UNIVERSITY OF CALICUT

(Abstract)

Scheme and Syllabus of M.Sc Plant Science of affiliated colleges under Credit Semester System (CUCSS – PG 2010) implemented with effect from 2010 admission - orders issued.

GENERAL & ACADEMIC BRANCH-IV 'J' SECTION

No. GA IV/J1/3609/10 Dated, Calicut University PO, 16.08.2010

Read: 1. U.O.No.GAIV/J1/1373/08 dated 23.07.2010.
2.Item 2 and 3 of the meeting of the Board of Studies in Plant Science of 21.06.2010
3. Orders of the Vice-Chancellor, in the file of even No. dated 10.08.2010

O R D E R

As per reference cited (1) above Calicut University Credit Semester System at Post Graduate level in affiliated colleges (CUCSS-PG-2010) has been implemented from the academic year 2010 onwards.

The Board of Studies at its meeting, vide paper read as (2) above, resolved to restructure the existing M.Sc Plant Science Course as per the regulations of the Credit Semester System for PG curriculum for affiliated colleges with effect from 2010 admissions.

The Vice-Chancellor, in view of exigency, has approved the minutes of the meeting of the Board, subject to ratification by the Academic Council.

Sanction has therefore been accorded to implement the Scheme and Syllabus of M.Sc Plant Science programme of affiliated colleges under Credit Semester System with effect from 2010 admission.

Orders are issued accordingly. Scheme and Syllabus appended.

Sd/-
DEPUTY REGISTRAR(G&A IV)
For REGISTRAR

To

1. The Principals of all affiliated Colleges offering M.Sc Plant Science.
2. Self-financing centers of the University of Calicut offering M.Sc Plant Science.

Copy to:

PS to VC/PA to Registrar/CE/Digital wing (with a request to upload in the University website)/Enquiry/Information Centres/DR III(Exams)/EG-I/DR PG/Tabulation Section/GA I 'F' 'G' sections/GAII/GAIII/SF/FC

Forwarded/By Order

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SECTION OFFICER

M Sc PLANT SCIENCE

Course Structure, Credit and Hours distribution, and Scheme of Examination

(effective from 2010 admission onwards)

Semester No.	Course No.	Subjects Theory/Practical	Working Hours		Credits
			Per Sem	Per Week	
I	PS1C01	Phycology, Mycology, General Microbiology, Plant pathology	90	5	4
	PS1C02	Bryology, Pteridology, Gymnosperms,	90	5	4
	PS1C03	Research Methodology, Histochemistry & Microtechnique, Biophysics, Immunology	90	5	4
	PS1P01*	Phycology, Bryology, Mycology, General Microbiology, Plant pathology, Immunotechniques	90	5	4
	PS1P02*	Pteridology, Gymnosperms, Research Methodology, Histochemistry, Microtechnique, Biophysics	90	5	4
II	PS2C04	Angiosperm Anatomy, Plant Ecology, Embryology	90	5	4
	PS2C05	Plant Physiology, Biochemistry	90	5	4
	PS2C06	Biotechnology, Bioinformatics	90	5	4
	PS2P03	Anatomy, Embryology, Biotechnology, Bioinformatics	90	5	4
	PS2P04	Plant Physiology, Biochemistry, Plant Ecology	90	5	4
III	PS3C07	Angiosperm Morphology, Angiosperm Taxonomy, and Phytogeography	90	5	4
	PS3C08	Plant Breeding, Horticulture, biostatistics,	90	5	4
	PS3C09	Cell &Molecular Biology, Genetics, Evolution	90	5	4
	PS3P05**	Angiosperm Morphology, Angiosperm Taxonomy, Phytogeography Plant Breeding	90	5	4
	PS3P06**	Horticulture, Biostatistics, , Cell &Molecular Biology, Genetics	90	5	4
IV	PS4E01	Elective Course 1	90	5	4
	PS4E02	Elective Course 2	90	5	4
	PS4E03	Elective Course 3	90	5	4
	PS4Pr	Project/Dissertation	90	10	4
	PS4V	General/Course Viva Voce	-	-	4

* External Examinations at the end of 2nd semester; ** External Examinations at the end of 4th semester.
(Internal 25%; External 75%; Duration of External Examinations: 3 hours. Total credits for the course:80)

Practicals

Practicals courses will be conducted and internal marks awarded during the corresponding semester itself. External examinations for practical courses relating to the first and second semesters will be held at the end of the second semester and those relating to the third and fourth semesters will be held at the end of the fourth semester.

Electives

In the 4th Semester, the students can select from the following elective courses:

1. For Elective Course 1 (PS3E01) one of the following two courses:

Agrobiotechnology ***or*** Environmental Biotechnology

2. For Elective Course 2 (PS3E02) one of the following two courses:

Plant Tissue Culture ***or*** Ecophysiology of Plants.

3. For Elective Course 3 (PS3E03) one of the following two courses:

Principles & Applications of Ethnnbotany ***or*** Principles & practice of Horticulture & Garden Management.

Project

In the fourth semester, each student has to undertake a research project and to submit a dissertation. Topic of dissertation may be chosen from any area of botany and may be laboratory-based, field-based or both or computational, with emphasis on originality or approach. It may be started during 2nd / 3rd semester and shall be completed by the end of the 4th semester.

Viva Voce

At the end of the 4th semester, each student has to attend a comprehensive viva voce which will be based on all the courses taken in the MSc programme.

Record of Practical Work

A certified record of practical work done by the student should be submitted at the time of each practical examination.

Evaluation (Internal & External) and Grading

Calicut University Regulations for Credit Semester System for PG curriculum (2010)for affiliated colleges(CUCSS-PG) is to be followed for internal and external evaluation and grading.

Question Papers for External Examinations

1. For Theory Papers:

There shall be 14 short-answer questions (no choice, weightage = 1)), 10 paragraph-type questions (7 to be answered, weightage = 2) and 4 essay type questions (2 to be answered, weightage = 4).

2. For Practical Papers:

The Board of Examiners shall decide the pattern of question paper.

SYLLABUS

Module-wise break-up of instructional hours for each course

Semester I		**Theory** (Hours / Week)
PS1C01	Phycology	1½
	Mycology	1½
	Plant Pathology	1
	General Microbiology	1
PS1C02	Bryology	1 ½
	Pteridology	2
	Gymnosperms	1½
PS1C03	Research Methodology	1
	Histochemistry & Microtechnique	2
	Biophysics	1
	Immunotechniques	1
Semester II		
PS2C04	Angiosperm Anatomy	2
	Embryology	1
	Plant Ecology	1½
PS2C05	Plant Physiology	3
	Plant biochemistry	2
PS2C06	Biotechnology	3
	Bioinformatics	2
Semester III		
PS3C07	Angiosperm Morphology	1
	Angiosperm Taxonomy	3
	Phytogeography	1
PS3C08	Plant Breeding	2
	Horticulture	1½
	Biostatistics	1½
PS3C09	Genetics	1½
	Cell and Molecular Biology	2½
	Evolution	1

Semester IV

PS4E01	5
PS4E02	5
PS4E03	5

Semester I		**Practical** (Hours / Week)
PS1P01	Phycology	1
	Mycology	1
	Plant Pathology	1
	Microbiology	1
	Bryology	1
PS1C02	Pteridology	1
	Gymnosperms	1
	Histochemistry& Microtechnique	2
	Biophysics	½
	Immunotechnique	½

Semester II

PS2P03	Anatomy	1
	Embryology	1
	Biotechnology	2
	Bioinformatics	1
PS2P04	Plant Physiology	2
	Plant biochemistry	2
	Plant Ecology	1

Semester III

PS3P05	Angiosperm Morphology	½
	Angiosperm Taxonomy	3
	Phytogeography	½
	Pl. Breeding	1
PS3P06	Genetics	1½
	Horticulture	1
	Biostatistics	1
	Cell and Molecular Biology	1½

PS1C01 PHYCOLOGY, MYCOLOGY, PLANT PATHOLOGY AND MICROBIOLOGY

Module-1 PHYCOLOGY

1. History of Phycology: contributions of Indian Phycologists.
2. Classification of Algae: Comparison of systems of classification of F.E. Fritsch and van den Hoek et al.'s (1995) system.
3. Reproduction: different types of reproduction, life history patterns, parallelism in evolution, origin of higher plant groups from algae.
4. General characteristics of Cyanophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta, Euglenophyta, Dinophytes, Chrysophyta and Cryptophyta.
5. Ecology: Ecology of fresh water forms and marine forms.
6. Economic importance of algae.
7. Fossil algae: A general account.

References

I. Fritsch, F.E. 1945. The structure and Reproduction of Algae. Vol. 1 and 2. Cambridge University Press.
2. Smith, G.M. 1950. Manual of Phycology. Chronica Botanica Co.
3. Round, F.E. 1965. The biology of Algae. Edward Arnold.
4. Bold and Wayne. 1978. Introduction of Algae. Prentice-Hall.
5. Graham and Wilcox. 2000. Algae. Benjamin Cummings.
6. van den Hoek, C., Mann, D.G. and Jahns, N.M. 1995. Algae: An Introduction to Phycology. Cambridge University Press.
7. Barsanti, L. and Gualtieri, P.2007. Algae: Anatomy, Biochemistry, and Biotechnology. CRC Publishers.

