RNA and quantization by a spectrophotometric method.
10. Separation of plant RNA by agarose gel electrophoresis and visualization by EtBr staining.

Suggested Readings:

Lewin, B. 2000. Genes VII. Oxford University Press. New York.

Alberts, B., Bray D., Lewis. J., Raff, M., Roberts, K., and Watson, J.D. 1999.Molecular Biology of the Cell. Garland Publishing, Inc., New York.

Wolfe, S.L.1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California,USA.

Rost 1 et al. 1998. Plant Biology; Wadsworth Publishing Co., California, USA

Krishnamurthy, K.V. 2000. Methods in cell wall Cytochemistry. CRC Press,Boca Raton, florida.

PAPER - II: MICROBIOLOGY AND MYCOLOGY

UNIT I

Archaebacteria and eubacteria: General account; ultra-structure, nutrition and reproduction; biology and economic importance; cyanobacteria-salient features and biological importance.

Viruses: Characteristics and ultra-structure of virions; isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.

Phytoplasma: General characteristics and role in causing plant diseases.

UNIT II

General characters of fungi; substrate relationship in fungi; cell ultra-structure; unicellular and multicellular organization; cell wall composition, nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; parasexuality; recent trends in classification.

UNIT III

Phylogeny of fungi; general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina; Deuteromycotina Fungi in industry, medicine and as food; Fungal diseases in plants and humans; Mycorrhizae; fungi as biocontrol agents.

Suggested Laboratory Exercises

Morphological study of representative members of fungi and bacteria.

Albugo, mucor, Pilobolus, yeast, Chaetomium, Pleospora, Morchella, Polyporus, Drechslera, Phoma, Penicillium, Aspergillus,

Symptomology of some diseased specimens: White rust, downy mildew, pow-

dery mildew rusts. smuts, ergot groundnut leaf spot, red rot of sugarcane, wilts, citrus canker, angular leaf spot of cotton, tobacco mosaic. Little leaf of brinjal, seasame phyllody mango malformation.

Gram's staining of bacteria. Identification of fungal cultures: Rhizopus, Aspergillus, Chaetomium, Drechslera, Curvularia, Fusarium, Phoma, Coletotrichum

Sterilization methods, preparation of media and stains.

Suggested Readings

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

Clifton, A.1958. Introduction to the Bacteria. McGraw-Hill Book Co., New York

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 Intermediate Press.

Rangaswamy, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India (4(edition). Prentice Hall of India Pvt. Ltd., New Delhi.

Webster. J. 1985. Introduction to Fungi. Cambridge University press.

PAPER - III: ALGAE, BRYOPHYTES AND PTERIDOPHYTES

UNIT I

Phycology: Algae in diversified habitats (terrestrial, freshwater, marine);thallus organization; cell, ultra-structure; reproduction (vegetative, asexual, sexual); criteria for classification of algae: pigments, reserve food, flagella; classification salient features of protochlorophyta, Cholrophyta, Charophyta,Xanthophyta Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms, algal biofertilizers; algae as food, feed and uses in industry.

UNIT II

Bryophyta: Morphology, structure, reproduction and life history; distribution; classification; general account of Marchantiales; Jungermaniales, Anthocerotales Sphagnales, Funariales and Polytrichales; economic and ecological importance.

Unit III

Pteridophyta: Morphology, anatomy and reproduction; classification; evolution of stele; heterospory and origin of seed habit; general account of fossil pteriodophytes; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Suggested Laboratory Exercises

Study of thallus structures of different groups of algae through preparation of whole mounts and sections.

Study of morphology and anatomy of thalloid and leafy forms of Bryophytes; Study of Protonema

Study of fern gametophyte and soral variations

Morphological study of representative members of algae, bryophytes and pteridophytes:

Suggested Readings

Kumar,H.D. 1988. Introductory phyocogy. Affiliated East-West Press Ltd.,New Delhi.

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. Central Book Depot, Allahabad.

Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi.

Round, F.E. 1986. The biology of Algae. Cambridge University Press, Cam-bridge.

Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd., Bombay.

Stewart, W N. and Rathwe11, GW 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.

PAPER - IV: PLANT PHYSIOLOGY

UNIT I

Membrane transport and translocation of water and solutes: Plant water relations mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins.

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanisms, e.g. two-component sensor-regulator system in bacteria and plants, sugar-sensing mechanism.

UNIT II

Photochemistry and photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photo-oxidation of water, mechanisms of electron and proton transport, carbon assimilation-the Calvin cycle, photorespiration and is significance, the C4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.

Respiration: Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alterna-

tive oxidase system.

UNIT III

Sensory photobiology: History of discovery of phytochromes and cryptochromes, and their photochemical and biochemical properties, photo-physiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Stress physiology: Plant responses to biotic and abiotic stress, mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress,oxidative stress.

Suggested laboratory exercises:

1. Extraction of chloroplast from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.
2. To determine the chlorophyll a/chlorophyll b ratio in C3 and C4 plants.
3. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.
4. Qualitative and quantitative analysis of photosynthetic pigments and anthocyanins by spectrophotometric and chromatographic techniques

Suggested Readings:

Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.

Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition) Wadswoth Publishing Co., California, USA.

Singhal, GS., Renger, G, Sopory, S.K., Irrgang, K.D. and Govindjee 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa publishing house, New Delhi.

Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates,Inc., Publishers, Maddachusetts, USA.