Module-2 MYCOLOGY

1. General characteristics of fungi: thallus organization, modes of nutrition, cell-wall and hyphal tip growth, fungal organelles, reproduction and spores, vegetative incompatibility and sexual compatibility, parasexuality.
2. Kingdoms of fungi: Fungi, Chromista, Protozoa; phylum-level classification of Kirk et al (2008); Characters used in fungal classification.
3. Biology, general characteristics and classification of the following phyla: Myxomycota, Oomycota, Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota and Basidiomycota.
4. Asexual fungi (Deuteromycetes): General characters, habit and importance of asexual fungi, somatic structures, and structures associated with asexual reproduction, conidomata, conida and conidium ontogeny, other asexual propagules, teliomorph-anamorph connections, nomenclature and classification.
5. Fungi as symbionts: mycorrhizae, endophytes, insect-symbionts
6. Role of fungi in decomposition of cellulose and lignin.

7. Lichens: thallus structure, nutrition, reproduction, mutualistic interaction, ecological and economic significance.

8. Economic importance of fungi.

References

I. Alexopoulos, C.J. et. al. 1996. Introductory Mycology, 4th Edition, Wiley.

2. Carlile, M. J. and Watkinson, S.C. 2001. The Fungi. Academic Press.

3. Deacon, J.W. 2005. Introduction to Modern Mycology, Blackwell.

4. Jennings, D. H. and Lysek, G. 1999. Fungal Biology. Bios Scientific Publishers.

5. Kavanagh, K. (ed.) 2005. Fungi — Biology and Applications. Wiley.

6. Moore-Landecker. 1996. Fundamentals of Fungi. Cambridge University Press.

7. Nash, T. H. 1996. Lichen Biology. Cambridge University Press.

8. Webster, J. and Weber, R. 2007. Introduction to Fungi. Cambridge University Press.

Module-3 PLANT PATHOLOGY

1. Concepts of plant diseases causes and classification.

2. Symptoms of plant diseases.

3. Disease development: infection, progress of disease, role of enzymes and toxins

4. Defense mechanisms: structural and chemical

5. Effect of environment on plant disease development.

6. Plant disease management: control measures that exclude or eradicate pathogen, direct protection of plants from pathogens by biological control and chemical control, types of chemicals used for plant disease control, regulatory methods, control through use of transgenic plants, integrated control of plant diseases.

References

I. Agrios G.N. 2005. Plant pathology, 5th ed. Academic Press.

2. Lucas, J. A. 1998. Plant Pathology and Plant Pathogens, 3 ed. Blackwell.

3. Mehrothra R.S. 1980. Plant Pathology. Tata-McGraw Hill

4. Smith K.M. 1973. A text book of plant virus diseases, 3 ed. Academic Press.

5. Rangaswami G. 1988. Diseases of crop plant of India, 3” ed. Prentice Hall, India

6. Scheffer, R. P. 20O7. The Nature of Disease in Plants. Cambridge University Press.

7. WaIler, J. M., Lenne J. M. and WaIler S. J. (Ed.) 2001. Plant Pathologists’ Pocketbook.

Module-4 Microbiology

1. Bacteria: morphology and ultra-structure, nutrition, cultivation, growth, genetics, plasmids and their characteristics, bacterial classification and general characters of major groups; general accounts of actinomycetes and mycoplasmas.

2. Viruses: General account of plant and animal viruses and bacteriophages; classification of viruses; detailed study of plant viruses including their morphology, structure, isolation, purification, assay, infection, replication and transmission; general account of animal viruses, bacteriophages, viroids and prions.

3. Methods in microbiology: culture media and their preparation, methods of sterilization, isolation of pure cultures, cultivation of anaerobic bacteria, maintenance of microbial cultures, estimation of microbial number and biomass, bacterial staining.

4. Agricultural microbiology: Management of agricultural soils, biofertilizers and biopesticides.

5. Microbial Technology: industrial microorganisms and products, primary and secondary metabolites, production of alcohol, vinegar, antibiotics, vitamins, steroids, vaccines, organic acids, enzymes, fermentation technology - fermentor design and operation, upstream and downstream processes, solid substrate fermentation.

References

1. Madigan, M. T. et al. 2008. Brock Biology of Microorganisms. Benjamin Cummings

2. R.Y. Stanier et al. (1990). The Microbial World. Prentice Hall.

3. R.E.F. Mathew (1991). Plant Virology, 3rd ed. Academic Press.

4. M. Goodfellow et al. (1983). The Biology of Actinomycetes. Academic Press.

5. Pelczar, M.G, Chan E.C.S. and Krieg N.R. (1986) Microbiology, Tata McGraw Hill.

6. Prescott, L. M. *et al.* 2005. Microbiology. McGraw Hill

7. Singleton, P. 2004. Bacteria in Biology, Biotechnology and Medicine. Wiley.

PS1C02 Bryology, Pteridology, Gymnosperms, Immunology

Module-1 Bryology

1. General characters and systems of classification of bryophytes.

2. Contributions of Indian bryologists.

3. A general account of the anatomy, reproduction, life history and phylogeny of Spherocarpales, Marchantiales, Jungermaniales, Anthocerotales, Funariales, Polytricales

4. Origin and evolution of Bryophytes.

5. A general account of fossil Bryophytes and their affinities.

6.Economic importance of bryophytes.

References

1. Watson E.V. 1971. The structure and life of Bryophytes, Hutchinson Univ. Press London.

2. Cavers F. 1911. The interrelationship of Bryophytes. New Phytologist.

3. Kashyap, S.R. I 921. The Liverworts of Western Himalaya and the Punjab Plains, Vol. I & 11. Chronica Botanica.

4. Smith G.M. Cryptogamic Botany Vol. II. McGraw Hill. Book Co. N.Y.

5. Parihar N.S. 1965. An introduction of Embryophyta: Bryophyta, General Book House, Allahabad.

6. Verdoon, F.M. 1932. Manual of Bryology. Ashor & Co. Amsterdam.

7. Shaw, A. J. and Goffinet, B. 2000. Bryophyte Biology. Cambridge University Press.

Module-2 PTERIDOLOGY

I. General characters, Classification (modern trends) and life cycle of Pteridophytes, Contribution of Indian Pteridologists.

2. Diversity of forms among Pteridophytes club mosses, quill worts., mosquito ferns, braken ferns, bird's nest fern, maiden hair fern and tree ferns general morphology with special reference to South Indian species.

3. Fossil Pteridophytes, Psilophytales, Lepidodendrales Calamitales, and Primoficales morpho anatomical features.

4. Habitat ecology of Pteridophytes, epiphytes, lithophytes, Climbers, halophytes, Sciophytes, Xerophytes, rheophytes, hydrophytes.

5. Structure and evolution of stele in Pteridophytes.

6. Origin and evolution of sporangium —Heterospory and seed habit.

7. Development and evolutionary trends in the gametophytes of pteridophytes

8. Cytology of Pteridophytes, Chromosome number, polyploidy, origin of polyploids., apospory, apogamy, agamospory, vegetative reproduction and hybridization.

9. Applied Pteridology, Biofertilizer production from Azolla, Azolla Anabaena symbiosis— Biochemistry of nitrogen fixation — nif genes. Pteridophytes as weeds — Salvinia (Aquatic) Pteridium (Terrestrial) Weed problem, weed control — impact and management- Biological control. Ornamental and medicinal Pteridophytes. Pteridophytes as ecological indicators.

References

1. Bierhost, D.W. 1971. Morphology of Vascular Plants, Mac. Millan Co., New York.

2. Dyer, A.C. 1979. The experimental Biology of Ferns. Academic Press, London.

3. Jermy, A.C. 1973 (Ed.). The Phylogeny and Classification of Ferns.

4. Kramer, K.U. & Green, P.S. 1991. The Families and Genera of Vascular Plants, Narosa, New Delhi.

5. Sporne, K. R 1966. The Morphology of Pteridophytes: The Structure of Ferns and Allied Plants. Hutchinson.

6. Chandra, S. and Srivastava, M. 2003. Pteridology in the New Millennium. Kluwer Academic Publishers.

Module-3 Gymnosperms

1. General characters: Phylogeny, Classification.

2. Geological horizons, distribution, general account including morphology, anatomy, phylogeny and interrelationship of the following orders with special emphasis on the genera specified.

a) Pteridospermales: Lyginopteris, Heterangium, Sphenopteris, Sphaerostoma, Lagenostoma, Medullosa, Trigonocarpus, Pachytesta, Codonótheca. -

b) Clossopteridales Glossopteris

c) Caytoniales: Caytonia

d) Cycadoideales: Williamsonia

e) Pentoxylales: Pentoxylon

f) Cycadales: Zamia

g) Ginkgoales:Ginkgo

h) Coniferales: Cedrus, Cryptomeria, Cupressus, Agathis, Podocarpus.

i) Taxales: Taxus

j) Ephedrales: Ephedra

k) Welwitschiales: Welwitschia

l) Gnetales: Gnetum

3. Evolution of Gymnosperms

4. Distribution of living and fossil gymnosperms in India.

5. Economic importance of Gymnosperms.

References

1. Andrews, H.N. 1961. Studies in Paleobotany, Wiley,N.Y.

2. Banks, H P. 1970 Evolution and plants of the past. Wadsworth.

3. Bierhost, D.W. 1971. Morphology of Vascular plants, Macmillan.

4. Bower F.O. 1935. Primitive plants. Macmillan.

5. Chamberlain, C.J. 1935. Gymnosperms Structure and Evolution. Univ. of Chicago Press.

6. Foster, A.S. & E.M. Gifford. 1974. Comparative morphology of vascular plants. Freeman.

7. Maheshwari, P & V. Vasil. Gnetum. CSIR, New Delhi.

8. Ramanujam, C.G.K. 1976. Indian Gymnosperms in time and Space. Today & Tomorrow, Dehra Dun.

9. Sewart, W.N. 1983. Paleobotany and the Evolution of Plants. Cambridge Univ. Press.

10. Stockey, R.S. 1981. Some comments on the origin and evolution of conifers. Canadian J. Bot. 59: 75-82.

11. Taylor,T.N. 1982.Reproductive biology in early seed plants. Bioscience 32: 23-28.

12. Walton, 1951. An introduction to the Study of Fossil Plants.

Module-4 Immunology

Immune system – antigens, antibodies, structure and function of different classes of immunoglobulins, primary and secondary immune response, lymphocytes and accessory cells, lymphokines, antibody diversity, humoral and cell-mediated immunity, MHC, antigen presentation, complement fixation, hypersensitivity and allergy, opsonisation, mechanism of immune response and generation of immunological diversity, genetic control of immune response, superantigens, applications of imunological techniques – ELISA, immunodiffusion, immunoelectrophoresis. Monoclonal and polyclonal antibodies, HAT medium.

References:

1. Alberghina, C. 2000. Protein Engineering in Industrial Biotechnology. Harwood Academic Publications.

2. Berg, J. M., Tymoczko, J. L., & Stryer L. 2006. Biochemistry (6th Edn). WH Freeman & Co.

3. Delves, P., Martin, S., Burton, D. & Roitt, I. 2008. Roitt's Essentials of Immunology (11th Edn). Blackwell Publishing.

4. Voet, D. J. & Voet, J. J. 2005. Biochemistry (5th Edn).John Wiley & Sons

5. Jain, J. L., Sanjay, J. & Nithin, J. S. 2006. Fundamental of Biochemistry (6th Edn). S. Chand & Co. Ltd.

6. Kindt, T. J., Goldsby, R. A. & Osborne, B. A. 2008. Kuby Immunology (6th Edn). WH Freeman and Co.

7. Lewin B. 2008. Genes IX. Pearson Educational International.

8. Nelson, D. L. & Cox, M. M. 2008. Lehninger Principles of Biochemistry (4th Edn). W.H. Freeman and Co.

9. Pandey, A., Webb, C., Soccol, C. & Larnche, C. 2007. Enzyme Technology. Springer.

10. Rao, C. V. 2005. Immunology: A Text Book. Narosa Publishing House.

11. Sambrook, J. & Russel, D.W. 2008. Molecular Cloning – A laboratory manual (5th Edn). Cold Springer Harbor Laboratory Press.

PS1C03 Research Methodology, Histochemistry, Microtechnique, Biophysics

Module-1 Research Methodology

I. Introduction — (i) Need for research (ii) Stages of research — (a) Definition of a

problem (b) Execution of work (c) Interpretation of research; (iii) Methods — (a)

Technical (b) Logical; (iv) Logical methods — (a) Description and classification (b)

Evolutionary (c) Determination of casual function — Inductive methods (1)

Method of difference (2) Method of concomitant variation (3) Method of residue

4) Method of agreement, Statistical methods, Deductive inductive method; (v)

Relevance and assumptions

2. Review of literature — (A) Library: (i) Structure of a scientific library—journals — current and back volumes, Books — reference and issues, periodicals and other sources (ii) Catalogue — what is a catalogue and how to use it? Types of catalogues — card catalogue, holdings, computerized catalogue (iii) Classification of books Universal decimal system; (B) Journal (a) Indexing journals (b) Abstracting journals (c) Research journals (d) Reviews; (C) Other sources: (a) Reprints -- Acquisition & Filing (b) CD Rom (c) Internet, world wide web (d) INSDOC Services; (D) Preparations for review: (a) Outline of review (b) Selection of key words (c) Preparation of index cards — author index & Subject index.

3. Preparation of project proposal — (a) Title and abstract (b) aim and scope, (c) Present status, (d) Location of experiments (e) Materials and methodology, (f) Date of commencement (g) Estimated date of completion, (h) Estimation cost.

4. Preparation of a dissertation (a) Consolidation and analysis of data, photographs, illustration, tables and graphs, (b) Preparation of the outline, (c) Preparation of manuscript — introduction, review of literature, materials and methods, results, discussion, summery, acknowledgements, references; (d) language text tense, capitalization, italics, punctuation, proof reading, abbreviation (e) Bibliography —methods of citing references, arrangement of references (f) Presentation — Title page, certificates, binding, (g) Presentation of research findings in seminars and workshops — OHP, Slides, Computer assisted (power point).

References

1. Riker, A.J. & Riker R.S. (1936) Introduction to research on plant diseases, John Swift&Co, USA 1

2. Krishnakumar, K (1981). An introduction to cataloguing practice, Vikas Publ. House, New Delhi, 298p.

3. Parashar, R.G. (1989) Index and indexing systems, Medallion Press, New Delhi, l9

4. Bercy, R. (1994) The research project, how to write it, Rutledge, London, I16p.

Module-2 HISTOCHEMISTERY & MICROTECHNIQUE

1. Scope of histochemistry and cytochemistry in Biology.
2. Microscopes: Light microscope, Phase contrast and electron microscope, Micrometric measurements and camera lucida.
3. Microtomes: Rotary, Sledge, and Cryostat.
4. Processing procedure for micropreparation:

(i) Killing and fixing: Principle and purpose, Common chemical fixatives, their preparation and specific uses; FAA, Carnoy's fluid, acetic alcohol, CRAF, Nawashins fluid, and Zircle's fluid.

(ii) Dehydration: Principle and procedure, Dehydrating agents – Ethyl alcohol, n- Butyl alcohol, Tertiary butyl alcohol, Isopropyl alcohol and Chloroform. Different dehydrating series: Alcohol-Xylene method, Alcohol-TBA method & Alcohol Chloroform method.

(iii) Paraffin infiltration – use of embedding oven

(iv) Embedding: Preparation of blocks. 'L' block and paper boat.

(v) Sectioning of paraffin blocks using rotary microtome: Trimming individual blocks and section cutting.

(vi) Adhesives and their preparations.

(vii) Mounting and spreading of paraffin ribbons on micro slides.

5. Staining: Stains used in microtechnique;

Classification – Natural – Hematoxylene, Carmine, Orcein.

Synthetic (coal tar) –

Basic: Safranin, Crystal violet, Basic fuchsin, Cotton blue

Acidic: Fast green, Orange G, Erythrosine, Eosin, and Toluedin blue.

Staining procedure: Single, double and triple staining

Staining combination: safranin and fast green /cotton blue crystal violet and orange-G/erythrosine, Hematoxyline, and safranin.

6. Techniques of clearing, mounting, labeling and storing of permanent slides.
7. Whole mounts, Vein clearing, and tissue maceration.
8. Histochemical staining: Localization of proteins, nucleic acids, insoluble carbohydrates, & lipids.Enzyme histochemistry – General account.
9. Vital staining: Principle, procedure, and applications.

References:

1. Miksche, J. P. (1976). Botanical Microtechnique and Cytochemistry. Iowa State University Press.
2. Gahan, P. B. (1984) Plant Histochemistry. Academic Press.
3. Jensen, W. A. (1962) Botanical Histochemistry. WH Freeman & Company.
4. Johansen, D. A. (1940) Plant Microtechnique. McGraw Hill.
5. Khasim, S. M. (2002) Botanical Microtechnique: Principles and Practice. Capital Publishing Company.

6. Krishnamoorthy K. V. (1999) Methods in Cell Wall Cytochemistry. C.R.C. Press.

7. Pearse, A. G. E. (1980) Histochemistry, Theoretical and Applied. 4th Edition, Vol. 1 & 2. Churchhill Livingstone.

8. Sanderson, J. B. (1994). Biological Microtechnique. Bios Scientific Publishers.

Module-3 Biophysics

1. Energy metabolisms - concept of free energy, entropy, enthalpy, chemical equilibria, principles of thermodynamics, thermodynamics of phosphate compounds, thermodynamics of life; thermodynamics, kinetics and mechanisms of membrane transport, energy rich bonds, redox reactions, synthesis of ATP, substrate level-, oxidative- and photo-phosphorylations.

2. Instrumentation, principles and functioning of: colorimetry and spectrophotometry, centrifugation, ultracentrifugation, electrophoresis, isoelectric focusing, chromatography (TLC, gel filtration, iron exchange, affinity, GC, GC-MS, HPLC, FPLC), NMR, X-ray crystallography, MRI, tools in nanotechnology (Atomic Force Microscopy, Scanning Tunneling Microscope, Scanning Probe Microscope), Fluorescent Microscopy, Flow-cytometry, liquid scintillation.