Thomas, B. and vince-Prue, D. (1997) Photoperiodism in Plants (second edition). Academic press, San Diego, USA.

COURSE DETAILS: SECOND SEMESTER

PAPER -V: GENETICS AND CYTOGENETICS

UNIT I

Genetics of prokaryotes and eukaryotic organelles: Mapping the bacteriophage genome; phage phenotypes; genetic recombination 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 eukaryot).

Genetic recombination and genetic mapping: Recombination; independ ent assortment and crossing over; molecular mechanism of recombination; role of RecA and RecBCD enzymes; site-specific recombination; chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps; somatic cell genetics; an alternative approach to gene mapping.

UNIT II

Origin, occurrence, production and meiosis of haploids, aneuploids and euploids; Effect of aneuploidy on phenotype in plants; origin and production of autopolyploids; chromosome and chromatid segregation; allopolyploids, type, genome constitution and analysis; evolution of major crop plants; induction and characterization of trisomics and monosomics; transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploid species;.

UNIT III

Molecular cytogenetics: Nuclear DNA content; C-value paradox; cot-curve and its significance; restriction mapping — concept and techniques; multigene families and their evolution; in situ hybridization — concept and techniques; physical mapping of genes on chromosomes; computer assisted chromosome analysis; chromosome micro-dissection and microcloning; flowcytometry and confocal microscopy in karyotype analysis.

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

Suggested Laboratory Exercises

1. Linear differentiation of chromosomes through banding techniques, such as 0-banding and Q-banding.
2. Orcein and Feulgen staining of the salivary gland chromosomes of Chironomas and Drosophila.
3. Characteristics and behavior of B chromosomes using maize or any other appropriate material.
4. Construction of a linkage map using available data.
5. Induction of polyploidy using colchicine; different methods of the application of colchicine.

6. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
7. Effect of translocation heterozygosity on plant phenotype, chromosome pairing and chromosome disjunction. Pollen and seed fertility.
8. Meiosis of complex translocation heterozygotes.
9. Isolation of chlorophyll mutants following irradiation and treatment with chemical mutagens.
10. Estimation of nuclear DNA content through microdensitometry and flow cytometry.

Suggested Readings:

Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants: American Society of Plant Physiologists, Maryland, USA.

De, D.N. 2000. Plant Cell Vacuoles: An Introduction. CSIRO Publication,Collingwood, Australia. Kleinsmith, L.J. and Kish, V.M. 1995. Principles o f Cell and Molecular:Biology(2" edition). Harper Collins College Publishers, New York, USA.

Lodish, H., Berk, A., Zipursky, S.1., Matsudaira, P., Baltimore, D. and Darnell. J. Molecular Cell Biology (4th edition) W.H. Freeman and Co., New York, USA.

See the following Review JournalsAnnual Review of Plant Physiology and Molecular Biology.Current Advances in Plant Sciences.Trends in Plant Sciences.Nature Reviews: Molecularand Cell Biology

PAPER VI: GYMNOSPERMS AND PALEOBOTANY

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.

UNIT II

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, Welwistschiales.

UNIT III

Paleobotany: History of paleobotany, Formation and types of fossils, Techniques of study of fossils, Geological time-scale.

Paleobotany and evolution of vascular plants. Applied aspects of paleobotany used in coal and petroleum exploration.

Suggested Laboratory Exercises

1. Comparative study of the anatomy of vegetative and reproductive parts of Cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria, Cryptomeria, Taxodium, Podocarpus, Agathis, Taxus, Ephedra and Gnetum.
2. Study of vascular elements in gymnosperms by maceration.
3. Study of important gymnosperms from prepared slides and specimens.

Suggested Readings:

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

Singh, H. 1978. Embryology of Gymnosperms. Encyclopedia of Plant Anatomy X. Gerbruder Bortraeger, Berlin.

PAPER VII: TAXONOMY OF ANGIOSPERMS

Unit I

Origin of intra population variation: Population and the environment: Ecads and ecotypes; evolution and differentiation of species-various models.

The species concept: Taxonomic hierarchy, Species, Genus, Family and other categories: principles used in assessing relationship, delimitation of taxa and attribution of rank.

Salient features of the international code of botanical nomenclature.

Unit II

Taxonomic evidence: Morphology anatomy palynology, embryology cytology: phytochemistry; genome analysis and nucleic acid hybridization.

Taxonomic Tools: Herbarium; floras; histological, cytological, phytochemical, serological, biochemical and molecular techniques; computers and GIS.

Unit III

Systems of angiosperm classification: Phenetic versus phylogenetic systems: cladistics in taxonomy; relative merits and demerits of major systems of classification; relevance of taxonomy to conservation, sustainable utilization of bio-resources and ecosystem research.

Suggested laboratory exercises:

1. Description of a specimen from representative, locally available families.
2. Description of a species based on various specimens to study intraspecific variation: a collective exercise.
3. Description of various species of a genus; location of key characters and preparation of keys at generic level.
4. Location of key characters and use of keys at family level.
5. Field trips within and around the campus; compilation of field notes and

preparations of herbarium sheets of such plants, wild or cultivated, as are abundant.

6. Training in using floras and herbaria for identification of specimens described in the class.
7. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
8. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

Suggested Readings:

Cole, AJ 1969 . Numerical Taxonomy. Academic Press , London

Davis, P.H and Heywood. VH 1973. Principles of Angiosperms Taxonomy Robert E. Kreiger Pub. Co. NewYork

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

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

Harrison, H.J 1971 New Concepts of Flowering Plant Taxonomy. Hieman Educational Books Ltd., London

Heslop — Harrision J. 1969 Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd. UK

Heywood, VH and Moore, D. M. 1984. Current Concept in Plant Taxonomy. Academic Press, London

Jones, A.D and Willbins. A.D.1971 Variations and Adaptations in Plant &#pecies.Hieman & Co. Educational Books Ltd.. London.

Jones.S.B Jr, and Luchsinger. A.F 1986. Plant Systematics (II 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

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

Solbrig, O.T. and Solbrig, D.J.-1079. Population Biology and Evolution. Addison-Wesley Publication Co. Inc., USA

Stebbins, G.L. 1974. Flowering Plant-EvolutionAbove species Level. Edward Arnold Ltd., London.

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

PAPER VIII: PLANT BIOCHEMISTRY AND GROWTH PHYSIOLOGY

Unit I

Energy flow: Principles of thermodynamics, free energy and chemicalpotential, redox reactions, structure and functions of ATP.

Fundamentals of enzymology: General aspects, allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menten equation and its significance.

Unit II

Lipid metabolism : Structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism.

Nitrogen fixation & Nitrogen metabolism : Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation,

Sulphur metabolism: sulfate uptake, transport and assimilation.

Unit III

Plant growth regulators and elicitors: Discovery, structure, bioassay, physiological effect on plants and mode of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid. Physiological effects of various synthetic growth retardants. Role of various growth regulators in agriculture and horticulture.

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development-genetic and molecular analysis role of vernalization.

Suggested Laboratory Exercises

1. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase, nitrate reductase).
2. Effect of substrate concentration on activity of any enzyme and determination of its Km value.
3. Demonstration of the substrate on activity of any enzyme nitrate reductase.
4. Extraction of seed proteins depending upon the solubility.

5. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry or bradford's method.
6. 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.
7. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoresis
8. Principles of colorimetry, spectrophotometry and fluorimetry
9. Bioassay for various plant growth regulators.
10. Preparation of standard curve of auxin.

Suggested Readings:

Dennis, D.T., Turpin, D.H. Lefebvre, D.D. and Layzell, D.B. (eds) 1997. Plant Metabolism (second edition). Longman, Essex England.

Salston, A.W. 1989. Life Processes in Plants. Scientific American Library,Springer-Verlag, New York, USA.

Hooykaas, P.J.J. Hall, M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, The Netherlands.

Hopkings, W.G 1995. Introduction to Plant Physiology, John Wiley & Sons,Inc., New York, USA.

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.

Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.

Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (secondedition). Academic Press, San Diego, USA.

Westhoff, P. (1998) Molecular Plant Development. Oxford University press, Oxford, UK.

COURSE DETAILS: THIRD SEMESTER

PAPER IX: PLANT DEVELOPMENT

UNIT I

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

Seed germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves; tropisms; 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; control of tissue differentiation, especially xylem and phloem; secretory ducts and laticifers; wood development in relation to environmental factors.

UNIT II

Leaf growth and differentiation: Determination; Phyllotaxy; differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

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

UNIT III

Seed development and fruit growth: Endosperm development during early, maturation and desiccation stages; embryogenesis, ultrastructure and nuclear cytology; 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.

Suggested laboratory exercises:

1. Study of apical meristems with the help of dissections (using aquatic plants such as Ceratophyllum and Hydrilla), whole mount preparations, sections and permanent slides.
2. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such of Coleus, Kalanchoe, tobacco. Examination of shoot apices in a monocots in both T.S. and L.S. to show the origin and arrangement of leaf premordia.
3. Study of alternate and distichus, alternate and superimposed, opposite and decussate leaf arrangement. Examination of rosette plants (Launeas,Mollugo, Raphanus, Hyoscyamus etc) and induction of bolting under natural conditions as well as by GA treatment.
4. Origin and development of epidermal structures (trichomes, glands and lenticels).
5. Study the C3 and C4 leaf anatomy of plants.
6. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
7. Study of secretory structures (nectaries and laticifers).
8. Study of secondary growth (normal and unusual) of selected woods
9. Study of whole roots in monocots and dicots. Examination of L.S. ofroot from a permanent preparation to understand the organization of root apical meristem and its derivatives. (use maize, aerial roots of banyan,Pistia, Jussie etc.) Origin of lateral roots. Study of leguminous roots with different types of nodules.
10. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedlings.
11. Demonstration of the effect of ABA on stomata closure.

Suggested Readings:

Atwell, B.J. Kriedermann, P.E. and Jrunbull, C.G.N. (eds) 1999. Plant in Action: Adaptation in Nature, performance in Cultivation. MacMillan Education,Sydney. Australia.

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

Burgess. J. 1985. An Introduction to Plant Cell Development. Cambridge Univer-

sity Press. Cambridge.
Fageri, K. and Van der Piji, L. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford,
Fahn, A. 1982. Plant Growth and Development. A Molecular Approach Academic press, San Diego.
Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University. Press, Cambridge.
Leins, P., Tucker, S.C. and Endress, P.K. 1988. Aspects of Floral Development J. Cramer, Germany.
Lyndon, R.F. 1990. Plant Development. The Cellular Basis. Unnin Hyman. London.
Murphy, T.M. and Thompson, W F. 1988. Molecular Plant Development Prentice Hall, New Jersey.
Proctor, M. And Yea, P. 1973. The Pollination of Flowers. William Collins Sons, London.
Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-verlag, New York.
Raven, P. H., Evert, R.F. and Eichhorn, S.E. 1992. Biology of Plants (5th edition) worth, New York.
Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing, Belmont, California.
Steeves, T.I. and Sussex, I.M. 1998. Patterns in Plant Development (2nd edi-tion). Cambridge University press, Cambridge.