3. Radio isotopes, radioactive decay, radiations and their applications in biology.

References

1. Green N.P.O *et al*; 1990. Biological Science, 2 Edit Vol. 1 & 11 Cambridge University Press, New York.

2. Meidner H. 1984. Class Experiments in Plant Physiology, George Allen and Unwin, London.

3. Moore T.C. 1981. Research Experience in Plant Physiology — A laboratory Mannual. 2 Edn. Springer Verlag.

4. Daniel, M. 1989. Basic Biophysics for Biologists. Agro-Botanica Publishers and Distributors.

5. Voet, D. J. & Voet, J. J. 2005. Biochemistry (5th Edn).John Wiley & Sons

6. Glaser, R. 2001. Biophysics (5th Edn). Springer.

7. Hammes, G. G. 2005. Thermodynamics and Kinetics for Biological Sciences. John Wiley & Sons Inc.

8. Jain, J. L., Sanjay, J. & Nithin, J. S. 2006. Fundamental of Biochemistry (6th Edn). S. Chand & Co. Ltd.

9. Lewin B. 2008. Genes IX. Pearson Educational International.

10. Nelson, D. L. & Cox, M. M. 2008. Lehninger Principles of Biochemistry (4th Edn). W.H. Freeman and Co.

11. Sambrook, J. & Russel, D.W. 2008. Molecular Cloning – A laboratory manual (5th Edn). Cold Springer Harbor Laboratory Press.

12.Upadhay, A., Upadhay, K. & Nath, N. 2008. Biophysical Chemistry – Principles and Techniques. Himalaya Publishing House.

PS1P01 Phycology, Bryology, Mycology, General Microbiology, Plant pathology, Immunotechniques

Module-1 Phycology

I. Collection and study of Algae mentioned below. Identification up to generic level.

2. Collection, preservation and preparation of algal herbarium (specimens).

3. Staining Techniques for permanent mounts.

Genera for the Practicals

Cyanophyta Gloeocapsa, Oscillatoria, Microcoleus, Anabaena, Nostoc, Scytonema, Stigonema.

Chlorophyta Chlorella, Hydrodictyon, Scenedesmus, Enteromorpha, Ulva, Cladophora, Pithophora, Bulbochaete, Cephaleurous, Chaetophora, Oedogonium, Acetabularia, Bryopsis, Codium, Caulerpa, Halimeda, Desmids Closterium, Cosmarium, Mougetia, Zygnema, Chara and Nitella.

Xanthophyta : Botrydium, Vaucheria.

Bacillariophyta Coscinodiscus, Pinnularia. Phaeophyta : Ectocarpus, Dictyota, Padina, Sargassum, Porphyra.

Rhodophyta Gracillaria, Gelidium,

Module-2 Bryology

Morphological and structural study of representation members of following groups using cleared whole mount preparations, dissections and sections: Riccia, Targionia, Fimbriaria, Cyathodium, Marchantial, Riccardia, Fossombronia, Porella, Anthoceros, Sphagnum, Funaria and Polytrichum.

Module-3 Mycology

Using appropriate mycological methods and techniques the students shall collect and study the morphology and anatomy of the reproductive structures of the following genera of fungi Stemonites, Synchytrim, Saprolegnia, Pythium, Albugo, Pilobolus, Mucor, Saccharomyces, Taphrina Ascobolus, Xylaria, Geoglossum, Phomopsis, Drechslera, Aspergillus, Alternaria, Cercospora, Fusarium, Tremella, Auricularia, Puccinia, Ustilago, Ganoderma, Lycoperdon, Geastrum, Dictyophora, Cyathus, Parmelia and Usnea.

Module-4 Plant pathology

Study of the following diseases with reference to signs and symptoms in the laboratory: cassava mosaic, bunchy top of banana, soft rot of carrot, sesamum phyllody, tikka disease of groundnut, wheat rust, coffee rust, blister blight of tea, powdery mildew of rubber, grey leaf spot of coconut.

Module-5 General Microbiology

I. Test for the presence of coliform bacteria in contaminated water.

2. Isolation of bacteria from soil by dilution plate method.

3. Isolation of pure bacterial culture by streak plate method.

4. Staining of bacteria and their spores.

5. Demonstration of bacterial motility by hanging drop method.

Module-6 Immunotechniques

1. Human Blood typing
2. Immunodiffusion
3. Immunoprecipitation

PS1P02 Pteridology, Gymnosperms, Research Methodology, Histochemistry & Microtechnique, Biophysics

Module-1 Pteridology,

I. Morphological anatomical and reproductive features of Ophioglossum, Angiopteris, Osmunda, Lygodium, Ceratopteris, Pteris, Blechnum, Asplenium, Trichomanes, Acrostichum, Salvinia and Azolla.

2. Fossils — Rhynia, Lepidodendron, Calamites, Botryopteris.

3. Spore germination and development of prothallus in Knop's agar medium.

4. Habitat study of Lycopodium, Gleichenia, Actiniopteris, Pyrrosia, Drynaria, Acrostichum, Salvinia.

5. Submission of 10 herbarium specimens of local Pteridophytes.

Module-2 Gymnosperms

1. Identification of petrifications, compressions, impressions, slides of fossil types include in groups mentioned above.

2. Comparative study of vegetative and reproductive structures of the living genera mentioned above.

3. Morphological and anatomical studies of above mentioned taxa.

Module-3 Research Methodology

1. Preparation of a project proposal and its presentation in the class with the help of OHP.

2. Critical examination of a model dissertation with special reference to citation and listing of references.

3. Critical examination of a model research paper from the perspective of a journal editor.

4. Preparation of a review article on any selected topic.

Module-4 Histochemistry & Microtechnique

1. Preparation of stained permanent slides of the following:

Whole mounts, free hand sections, maceration and serial microtome sections using double, triple, and histochemical staining procedures. At least twenty permanent micropreparations representing whole mounts, free hand sections and serial sections

should be submitted for evaluation.

Module-5 Biophysics

1. Preparation of molal, molar, normal and percentage solutions and their dilutions.
2. Dry Weight/moisture content determination of plant materials.

3. Factors affecting membrane permeability.

4. Measurement of water potential of plant tissues.

5. Solute potential of sap by density gradient method.

6. Plasmolysis — Deplasmolysis method.

7. Histochemical localization of potassium in the guard cells under different conditions of transpiration.

8. Separation of plant pigments by paper chromatography, thin layer chromatography and absorption spectrum of each pigment separated.

9. Quantitative estimation of chlorophyll content using spectrophotometer.

10. pH changes in root surfaces.

11. Role of phytochrome: the germination of light sensitive seeds.

112. Measurement of growth rate using various parameters.

13. Amylase activity and gibberellic acid effect in germinating cereal seeds.

II SEMESTER

PS2C04 Angiosperm Anatomy, Embryology, Plant Ecology

Module-1 Angiosperm Anatomy

1. Differentiation: Concept, its significance in developmental studies, totipotency, phylogenetic perspectives of differentiation — general idea of entropy.

2. Meristems: Recent theories on organization of root and shoot apical meristems. Origin of lateral root. Leaf and bud development. Plastochronic stage, experimental studies on meristems, vegetative to reproductive apex. Reversion from reproductive to vegetative apex.

3. Tissue systems: Differentiation and functions of different tissue systems such as epidermis, parenchyma, chlorenchyma, sclerenchyma, laticifers, glands, transfer cells. Environmental factors influencing differentiation of the divergent tissue systems, experimental studies, and their economic importance.

4. Secondary cambium: Concept, classification, origin and constitution of cambium, cambial activity, cambium in wound healing and grafting, factors influencing cambial differentiation and activity, cork-cambium, different types, origin and function.

5. Abnormal Cambium: Classification, origin and function, experimental studies.

6. Seedling and nodal anatomy, root cot vascular connection, pattern of nodal anatomy, controversies on phylogenetic trends in nodal anatomy.

7. Xylem: Origin, Structural features and function of fibres, fibre trachieds, trachieds, vessel elements, xylem parenchyma, the trends of specialization, taxonomic significance, factors affecting xylem differentiation, elements of wood anatomy.

8. Phloem: Origin, structure and function of sieve cells, sieve tubes companion cells and fibres, trends of specialization, taxonomic significance, factors affecting phloem differentiation.

9. Leaf: Origin and development of lamina —general pattern.

10. Fruit and seeds: general anatomy of fleshy and dry fruits-anatomy of seeds in general, development dormancy and drought resistance from anatomical point of view.

11. Roots: Initiation and development of specialized roots.

References

1. Esau, K. 1983. Plant Anatomy — Wiley Eastern Limited.

2. Fahn, A. 1977. Plant Anatomy Pergamon Press.

3. Cutter, E.G. & Edward, E. 1978. Plant Anatomy: Experiment and Interpretations Part 1, 2.

4. Mauseth, J.D. 1988. Plant Anatomy — The Benjamin Cumming Publishing Co.

5. Forester, A.S. 1960 Practical Plant Anatomy D. Van Nostrand Company. Inc.

6. Roberts, L.W. 1976. Cytodifferentiation in Plants — Cambridge University Press, Cambridge.

Module-2 Embryology of Angiosperms

1. History and development of angiosperm embryology.

2. Microsporogenesis — Structure and function of wall layers, ultrastrutural changes in tapetum in pollen development.

3. Male gametophyte — microspore/pollen mitosis, division of generative cell heterogenicity in sperms, pollen fertility and sterility, pollen storage, viability and germination.

4. Ovule — ontogeny, types and evolution, reduction, nutrition.

5. Megasporogenesis — subcellular features of archesporial and megaspore mother cells, megaspore tetrad, dyad and coeno megaspore, termination of functional megaspore.

6. Embryo sac — Classification and types, ultrastructure of components; synergid and antipodal haustoria, nutrition of embryo sac.

7. Pollination: Ultrastructural histochemical details of style and stigma, significance of pollen-pistil interaction, role of pollen wall proteins and stigma surface proteins, intra-ovarian pollination and in vitro fertilization.