PAPER X: ENVIRONMENTAL BIOLOGY

Unit I

Climate, soil and vegetation patterns of the world: life zones; major biomes, major vegetation and soil types of the world.

Vegetation organization: Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; inter-specific associations; ordination; concept of ecological niche.

Unit-II

Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic compo7sition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession. Climate change: Greenhouse gases (CO_2, CH_4. N_2O, CFCs: sources, trends and role): ozone layer and ozone hole; consequences of climate change (CO, fertilization, global warming, sea level rise, UV radiation)

UNIT III

Ecosystem organization: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies): litter-fall and decomposition (mechanism, substrate quality and climatic factors);global biogeochemical cycles of C, N, P and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

Suggested Laboratory Exercises:

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use t-test for comparing two means related to ecological data.
2. To prepare ombrothermic diagram for different sides on the basis of given data set and to comment on climate.
3. To find out the relationship between two ecological variables using correlation and regression analysis.
4. To determine minimum size and number of quadrates required for reli-able estimate of biomass in grasslands.
5. To find out association between important grassland species using Chi-square test.
6. To compare protected and unprotected grassland stands using community coefficients (similarity indices).
7. To analyze plant communities
8. To determine diversity indices (Shannon-Wiener, concentration of dominance, species richness, equitability and B-diversity) for protected and unprotected grassland stands,
9. To estimate IVI of the species in a woodland using point centered quarter method.
10. To determine gross and net phytoplankton productivity by light and dark bottle method.
11. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
12. To determine the water holding capacity of soils collected from different locations.
13. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
14. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Winkler's method.
15. To estimate Chlorophyll content in SO_2 fumigated plant leaves.
16. To estimate rate carbon dioxide evolution from different soils using soda lime of alkali absorption method.

Suggested Readings:

Smith, R.L 1996. Ecology and Field Biology. Harper Collins, New York.
Muller-Domboi s, D. and Ellenberg, H. 1974. Aims and Methods of Vegetation Ecology; Wily, New York.
Begon, M., Harper, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science, Cambridge, U.S.A.
Ludwig, J. and Reynolds, J.F. 1988. Statistical Ecology. John Wily & Sons.
Odum, E.P. 1971. Fundamental of Ecology. Saunders, Philadelphia.

PAPER XI: PLANT BIOTECHNOLOGY

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 protoplast 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.

Unit III

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

Suggested Laboratory Exercises

1. Growth characteristics of E. coli using plating and turbidimetric methods.
2. Isolation of plasmid form E. coli by alkaline lysis method and its quantization spectrophotometrically.
3. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
4. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
5. Demonstration of DNA sequencing by Sanger's dideoxy method.

Suggested Readings:

Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice (a revised edition) Elsevier Science Publishers, New York, USA.

Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA

Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. 1997. Biotechnology and Plant Genetic Resources: Conservation and use. CAB International, Oxon, UK.

Chrispeels, M.J. and Sadava, D.E. 1994. Plants, and agriculture Jones & BartlettPublishers, Boston, USA.

Collins, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.

ELECTIVE PAPERS

PAPER XII (A): ADVANCED PLANT PATHOLOGY: PRINCIPLES AND TECHNIQUES

UNIT I

Principles and Techniques: Phenomenon of plant infection penetration post infection development, factors affecting infection defence mechanisms. Inoculum potential, epiphytotics and disease forecasting physicial control, chemical control, plant quarantines

UNIT II

Techniques of isolation, purification, culture and inoculation of pathogens, Histopathology, microscopes and measurements, photographs and illustrations (camera lucida drawings)

UNIT III

Symptomatology of fungi, bacteria and virus.

Disease identification of fungal diseases; Methods of identification of bacterial pathogens; Methods used in Nematology; Transmission of viral diseases.

Mechanism and physiology of insect galls.

Suggested Laboratory Exercises

1. Culture transfer technique
2. Techniques for isolation of pure culture
3. Isolation of discrete colonies from a mixed culture.
4. Isolation of pure culture from a spread plate or streak plate preparation.
5. Culture characteristics of micro organisms.
6. Grams staining.
7. To draw camera lucida drawings of fungal spores.

Suggested Readings:

1. Alexopoulos, C.J. 1980. Introductory Mycology. Wiley Eastern ltd., New Delhi, Bangalore, Bombay. Kolkata.
2. Alexpoulos, C.J. C.W. Mims and M.Blackwell 1996 Introductory Mycology4th Edition wilery, New York.
3. Agrios. N.George 2004 Plant pathology Academic press. Elsevier, DW ofRead Elsevier Rvt. Ltd. New Delhi.
4. Bilgrami, KS. And H.C. Duke 1997 A text Book of Modern plant pathology.Vikas Perb House. New Delhi.
5. Chatopadhyay. S.B. and N.Samajpati 1982 Advances in Mycology and plant pathology Oxford & IBH Perb Co. New Delhi.
6. Hatton, C. S.1967 O. W/ Fisher: R.W. Fulton. Helen Hart: S.E. A. Macclan19 Plant pathology problems & programmes Central Book Depot.Allahabad.
7. Harry, NV; Scclav, la Paul and Vodemark. 1975. Microbes in Action-A labmanual of Microbiology.
8. James, C. Cappucino. and N.Sharma 1999. Microbiology- A lab Manual.