8. Fertilization: Role of synergids, filiform apparatus, heterospermy, differential behavior of male gametes, syngamy and triple fusion, post fertilization metabolic and structural change in embryo sac.

9. Endosperm— Classification and types, ultrastructure, cellularisation in nuclear endosperm, endosperm haustoria, their extension and persistence, function, storage metabolites.

10. Embryo — Polarity in relation to development, classification and types, Histo- and organogenesis of mono- and dicot embryos, delayed differentiation of embryo structure, cytology and function of suspensor, physiological and morphogenetic relationship of endosperm and embryo.

11. Polyembryony— Classification and types.

12. Apomixis — diplospory — apospory, parthenogenesis of embryos.

13. Fruit and seed — parthenocarpy — induction of seedless fruits.

14. Embryology in relation to taxonomy.

15. Experimental embryology — embryo culture, anther culture, ovary culture.

References

1. Bouman F. 1978. Ovule initiation, ovule development and seed coat structure in angiosperms. Today and Tomorrow publishers, New Delhi.

2. Bhojwani 5.5. and Bhatnagar 5.5. 1974. The embryology of angiosperms. Vikas publication, New Delhi.

3. Davis C.L. 1965. Systematic embryology of angiosperms: John Wiley, New York.

4. Eames A.J. 1960. Morphology of angiosperms. McGraw Hill. New York.

5. Johanson D. 1950. Plant embryology, Waltham, Massachusetts.

6. John B.D. (ed) 1984. Embryology of angiosperms. Springer Verlag, Berlin.

7. Maheswari P. 1950. An introduction to the embryology of angiosperms. McGraw Hill, New York.

8. Raghavan V. 1976. Experimental embryogenesis in plants, Academic Press, New York.

9. Wardlaw C.W. 1976. Embryogenesis in plants. Methusen, London.

Module-3 Plant Ecology

1. Ecosystem — Structural components, relationship between structural and function; trophic structures — Ecological awareness.

2. Productivity and energy flow — concept, limits and processes of primary production; methods of productivity measurement; efficiency with regard to energy capture and transfer.

3. Biogeochemical cycling — basic types; the global water, Carbon and Nitrogen cycles.

4. Succession, climax and stability — concepts, characteristics of pioneer and climax species; climax concept and stability.

5. Population characteristics — density, diversity indices, alpha beta and gamma diversity, natality, mortality, age distribution, biotic potential, carrying capacity, aggregation, dispersal, ecotone and edge effect. Growth curve, population regulation, life history strategies

6. Genecology — basic concepts, ecotype, ecophenes, ecads.

7. Environmental pollution — types Land, air, and water : Minamata and Love Canal episode; pesticides, radiation, noise and automobile pollution; effect on plant; control with emphasis on biological methods, El Nino, La Nina, green house effect, Ozone depletion, Ozone day. Global environmental change; biodiversity status, major drivers of biodiversity changes

References

1. Agarwal, V.P., 1988. Forests in India. Oxford & IBH Publishing Co. Pvt. Ltd.

2. Clarks, G.L. 1954. Elements of Ecology. John Wiley & Sons.

3. Cox. G.W. 1969. Readings in Conservation Ecology. Appleton-Century-Crofts.

4. Dasman, R.F. 1968. Environmental conservation. John Wiley and Sons.

5. Lucas, U. & Synge, H., 1986. IUCN Plant Red Data book. IUCN

6. Misra, R., 1968. Ecology Workbook. Oxford-IBH Publishing Co.

7. Nayar, M.P, & Sastry, A.R.K. 1987, 1989, 1990, Red Data Book of Indian Plants.

3 VoIs. Botanical Survey of India.

8. Odum, E.P., 1976. Fundamentals of Ecology. W. B. Sanders.

9. Odum, E.P. 1983. Basic Ecology. W.B. Saunders

10. Puri , G. Indian Forest Ecology. Oxford-IBH Publishing Co.
11. Grange, J.M. et al. 1991. Immunological Techniques in Microbiology. Wiley Blackwell.

PS2C05 Plant Physiology, Biochemistry

Module-1 Plant Physiology

1. Water and plant cells: Water in plant’s life, properties. Diffusion and facilitated diffusion. Absorption and short distance transport, pressure driven bulk flow and long distance transport. Osmosis driven by water potential gradient. Water absorption by roots via apoplastic, symplastic and transmembrane pathways. Role of aquaporins. Water movement through xylem. Mechanism and theories of transport.

Cavitation and embolism. Soil-plant-atmosphere-continuum; physiology of stomatal function- blue light effect.

2. Plants and inorganic nutrition: Nutrient elements: Classification based on biochemical functions. Physiological roles. Nutrient uptake: interaction between roots and microbes. Ion uptake by roots: diffusion, facilitated diffusion and apparent free space. Apoplastic and symplastic pathways. Membrane potential. Passive and active transport. Transport proteins: carriers, - Michaelis-Menten Kinetics. Channels: Voltage dependent K+ channels, voltage gated channels, Calcium channels, Vacuolar malate channels. ATPase activity and electrogenic pumps. Patch clamp studies. Application of Nernst equation. Active transport and electrochemical potential gradients,

3. Assimilation of mineral nutrients; Nitrogen and bio-geocycle nitrate assimilation, reduction, biological nitrogen fixation. Symbiosis: nitrogenase activity, assimilation of ammonia; pathways and enzymes - GS, GOGAT and GDH. Transport of amides and ureides. Sulphur assimilation, bio-geocycle, reduction of sulphates. Importance of phosphorus, iron, magnesium, calcium and potassium assimilation. Energetics of nutrient assimilation, molecular physiology of micronutrient acquisition.

4. Photosynthesis : Light absorption and energy conversion, electron transfer system in chloroplast membranes: ATP synthesis in chloroplast. Photosynthetic carbon reduction, carbon oxidation and photorespiratory cycles. C4 and CAM metabolism. Physiological and environmental consideration of photosynthesis. Distribution of photoassimilates- export. Starch and sucrose synthesis. Allocation and partitioning: Phloem loading and unloading. Concept of osmotically generated pressure flow. Importance of plasmodesmata in symplastic transport.

5. Respiration: Glycolytic reactions: Pyruvate entry into mitochondria and citric acid cycle. Electron transfer system and ATP synthesis. Transporters involved in exchange of substrates and products, ATP synthesis, unique electron transport enzymes of plant mitochondria: external NAD(P)H dehydrogenase, rotenone and cyanide insensitive cytochrome C Oxidases. Interaction between mitochondrial and other cellular components. Metabolites and specific transporters. Lipid metabolism.

6.Growth, differentiation and development: Analysis of plant growth: production of cells, growth velocity profile. Cytological and biochemical events. Differentiation : secondary cell wall formations, multinet growth hypothesis of cell wall. Development: initiation and regulation of development, genes involved in the control of development, role of protein kinases. Types of development: flowering-floral induction, evocation and morphogenesis. Floral organ identity genes. Biochemical signaling: Theories of flowering. Control of flowering-phytochrome, cryptochrome and biological clock. Factors affecting flowering: Photoperiodism and thermoperiodism.

7. Fruit development and ripening: physiology of ripening- cell wall architecture and softening, enzymes involved in biochemical changes.

8. Seed development: deposition of reserves during seed development, desiccation of seeds: hormones involved, desiccation tolerance. Classification of seeds, seed dormancy

9. Germination physiology: Imbibition, germination and reserve mobilization.-metabolism of carbohydrates, lipids, proteins and phytins, physiology of seed dormancy.

10. Plant growth regulators: auxins- biosynthesis, transport, physiological roles. Role in signal transduction pathways. Gibberellin-biosynthesis, physiological roles, signal transduction. Amylase activity in germinating seeds. Cytokinin-biosynthesis. biological role, morphogenesis in cultured tissues; mode of action. Ethylene – biosynthesis, physiological role, commercial uses, and mode of action. Abscisic acid: biosynthesis and metabolism, physiological effects, role in seed dormancy and senescence. Hormonal balance concept.

11. Photoreceptors: Phytochromes - photochemical and biochemical properties, localisation in cells and tissues, phytochrome induced whole plant responses, Ecological functions. Mechanisms of phytochrome regulated differentiation. Signal transduction pathways, role in gene expression. Cryptochromes: blue light hormones photophysiology, effect on stem elongation, gene expression, stomatal opening, proton pumps, phototropism, role of carotenoids.

12. Senescence and programmed cell death: Apoptosis and necrosis. Programmed cell death in relation to reproductive development, and stress response. Genes associated with senescence, metabolism during senescence.

13. Stress physiology: Water deficit and drought resistance, heat stress and heat shock, chilling and frost, salinity stress, oxygen deficiency stress and heavy-metal pollution stress.

14. Signal transduction. Classes of signals; receptors, signal perception, signal amplification and transduction reactions, role of Ca++ as second messengers, role of Calmodulin .

References:

1. Anderson, J. W. and Boardall, J. (1991) Molecular Activation of Plant cells - An Introduction to Plant Biochemistry. Blackwell Scientific Publishers.

2. Beck, C. B. (2005). An Introduction to Plant Structure and Development. Cambridge University Press.

3. Bewley, J. D. and Black E. (1994) Seeds: Physiology of Development and Germination. 2nd Edn. Plenum Publishing Corporation.