9. Kaushik, P 1996 Introductory Microbiology Emkay Pub. New Delhi.
10. Mehrotra, R.S. 1987 Plant pathology. Tata Macgrawthll Pub. Co.Ltd.
11. Nagarajan, 5.1983. Plant disease epidemiology to IBH perb.co. N. Delhi. Bombay. Kolkata.
12. Purohit S. S. 2002 Microbiology- Fundamentals & applications Agrobios (India) Pub. Jodhpur.

PAPER XII (B):: ADVANCED PLANT PHYSIOLOGY: SECONDARY METABOLITES

UNIT I

Biosynthetic Metabolism : Primary and Secondary Metabolism; Shikimate Pathway; Synthesis of IPP; Biogenesis of Chlorophyll.

UNIT II

Secondary metabolites: Structure, Classification, biosynthesis and functions of terpenoids and alkaloids

UNIT III

Phenyl propanoid and phenyl propanoid acetate pathway metabolites and their biosynthesis.

Lignans and lignins: Structure, Biosynthetic pathway and functions of lignans and lignins; flavonoids and coumarins

Suggested Laboratory Exercises

(1) Separation of Photosynthetic pigments using paper and column chromatography
(2) Estimation of chlorophyll by DMSO Method
(3) Calculation of iodine Number
(4) Calculation of Acid value
(5) Calculation of saponification value
(6) Estimation of Total carotene
(7) Estimation of xanthophylls & Carotene
(8) Estimation of Anthocyanin pigment
(9) Separation of Anthocyanin pigment by paper and thin layer chromatography
(10) Estimation of Total Nitrogen by kjeldahl Method.
(11) Separation of different Phenolic Compounds.
(12) Separation of Terpenoids
(13) Separation of Nitrogenous compounds.

Suggested Readings:

Buchanan, B.B., Grisussem, W and Jones R.L. 2000 Biochemistry and molecular Biology of plants, American society of plant physiologist, Maryland, U.S.A.
Dey. P. M. and Harbome 1997 Plant Biochemistry
Goodwlin, T.W. and E.I. Mercer 1990 Introduction to plant physiology
Heimann, E. 1970 Stereo Biochemistry, Academic Press, New York
Hess, Dieter, 1981, Plant Physiology. Narosa Publishing House, New Delhi

Hooykass P.J.J., Hall, M.A. and libbenga, K.R. (eds.) 1999 Bubo chemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam. The Netherland
Lea, P.J. and Leegood, R. C. 1999 plant Biochemistry and Molecular Biology. 2nd Edition John Wiley and Sons, Chichester, England

PAPER XII (C) ADVANCED PLANT ECOLOGY: ENVIRONMENT AND ARID ZONE ECOLOGY

UNIT I

Environment- Holistic concept- Impact of man on environment and eco-system. Pollution and conservation, forests, agriculture, grazing lands, soil and water pollution. Urban and rural ecosystem. Role of international organizations - IUCN, UNEP, UNESCO. Equilibrium and non-equilibrium Thermodynamics. Living organisms as dissipative structures.

UNIT II

Deserts- their formation, topography, distribution, characteristics, water economy, hot and cold deserts. Rajasthan desert Geology, physiography, climate, soil, vegetables, saline tracts and vegetation. Plant communities in thedeserts of Rajasthan. Soil erosion and reclamation. Desert stabilization techniques. Adaptations of plants to arid conditions. Edaphic and Biotic factors.The vegetation is arid zones. Reproductive capacity of deserts plants, seed out put, germination, dormancy, mechanism of seed dormancy viability and perennation. Desert as an ecosystem.

UNIT III

Waste treatment and Management technology- Production of microbialseed. Use of bio-augmentation in waste treatment use of enzymes in waste treatment, BOD sensor. Wastewater treatment and disposal Root Zone technology

Suggested Laboratory Exercises

Physicochemical Analysis of soil or water:

Water Analysis Chemical Oxygen Demand (COD);Biological Oxygen Demand (COD);pH ;Total hardness; Chloride by titration; Phosphate by spectrophotometer; Total residual Chlorine Conductivity using conductivity Meter; Alkalinity (Carbonate and Bicarbonate)

Soil Analysis:pH of soil using pH meter; Soil composition/soil texture; Soil Moisture content; Percentage organic carbon of soil; Sodium/ potassium by flame photometer

- Calcium, Magnesium by titration method

Suggested Readings:

1. Odum, E.P. 1975. Ecology. Oxford & 2BH, Pub. New Delhi, Kolkata, Mumbai.
2. Pandey, S.C. G.S. Furl and J. Singh 1967. Research methods in plant Ecology Asia, Pub. House New Delhi.
3. Sen, Daved. N. 1978:concepts in Indian Ecology. S. Nager & Co. New Delhi.
4. Soil survey Maniacal 1969. by soil survey staff. Beiran of plant, soil and

Agriculture Engraining. Oxford & IBH Pub. Co. New Delhi.
5. Sharma P.D. 2000. Ecology & Environment Rastogi Pub. Meerut.
6. Sir, D.N. 1990. Environ & Plant life in India desert Geobios International, Jodhpur.
7. Shukla, R.S. and P.S. Chandel, 1994. plant Ecology S. Chand & Co. New Delhi.
8. Sen, D.N. 1978. Ecology & Vegetation of India Desert.
9. Svizreher, V.M. and D.D. Logofet 1978. Stability of Biological Communities Mir Pub. Moscow.

COURSE DETAILS: FOURTH SEMESTER

PAPER XIII: PLANT REPRODUCTION

Unit-I

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

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

Unit II

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; breeding systems; commercial considerations; structure of the pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects); double fertilization; in vitro fertilization.

Unit-III

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 Laboratory Exercises

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollengrains for microscopic examination (maize, grasses, Cannabis sativa,Crotolaria, Tradescantia, Brassica, petunia, Solanum melongena, etc.).
3. Study of the stages of pollen and ovule development in the wild and mutant plants using permanent slides, electron micrograph and available phenotypes.

4. Pollen in vitro germination methods: Sitting drop culture, suspension culture, surface culture.
5. Estimating percentage and average pollen tube length in vitro.
6. Effect of transcription and translation inhibitors on pollen germination and pollen tube growth.
7. Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (in vitro) of pollen grains.
8. Assessment of stigma receptivity by localizing peroxidases, non-specific esterases and phosphatases.
9. Aniline blue fluorescence method to localize pollen tubes to study different aspects of pollen-pistil interaction.
10. Use of DNA fluorochromes to localize nuclei during pollen and ovule development.
11. Study of ovules in cleared preparation; study of monosporic, bisporic and tetrasporic types of embryo sac development thorough examination of permanent, stained serial sections study of several types of flower with different pollination mechanisms (wind pollination, thrips pollination, bee/butterfly pollination, bird pollination),
12. Emasculation, Bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate out crossing systems. Study of cleistogamous flowers and their adaptations.
13. Study of post-fertilization stage with the help of permanent slides and electron micrographs.
14. Dissection of embryo and endosperm.
15. Study of nuclear and cellular endosperm through dissections and staining.
16. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun(Syzygium cumini) etc. by dissections.
17. Study of seed dormancy and methods to break dormancy.

Suggested Readings:

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

Sedgely, M. And Griffin, A.R. 1989. Sexual Reproduction of tree Crops. Academic Press, London

Shivanna, K.R. and Sawhney. V.K. (eds) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University press, Cambridge.

Shivanna, K.R. and Rangaswamy, N.S. 192. Pollen Biology: A laboratory Manual. Springer-Verlag, Berlin.

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

The Plant Cell, Special Issue on Reproductive Biology of Plants, Vol. 5(10) 1993. TheAmerican Society of Plant Physiologists, Rockville, Maryland, USA.

PAPER XIV: PLANT RESOURCES: CONSERVATION AND UTILISATION.

UNIT I

Biological diversity: Concept and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction: IUCN categories of threat; distribution and global patterns; terrestrial biodiversity hot spots; inventory. Air, water and soil pollution: Kinds; sources; quality parameters; effects on plants and ecosystems.

UNIT II

Ecosystem stability: Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystem; ecology of plants invasion; environmental impact assessment; ecosystem restoration. Ecological management: Concept; sustainable development: sustainability indicator.

Unit III

Origin, evolution, botany, cultivation and uses of (i) Food,Forage andfodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants, and (iv) vegetable oil-yielding crops. 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 for 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 (I CAR). Council of Scientific & Industrial Research (CS IR) and the Department of Biotechnology (DBT), for conservation, non-formal conservation efforts.

Concept of Phytogeography: Endemism, hotspots and hottest hotspots; plant explorations invasions and introductions; local plant diversity and its socio-economic importance.

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, micro-chemical tests forstored food materials.
2. Forage/fodder crops: Study of any five important cropS of the locality(for example fodder Sorghum, berseem, clove, guar bean, gram, Ficussp.)

3. Plant fibers :(a) Textile fibers : cotton, jute, linen, sun hemp, Cannabis(b)Cordage fibers : coir(c) Fibers for stuffing : silk cotton or kapokMorphology, anatomy, microscopic study of whole fibers using appro-priate staining procedures.
4. Medicinal and aromatic plants: Depending on the geographical loca-tion college/university select five medicinal and aromatic plants eachfrom a garden crop field (or from the wild only if they are abundantly available).Papaver somniferum, Atropa belladonna, Catharanthus roseus, Adhatoda ceylanica. syn. A. vasica).Album sativum, Rauvolffia serpentina, Withania somnifera, Phyllanthus amarus, (P fraternus), Andrographis paniculata, Aloe barbadense, Mentha arvensis, Rosa sp., Pogostemon cablin, Origanum vulgare, Vetiveria zizanioides, Jasminum grandiflorum, Cymbopogon sp., Pandanus odoratissimus.
   Study of live or herbarium specimens or other visual materials to become familiar with these resources.
5. Vegetable oils: Mustard, groundnut, soybean, coconut, sunflower, castor. Morphology, microscopic structure of the oil-yielding tissues, tests foroil and iodine number.
6. Gums, resins, tannins, dyes: Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (Acacia, Terminalia, tea,ssia spp, myrobalans) and dyes (turmeric, Bixa orellana, indigo, Butea monosperma, Lawsonia inermis) and perform tests to understand theiremical nature.

Field Survey

7. Firewood and timber-yielding plants and 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.B. Prepare an inventory of the bamboos and rattans of your area giving their scientific and local names and their various uses with appropriateillustrations!