4. Bidwell, R.G. S. (1979) Plant Physiology. 2nd Edn. Macmillan Publishing Corporation.

5. Buchanan, B. B,, Gruissem, W. and Jones, R. L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.

6. Devlin, R. M. and Witham, F. H. (1986). Plant Physiology. IVth Edn. CBS Publishers & Distributers.

7. Hopkins, W. G. (2004). Introduction to Plant Physiology. John Wiley & Sons Inc.

8. Karp G. (1996). Cell and Molecular Biology – Concepts and Experiments. John Wiley & Sons, Inc.

9. Mayer and Poljakoff- Mayber. (1989). The Germination of Seeds. IVth Edn. Pergamon Press.

10. Moore. T. C. (1981) Research Experience in Plant Physiology. A Laboratory Manual. Springer Verlag,

11. Noggle, G. R. and Fritz G. J. (1992). Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd.

12. Salisbury, F. B. and Ross C. W. (1992) Plant Physiology. 4th Edn. Wordsworth Publishing Corporation.

13. Steward, F. C. Plant Physiology – A Treatise. Vol. I to X. Academic. Press.

14. Stumpf, P. K. and Conn, E. E (1980). The Biochemistry of Plants: A Comprehensive Treatise. Academic Press.
15. Taiz, L. and Zeiger, E. (2002). Plant Physiology. The Benjamin Cummings Publishing Corporation Inc.
16. Wilkins, M. B. (1984). Advances in Plant Physiology. Longman Scientific & Technical.

Module-2 Biochemistry:

1. pH and buffers – properties of water, acids, bases and buffers, Henderson-Hasselbalch equation, pH, pKa, Kw, proton hopping, buffers in living system, common buffers.
2. Carbohydrate: introduction to mono-, di-, oligo- and polysaccharides, linear and ring structures, homo- and heteroglycans, major reactions of reducing and non reducing sugars, artificial sweeteners, structure and function of major homo- and heteropolysaccharides, metabolism of starch, cellulose and glycogen. Gycolysis, TCA cycle, terminal oxidation, gluconeogenesis, glyoxylate pathway, PPP pathway, glycoproteins and proteoglycans, biosynthesis of peptidoglycan, metabolic mill.
3. Amino acids and proteins: amino acids – classification, properties, optical activity, unusual aminoacids, ninhydrin reaction; biosynthesis and breakdown of amino acids, classification and conformation proteins, Ramachandran plot, structure, function, mechanism and allosteric regulation of haemoglobin, abnormal haemoglobin, structure and function of leghaemoblobin, Brief account on the biosynthesis of protein.
4. Enzymology – structure, function and classification of enzymes, coenzymes, substrate specificity, regulation of enzyme activity, active sites, inhibitors, allosteric enzymes, kinetics, negative and positive co-operativity, multienzyme, isoenzymes, ribozyme, abzyme, detailed study of FAS and Rubisco, penicillin and magic bullet, suicidal inactivators, enzyme in curing Trypanosomiasis.
5. Lipids – classification, brief account on compound and derived lipids with examples, classification of fatty acids, biosynthesis of fatty acids (microbes, plants and animals), alpha, beta and omega oxidation of fatty acids, omega fatty acid and functional food, trans-fatty acids and their dangers, detailed study of coconut oil.
6. Nucleic acid: biosythesis and break down of purines and pyrimidines. Brief account on the types and conformation of DNA and RNA.
7. Vitamins and hormones: classification, structure, function and source of vitamins, vitamins as coenzymes, phytohormones – classification, structure, function and biosynthesis.

Referances

1. Alberghina, C. 2000. Protein Engineering in Industrial Biotechnology. Harwood Academic Publications.

2. Berg, J. M., Tymoczko, J. L., & Stryer L. 2006. Biochemistry (6th Edn). WH Freeman & Co.

3. Daniel, M. 1989. Basic Biophysics for Biologists. Agro-Botanica Publishers and Distributors.

4. Delves, P., Martin, S., Burton, D. & Roitt, I. 2008. Roitt's Essentials of Immunology (11th Edn). Blackwell Publishing.

5. Voet, D. J. & Voet, J. J. 2005. Biochemistry (5th Edn). John Wiley & Sons

6. Glaser, R. 2001. Biophysics (5th Edn). Springer.

7. Hammes, G. G. 2005. Thermodynamics and Kinetics for Biological Sciences. John Wiley & Sons Inc.

8. Jain, J. L., Sanjay, J. & Nithin, J. S. 2006. Fundamental of Biochemistry (6th Edn). S. Chand & Co. Ltd.

9. Kindt, T. J., Goldsby, R. A. & Osborne, B. A. 2008. Kuby Immunology (6th Edn). WH Freeman and Co.

10. Lewin B. 2008. Genes IX. Pearson Educational International.

11. Nelson, D. L. & Cox, M. M. 2008. Lehninger Principles of Biochemistry (4th Edn). W.H. Freeman and Co.

12. Pandey, A., Webb, C., Soccol, C. & Larnche, C. 2007. Enzyme Technology. Springer.

13. Rao, C. V. 2005. Immunology: A Text Book. Narosa Publishing House.

14. Sambrook, J. & Russel, D.W. 2008. Molecular Cloning – A laboratory manual (5th Edn). Cold Springer Harbor Laboratory Press.

15. Upadhay, A., Upadhay, K. & Nath, N. 2008. Biophysical Chemistry – Principles and Techniques. Himalaya Publishing House.

PS2C06 Biotechnology, Bioinformatics

Module-1 Biotechnology

1. Definition, impact of biotechnology - an overview

2. Plant tissue culture techniques: introduction, history, scope. Basic aspects of plant tissue culture; Different culture media; components; growth regulators; growth retardants; Undefined supplements; Explants; Sterilization; Inoculation; Subculturing, etc. Various media and their composisition.

3. Different types of cultures: Callus- different types; Cell culture; Suspension culture-different types; culture methods of single cells; Testing of viability of cells; Application of cell and callus culture with special reference to medicinal and aromatic plants. *In vitro* morphogenesis;differentiation.

4. Organogenesis- different types; factors effecting; problems related to micropropagation of woody (Medicinal) plants. Different stages of micropropagation, Somaclonal variation and its importance with special reference to medicinal and aromatic plants.

5. Somatic embryogenesis: direct and indirect; Factors effecting; embryo maturation; application. Synseeds and its significance.

6. Production of pathogen-free plants: Different methods; Meristem culture and its importance in commercialization especially of Medicinal and Aromatic plants.

7. Protoplast: Isolation and culture methods; Factors effecting; Somatic hybridization: Different types; Fusion methods. Application with special reference to Medicinal and Aromatic plants.

8. Haploids: Different types: Androgenesis and gynogenesis, Advantages; Significance in crop improvement with special emphasis on Medicinal and aromatic plants.

9. Ovary, ovule, endosperm and embryo culture; importance. *In vitro* fertilization (recent advances) and its significance.

10. Secondary metabolites: Different classes; methods of production- factors effecting yield.

11. Application of Plant Tissue Culture: Clonal propagation, artificial seed production of hybrids and somaclones, drugs, products, cryopreservation and germplasm storage.

12. Conservation of Plant Genetic Resources-Importance of plant genetic Resources-Indian gene centres-Developments in PGR-CBD-Biodiversity Act-Protection of Plant Varieties-Genebanks, types.

13. Plant genome - Nuclear, Chloroplast and Mitochondrial - their structure, organisation and expression.

14. Molecular Techniques: DNA markers & DNA probes, DNA Sequencing methods (Maxam & Gilbert, Sanger *et al*., capillary), RNA Sequencing, Sequanator, *In situ* hybridisation (DIRVISH & FISH), PRINS, colony hybridisation, dot & slot blots; blotting (Southern, Northern, Western, South-Western & North-Western), RFLP, RAPD, STS & PCR (Variants in PCR), Real-time quantitative PCR, PCR, LCR), DNA- & RNA fingerprinting, genomic library, cDNA library & gen bank; chromosome walking; protein sequencing-MALDI. Human genome project.

15. Recombinant DNA Technology: Tools in genetic engineering; prokaryotic and eukaryotic vectors; shuttle-, expression-, dominant selectable-, amplifiable-, integrating-, broad host range vectors; positive and negative selection; enzymes involved; gene cloning & gene farming; single cell protein, shotgun cloning, gene library; comparison of cloning vectors.

16. Gene transfer in prokaryotes and eukaryotes: Recombinant viral method; DNA-mediated gene transfer; protoplast fusion, micro-cell fusion; metaphase chromosome transfer; liposome mediated gene transfer; microinjection & electroporation; biolistics & organelle engineering.

17. Transgenesis in plants: Somaclones; plant cell - bacterium hybrids; biociders; biological control; pathogen resistance; herbicide resistance; stress resistance; homozygous cultivars; enrichment of storage proteins; improvement of photosynthesis; post harvest preservation; selection of auxotrophs & secondary metabolite production.

18. Genetic Engineering – Merits & Demerits: SCP; Protein engineering, fusion proteins & designer enzymes, Production of biopharmaceuticals, commodity & industrial chemicals, food & beverages; Metabolite engineering & nif-engineering; Anti-sense technology; IPR & patenting; Biological risks, GM food and terminator technology; Biosafety & biohazards, physical & biological containment; Genetic screening & privacy; Ethical, economic& legal issues.

19. Application of gene cloning and transformation techniques in plants- Genetically modified organisms and foods (GMO/GMF) - Social and ethical considerations in Indian Scenario.

References

1. Brown, C. M. 1987. Introduction to Biotechnology. Blackwell Scientific Publications, Oxford, London.

2. Brown, C.M. Campbell, I. and Priest, F.G. 1990. Introduction to Biotechnology. Blackwell Scientific Publications, Oxford, London.

3. Brown, T.A. 1999. Genomes. John Wiley & Sons. New York.

4. Chawla, H.S. 2000. Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

5. Dixon, R.A. and Gonzales, R. A. (Eds.) 1994. Plant Cell Culture - A Practical Approach. Oxford University Press, New York.

6. Gamborg, O.L and Phillips, G.C. 1998. Plant Cell, Tissue Organ Culture. 1998. Narosa Publishing House, NewDelhi.

7. Griffiths el al., 1999. Modern Genetic Analysis. W.H. Freeman & Co. New York.

8. Gupta, P.K. 1999. Elements of Biotechnology. Rastogi Publications, Meerut.

9. Jefrey. M.. Backer el al., 1996. Biotechnology- A Laboratory Course. Academic Press, New York.

10. Keshav Trehan, 1991. Biotechnology. Wiley Eastern Ltd, New Delhi.

11. Kumar, H.D. 2000. Modern concepts of Biotechnology. Vikas Publishing House Pvt. Ltd. New Delhi.

12. Old, R.W. and Primrose, S.B 1983. Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford, London.

13. Old R.W. and Primrose. S.B. 1986. An introduction to Genetic Engineering. Blackwell Scientific Publications, Oxford, London.

14. Pamela Peters. 1993. Biotechnology-Aguide to Genetic Engineering. Wim.C Brown Publishers, USA.

15. Primrose, S.B. 1989. Modern Biotechnology. Blackwell Scientific Publications, Oxford, London.

16. Thomas R. Mertins and Robert. L. Hammorsmith. 1998. Genetics a Loboratory Investigation.

17. Thorpe, T.A. 1981. Plant Tissue Culture Academic Press, London.

18. Trivedi, P.C. (Ed.) 2000. Plant Biotechnology - Recent Advances. Panima Publishing Co. New Delhi.

19. Wulf Crueger and Anneliese Crueger. 2000. Biotechnology - A Text book of Industrial Microbiology.

20. Lewin B (2009). Genes IX. Humana Press.

21. Flynne WG (2008). Biotechnology and Bioengineering. Nova Science Publishers

22. Lipps, G. (2008). Plasmids: Current Research and Future Trends. Caister Academic Press.

23. Torr, J. D. (2006). Genetic Engineering-Current Controversies. Greenhaven Press.

24. Engdahl, S. (2006). Genetic Engineering-Contemporary Issues. Greenhaven Press, San Diego, USA.

25. Magnien, E. & De Nettancourt, D. (1985). Genetic Engineering of Plants and Micro-Organisms Important for Agriculture. Springer Verlag.
26. Fox, M. W. (2000). Beyond Evolution: The Genetically Altered Future of Plants, Animals, the Earth ... and Humans. Lyons Press.
27. Ho, R. J. Y. & Gibaldi, M. (2003) Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs. Wiley-VCH.

Module-2 Bioinformatics

UNIT - 1: DATABASES & TOOLS: Introduction to Bioinformatics, Need for informatics tools and exercises, Significance of databases towards informatics projects. The nucleotide and protein sequence Databases: GenBank, DDBJ,EMBL, PIR, Primary and Secondary Databases; Format of databases, Gene bank flat file. Protein Data Bank (PDB) flat file; FASTA Format, PIR Format; Structure file formats, PDBSUM, PDB Lite, MMDB, SCOP, Pfam; Database of structure viewers. Specialized databases: NCBI, Pubmed, OMIM, Medical databases, KEGG, EST databases; Overview of other popular tools for bioinformatics exercises.

UNIT - 2: SEQUENCE ALIGNMENT AND DATABASE SEARCHES: Introduction, The evolutionary basis of sequence alignment, the Modular Nature of proteins, Optional Alignment Methods, Substitution scores, substitution matrices, PAM, BLOSUM, Gap penalties, Statistical significance of Alignments, Database similarity searching, FASTA, BLAST, Low-Complexity Regions, Repetitive Elements. Practical Aspect of Multiple Sequence Alignment, Progressive Alignment Methods, CLUSTALW ,Motifs and Patterns, PROSITE, 3DPSSM. Hidden Markov Models (HMMs), and threading methods. Conceptual numericals.

UNIT - 3: PHYLOGENETIC ANALYSIS: Introduction to Phylogenetic analysis, rooted and unrooted trees, Elements of phylogenetic Models, Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation, Building the Data Model (Alignment), Determining the Substitution Model, Tree-Building Methods, Searching for Trees, Rooting Trees, Evaluating Trees and Data, Phylogenetic softwares (CLUSTALW, PHYLIP etc), Conceptual numericals.

UNIT - 4: PREDICTIVE METHODS: Predictive Methods using Nucleotide sequences: Framework, Masking repetitive DNA, Database searches, Codon Bias Detection, Detecting Functional Sites in the DNA (promoters, transcription factor binding sites, translation initiation sites), Integrated Gene Parsing, finding RNA Genes, Web based tools (GENSCAN, GRAIL, GENEFINDER). Predictive Methods using Protein sequences: Protein Identity based on composition, Physical properties Based on sequence, secondary structure and folding classes, specialized structures or features, tertiary structure. Related web based software (JPRED, PROSEC, NNPREDICT, SOPMA)

UNIT - 5: PLASMID MAPPING AND PRIMER DESIGN: Restriction mapping, Utilities, DNA strider, MacVector and OMIGA, gene construction KIT, Vector NTI, Web based tools (MAP, REBASE); Primer design – need for tools, Primer design programs and software (PRIME3). Conceptual numericals.

UNIT - 6: GENOME BIOINFORMATICS: Sequencing methods (qualitative), Bioinformatics tools and automation in Genome Sequencing, analysis of Raw genome sequence data, Utility of EST database in sequencing, Bioinformatics in detection of Polymorphisms, SNPs and their relevance, Bioinformatics tools in microarray data analysis, tools for comparative genomics.

UNIT - 7: MOLECULAR VISUALIZATION: Generation or Retrieval, Structure Visualization, Conformation Generation. Graphical representation of molecular structures: small molecules (low molecular weight – peptides, nucleotides, disaccharides, simple drugs molecules) and macromolecules (high molecular weight molecules - proteins, DNA, RNA, membranes). Usages of visualization software available in public domain like VMD, Rasmol, Pymol, Spdb Viewer, Chime, Cn3D.Rotameric Structures of Proteins (Conformational Flexibility), Canonical DNA Forms (DNA Sequence Effects). Systematic methods of exploring conformational space.

UNIT - 8: IN SILICO MODELING & DRUG DESIGN: Scope and applications of in silico modeling in modern biology. Comparative modeling, Constructing an initial model, refining the model, manipulating the model, molecule superposition and structural alignment, concept of energy minimization, different types of interactions and formulation of force fields. Basic MD algorithm, its limitations, treatment of long range forces. Molecular modeling in drug discovery, deriving bioactive conformations, molecular docking, quantitative structure-activity relationship (QSAR), deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Ligand – Receptor Interactions: Docking, Calculation of Molecular Properties using Energy Calculations (no derivation). Conceptual numericals.

References

1. Bioinformatics – Andreas D Baxevanis. Wiley Interscience, 1998.
2. Bioinformatics –David W Mount, Cold spring harbor, 2001.
3. Introduction to Bioinformatics – Arthur Lesk, Oxford, 2006.
4. Bioinformatics – Stuart M Brown, NYU Medical Center, NY USA. 2000.
5. Fundamental Concepts of Bioinformatics – D E Krane & M L Raymer, Pearson, 2006.
6. Structural Bioinformatics – PE Bourne and H Weissig, Wiley – Liss, 2003.
7. Computational methods for macromolecular sequence analysis – R F Doolittle. Academic Press, 1996.
8. Computational methods in Molecular Biology – S.L.Salzberg, D B Searls, S Kasif, Elsevier, 1998.
9. Bioinformatics, Methods And Applications – Genomics, Proteomics And Drug Discovery – S C Rastogi, N Mendiratta & P Rastogi, PHI, 2006.
10. The Molecular Modeling Perspective in Drug Design – N Claude Cohen – Academic Press, 1996.
11. Analytical Tools for DNA, Genes & Genomes: – Arseni Markoff, New Age, 2007.
12. Introduction to Bioinformatics – Anna Tramontano taylor & francis. (2007)
13. Bioinformatics – Des Higgins & Willie Taylor – Oxford. (2005)
14. Discovering Genomics, Proteomics and Bioinformatics – A M Campbel and L J Heyer, Pearson education, 2007.

PS2P03 Angiosperm Anatomy, Embryology, Biotechnology, Bioinformatics

Module-1 Angiosperm Anatomy

I. Diversity in cells and tissue in a monocot and dicot plant with respect to position, distribution, structure and function.

2. Epidermis — Trichomes, stomatal types, stomatal index.

3. Clearing shoots apical meristems —different patterns.

4. Clearing and staining of leaf, young twigs, roots, floral parts etc.

5. Nodal anatomy.

6. Vascular cambium and cork cambium.

7. Xylem and its constituents by sectioning and macerating the tissues.

8. Phloem and its components.

9. Abnormal secondary growth — different patterns: Dracaena, Bignonia, Aristolochia, Amaranthus, Nyctanthes, Aerva, Beetroot, Mirabilis, Pisonia, and Bougainvillea

10. Submission of slides—30 Nos.

Module-2 Embryology

1. Preparation of dissected whole mounts of endothecium, tapetum, ovule, endosperm, embryo and haustoria. Squash preparations of tapetum, microspore mother cells, dyads, tetrads, pollinia and massulae.