C. 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 identity the trees, mention their size, canopy shale, 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 nest batch of students/teachers/local communitiesi NGOor civic authorities. The purpose of exercise in item C above is ,making the students awareof the kinds of trees and value in urban ecosystems and ecological services Scientific Visits* The students should be taken to one of the following:

1. A protected area (biosphere reserve, national park, or a sanctuary)
2. A wet land
3. A mangrove /Desert region
4. National Bureau of Plant Genetic Resources, New Delhi-110012 or one of

its field stations.

5. Head Quarters of the Botanical Survey of India or one of its Regional Circles.
6. A CSIR Laboratory doing research on plants and their utilization
7. . An ICAR Research Institute or a field station dealing with one major crop or crops.
8. A recognized botanical garden or a museum (such as those at the Forest Research Institute, Dehra Dun; National Botanical Research Institute, Lucknow; Tropical Botanical Garden and Research Institute, Trivandrum),which has rich collection of plant products.

Suggested Readings:

Odum, E.P. 1983. Basic Ecology. Saunders, Philadalphai.
Barbour, M.G. Burk, J.H. and pins, W.D. 1987. Terrestrial Plant Ecology. Bejamini Cummings Publication Company, California.
Kormody, E.J. 1996. Concepts of Ecology. Prentice-Hall of India pvt, Ltd., New Delhi.
Chapman, J.L. and Reiss, M.J. 1988. Ecology: Principles and Applications. Cambridge University Press, Cambridge, U.K.
Moldan, B. and Billharz, S. 1997. Sustainability Indicators. John Wiley & Sons, New York.
Treshow M. 1985. Air pollution and Plant life. Wiley Interscience.
Mason, C.F. 1991. Biology of Freshwater Pollution. Longman.
Hill, M.K. 1997. Understanding Environmental Pollution. Cambridge University Press.
Brady, N.C. 1990. The Nature and Properties of Soils. MacMillan.
Heywood, V.H. and Watson. R.T. 1995. Global Biodiversity Assessment. Cambridge University Press.

XV: GENETIC ENGINEERING OF PLANTS AND MICROBES

Unit I

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 property rights, possible ecological risks and ethical concerns.

Unit-II

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

Unit III

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

Suggested Laboratory Exercises

1. Isolation of protoplasts from various plant tissues and testing there viability.

2. Effect of physical (e.g. temperature) and chemical (e.g. osmoticum) factors on protoplast yield.
3. Demonstration of protoplast fusion employing PEG
4. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seed.
5. Demonstration of androgenesis in Datura.
6. Electroporation of protoplasts and checking of transient expression of the reporter gene.
7. Co-cultivation of the plant material (e.g. leaf discs) with Agrobacterium and study GUS activity histochemically.

Suggested Readings:

Brown, T.A. 1999. Genomes. John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology. W.H. Freeman &Company, New York, USA.
Gustafson, J.P. 2000. Genomes, Kluwer Academic Plenum publishers, New York,USA.
Henry, R.J. 1997. Practical Applications of Plant Molecular Biology. Chapman& Hall, London, UK.
Jain, S.M., Sopory, S.K. and Veilleux, R.E. 1996.In Vitro Haploid production inHigher Plants, Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, the Netherlands.
Jolles, O. and Jornvall, H. (eds) 2000. Proteomics in Functional Genomics.Birkhauser Verlag, Basel, Switzerland.
Kartha, K.K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press,Boca Raton, Florida, USA. Old R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford, UK.
Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science Ltd.,Oxford, UK.
Raghavan V. 1986. Embryogenesis in Angiosperms: A Developmental andExpeimental Study. Cambridge University Press, New York, USA.
Raghavan V. 1997. Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
Sharitharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety, and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

ELECTIVE PAPERS

PAPER XVI (A): ADVANCED PLANT PATHOLOGY: PLANT DISEASES

UNIT I:

Fungal diseases: Some important diseases like kernel bunt and flag smut of wheat, brown spot and bunt of paddy, ergot, smut and green ear disease of bajra, Red rot of sugarcane; wilt of cotton; Early and late blight of potatoes; Tikka disease of groundnut and powdery mildew of grapes.

UNIT II:

Bacterial diseases: Study of diseases like Brown rot and ring rot of potatoes; Tundu diseases of wheat, soft rot of vegetable, red stripe of sugarcane. Crown gall disease and citrus canker.

Virology: Study of viral diseases: Bunchy top of banana, Bhindi yellow mosaic.

Unit-III

Nematode diseases: Ear cockle of wheat; root rot of vegetables and Molya disease of wheat.

Ceycidology: classification and anatomy of galls. Some insect induced plant galls of Rajasthan like Pongamia leaf gall. Cordia leaf gall. Zizyphus stem gall. Prosopis stem gall.

Suggested Laboratory Exercises

Study of various fungal diseases: flag smut of wheat, Green ear disease of bajra, red rot of sugarcane, wilt of cotton, Early and late blight of potatoes, Tikka disease of groundnut & downy and powdery mildew of grapes.

Study of various bacterial diseases: soft rot of vegetables, red stripeof sugarcane, crown gall disease and citrus canker.

Study of viral diseases: Cucumber mosaic, bunchy top of banana, Bhindi yellow mosaic.

Study of Nematode diseases: Ear cockle of wheat, root rot of vegetables and Molya disease of wheat.

Study of galls: Pongamia and Cordia leaf galls and Zizyphus and Prosopis stem galls.

Suggested Readings:

Ray chaudhari 1977 Virus & Mycoplasma diseases Oxford & IBH Perb Co, N. Delhi Bombay Kolkata.

Ramakrishnan, J.S. 1971 Diseases of Millets ICAR

Sasser, J.N. and W.R. Jenkras Ed. 1975 Nematology Euvasia pub Housing (P) Lid. New Delhi.

Singh, R.S. 1982 Plant pathogens (The fungi) Oxford & IBH Perb.Co. New Delhi, Bombay, Kolkata.

Singh, R.S. 1985 Diseases of Vegetable crops. Oxford & IBH Perb Co. N.Delhi , Bombay, Kolkata.

Southry, J.F. 1970 plant Nematology S. Chand & Co. N. Delhi.

XVI (B) ADVANCED PLANT PHYSIOLOGY: GROWTH PHYSIOLOGY

UNIT I

Concept of growth and development; Basic concept of growth analysis.

Physiology of Hormone Action:

Auxins: Biosynthesis, transportation, degradation and Inhibition;

Gibberellins: Biosynthesis and metabolism, translocation and antagonists.

UNIT II

Cytokinins: Biosynthesis and metabolism, translocation and synthetic cytokinins

Ethylene: Biosynthesis, movement and Regulatory actions

Growth Inhibitors: Chemical nature of inhibitors, Abscisic acid, Phenolic Inhibitors, other types of inhibitors

UNIT III

Hormone receptors, signal transduction and gene expression of Auxins, Gibberellins, Cytokinins, Abscissic acid and Ethylene.

Physiology of Senescence: Monocarpic plants; ageing of leaves in perennial plants.

Suggested Laboratory Exercises

1. Effect of IAA on the Elongation growth of Maize Coleoptile
2. Split pea stem Test for IAA
3. Effect of IAA on Root formation
4. Effect of IAA on Root inhibition
5. Effect of GA on Hypocotyl Elongation
6. Effect of GA on Retardation of Leaf Senescence
7. Bioassay of gibberellins by using lactuca seed germination
8. Effect of GA and Amylase induction in Cereal grain
9. Effect of cytokinin on chlorophyll Retention
10. Induction of seed dormancy by ABA and Reversal by GA& cytokinin
11. Prepare standard curve for auxin and phenol

Suggested Reading:

1. Moore, T.C. 1989 Biochemistry and physiology of plant Hormones, Spring verleg, New York,
2. Salisbury, F.B. and Ross, C.W. 1992 plant physiology, Wadsworth Publishing Co. Log.
3 Buchanan, B.B. Grisussem, W and Jones R.L. 2000 Biochemistry and molecular Biology of plants, American society of plant physiologist, Maryland, U.S.A.

PAPER XVI (C) ADVANCED PLANT ECOLOGY: ECOSYSTEM AND ECOSYSTEM ANALYSIS

UNIT I

Ecosystem- Concept, structure and function; Energetics, cybernetics,homeostasis. Flow of energy, cycling of materials, organic production in different types of ecosystems. Forest, grassland, fresh water and marine ecosystems. Natural and man-made ecosystems.

UNIT II

Renewable and Non Renewable Energy - Renewable and Non-renewableenergy sources. Fossil fuels-classification, composition, physico-chemical characteristics and energy content of cool, crude oil, natural gas, hydroelectric power nuclear Energy-fission and fusion. Radioactive waste Management.Energy conservation.

Biomass and bioenergy, biomass production, energy plantation, Energy and Microbes.

UNIT III

Ecosystem analysis: models of population growth and interactions mineral resources. Environmental impacts of exploitation of minerals and mining activities with reference to Rajasthan. Mineral and population. Aravallis mining lands types of mine reclamation practices. Re-vegetation of mine spoils through plant fertilization and related practice. Environmental monitoring, Environmental Auditing. Environmental health, education and ethics.

Suggested Laboratory Exercises

Study of soil microorganisms Biological monitoring

Macrophytes Phytoplankton/ zooplankton Diversity indices — Shanon Wienerl Simpson's index etc.- Measurement of pigments

Solid Water analysis:- Physical composition (by weight)- Moisture content- Total organic carbon Nitrogen, phosphorus and potassium (NPK).. Carbon, Nitrogen ratio (C: N ratio)- pH- Conductivity

Different Modes of graphical representation of data

Suggested Readings:

1. Ambasht, R.S. 1988. A text book of plant Ecology students, trends & Co. Varanase.
2. Beral, SW, FD. Hole &a ρ; E R J Mac Cracter. 1980. soil genesis and classification Oxford & IBH Pirb. Co. New Delhi, Kolkata.
3. Black, C.A. 1973. Soil plant Relationships Wiley Eastern P. Ltd., New Delhi.
4. Cloudsley, J.L. and Thompson 1974. Man & Biology of Arid Zones Ed-ward Arnold Pub. Ltd.,
5. Cloudsley, J.L. and Thompson, 1974. Micro-ecology. Edward Arnold Pub. Ltd.,
6. Chaudhari, Nag, B.D. 1983. Interdiction to Environ. Management. Interprint New Delhi.
7. Foth, H.D. & L.M. Turk, 1972. Fundamentals of sent science wrliy Eestem Pub. Ltd., New Delhi.
8. Kumar, H.D. 1995. Modern concepts of Ecology Vikas publishing House, New Delhi.
9. Kormondy, J. Edward. 1974. Concepts of Ecology Prentice Hall of India, New Delhi.
10. .Murthy, V.V.N. 1985. Land; Water Management Engineering Kalyan Publishers, New Delhi.

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