2. Study from permanent preparations — Development and structure of anther, pollen, ovule, megasporogenesis, embryo sac, endosperm and embryo. The comparative study of typical monocot and grass embryos.

3. Pollen germination—viability tests.

4. Intra-ovarian pollination.

Module-3 Biotechnology

1. Preparation of culture medium (MS, N& N, SH, B5 and Whites), sterilization and inoculation.
2. Shoot multiplication, Callus culture and organogenesis of important crops/medicinal plants/ornamentals.
3. Isolation of genomic DNA and estimation by spectro photometry.
4. Demonstration of Agarose gel electrohoresis.
4. Encapsulation of seeds/embryos incalcium alginate.
5. Genomic DNA isolation by CTAB method from plant tissues.
6. Estimation of DNA concentration by Spectrophotometric method.
7. Estimation of RNA concentration by Spectrophotometric method.

8. Students have to submit a record of the above work done.

Module-4 Bioinformatics

1. Exercises on Windows, Linux, UNIX, Networking, Internet search & Graphics.

2. Usage of Software for identification - Accessing existing databases on the World-wide Web; Software for identification of species;

3. Usage of softwares to elucidate structure of biomolecules, docking of molecules & molecular designing/modelling; Analytical software related to Genomics and proteomics.

4. Usage of similarity, homology and alignment softwares; Software of Microarray analysis – design, processing and analysis.

PS2P04 Plant Physiology, Biochemistry, Bioinformatics, Ecology

Module-1 Plant Physiology

1. Preparation of molal, molar, normal, and percentage solutions and their dilutions.
2. Determination of moisture content of plant materials,
3. Determination of osmotic potential by plasmolytic method.
4. Analysis of Phosphorus in plant tissues.
5. Separation of plant pigments by paper chromatography.
6. Quantitative estimation of chlorophyll content using spectrophotometry.
7. Measurement of Photosynthesis - Hill Reaction
8. Measurement of Light Intensity and Light Transmission Ratio.
9. Measurement of growth rate using various parameters
10. Demonstration of Amylase activity and gibberellic acid effect in germinating cereal seeds.
11. Regulation of Seedling Growth by Plant Hormones
12. Protein estimation by dye binding method.

Module-2 Biochemistry

1. Detection of non-reducing sugar in the presence of reducing sugar.
2. Quantitative estimation of reducing sugar from plant tissue by any suitable method.
3. Extraction and estimation of starch from plant tissue by a suitable method.
4. Colorimetric estimation of protein by Biuret method.
5. Colorimetric estimation of protein by Lowry et al. method.
6. Measurement of amylase/invertase/protease from any suitable plant/microbial source using suitable method.
7. Determination of Substrate saturation and Michaelis-Menten curve of any enzyme.
8. Paper chromatographic separation of sugars.

Module-3 Plant Ecology

1. Evaluation of biotic and abiotic components of any two important ecosystems.

2. Evolution of food chain in the ecosystems mentioned in I.

3. Determination of the importance value Index (IV of plant species in the community by quadrats, line and belt transect methods.

4. Comparative study of polluted and non-polluted aquatic ecosystems.

Module-4 Bioinformatics

1. Exercises on Windows, Linux, UNIX, Networking, Internet search & Graphics.

2. Usage of Software for identification - Accessing existing databases on the World-wide Web; Software for identification of species;

3. Usage of software to elucidate structure of biomolecules, docking of molecules & molecular designing/modelling; Analytical software related to Genomics and proteomics.

4. Usage of similarity, homology and alignment software; Software of Microarray analysis – design, processing and analysis.

III SEMESTER

PS3C07 Angiosperm Morphology, Angiosperm Taxonomy, Phytogeography

Module-1 MORPHOLOGY OF ANGIOSPERMS

1. General concepts of morphology, origin and evolution of flower, co-evolution of lowers vis-a- vis pollinators.

2. Origin and evolution of monocot and dicot flowers.

3. Evolution of carpels: Different types of carpels, concepts of foliar origin of carpels alternative concepts and approaches.

4. Specialized carpels — poly and syncarpy — superior, semi-inferior and inferior ovary- appendicular and receptacular concepts — evolution of placentation types.

5. Role of floral anatomy in interpreting the origin and evolution of flower and floral parts.

References

1. Eames A.J. Morphology of Angiosperms.

2. Barnard C. The interpretation of Angiosperm flower. Aust. J. Sci. 24; 64-72 (1901)

3. Manilal K.S. Vascularisation of corolla of Compositae. J. Ind. Bot. Soc. 50: 189-

196. (1981).

4. Meeuse A.D.J. Some fundamental principles of interpreting floral morphology. Intl. Biosci. Pub. Hissar (1974).

5. Melville R.A.New theory of angiosperm flower, Nature: 188 (14418) (1960).

6. Purl V. Inferior Ovary. Phytomorphology, 2:122 (1952).

7. Sporne K.R. The morphology of the Angiosperms. Hutchinson Univ. Press. London (1974).

Module-2 ANGIOSPERM TAXONOMY:

1. Taxonomy: Definitions, Objectives, Importance, Scope.

2. Historical development of theories and concepts of plant classification and classificatory systems.

3. Conceptual bases of the classifications of the following: Bentham & Hooker, Engler, Hutchinson, Cronquist, Takhtajan.

4. Taxonomic structure, taxonomic hierarchy, taxonomic categories – supraspecific and infraspecific categories; Concept of species, genus and family.

5. Taxonomic characters: Concept of character, character variations and their taxonomic implications.

6. Sources of taxonomic characters: Morphology, Anatomy, Embryology, Cytology, Palynology, Phytochemistry.

7. Modern trends in Plant Taxonomy: Biosystematics, Numerical Taxonomy (Taximetrics), Cladistics, Molecular Taxonomy.

8. Problems in Evolutionary taxonomy: Concept of primitive and advanced characters/groups, monophyly and polyphyly, parallelism and convergence, homology and analogy.

9. Practical identification of plants: Different kinds of Identification keys, Construction of dichotomous keys – Indented and bracketed keys.

10. Various kinds of Taxomonic literature: Floras, Revisions, Manuals, Monographs, Periodicals and Journals.

11. Plant Nomenclature: Brief History on the origin and development of nomenclature; detailed study of the major provisions of the International Code of Botanical Nomenclature (ICBN) - Effective and Valid Publication, Rule of Priority and its limitations, Typification, Different kinds of types, Author citation, Rejection and retention of names, Conserved names; Nomenclature of hybrids; Nomecnlature of cultivated plants. Common technical terms used in Plant nomenclature.

12. Methods of plant exploration; Management of Herbaria; Major Herbaria in India and the World; Role of Herbaria in taxonomy. Floristic studies in India; Major centers of taxonomic and floristic studies in India; Organization and functions of the Botanical Survey of India.

13. Botanical Gardens: Role in taxonomy and biodiversity conservation.

References:

1. Cronquist, A. 1988. The evolution and classification of flowering plants. New York Botanical Garden Press.

2. Dahlgren, R. M. T., Clifford, H. T. & Yeo, P. F. 1985. The Families of Monocotyledons. Springer-Verlag.

3. Davis, P. H. & Heywood, V. H. 1973. Principles of Angiosperm Taxonomy. Robert R Krieger Publishing Co.

4. Douglas, E. & Soltis et al. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates Inc.

5. Harris J. G. & M. W. Harris. 2007. Plant Identification Terminology. Spring Lake Publishing.

6. Hutchinson, J. 1959. The Families of Flowering plants. Oxford.

7. Mc Neill, J. et al. 2006. International Code of Botanical Nomenclature (ICBN) (Vienna Code). A.R.G. Gautner Verlag K.G.

8. Janick, J. et al. 2002. International Code of Nomenclature of Cultivated Plants. International Society for Horticulture Science.

9. Judith, E. W. 2002. Describing Plant Species. Bishen Singh Mahendrapal Singh.

10. Kitching, I. J.et al. 1998. Cladistics – the theory and practice of Parsimony Analysis. Oxford University Press.

11. Naqshi, A. R. 1993. An introduction to Botanical Nomenclature. Scientific Publishers.

12. Radford, E. A. 1986. Fundamentals of Plant Systematics. Harper & Row Publishers.

13. Simpson, M. G. 2006. Plant Systematics. Elsevier.

14. Sivarajan, V. V. 1991. Introduction to the Principles of Plant Taxonomy. Oxford & IBH Publishing Co. Pvt. Ltd.

15. Smeath, P. H. A. & Sokal, R. R. 1973. Numerical Taxonomy. WH Freeman & Co.

Stace, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold.

Module-3 PHYTOGEOGRAPHY:

Objectives of Phytogeography.

Descriptive Phytogeopgraphy: Types of plant distribution: Continuous distribution; cosmopolitan, circumpolar, circumboreal or circum-austral, and pantropical; Discontinuous distribution; Theory of land-bridge, theory of continental drift, theory of polar oscillations or Shifting of poles, glaciations. Centers of origin and diversity of plants; Methods of dispersal, migrations and isolation; Theory of area and theory of tolerance. Factors influencing plant distribution; Migration of floras, and Evolution of floras. Floristic regions of the world: Vegetation Zones in relation to latitudes and altitudes; a brief account of the phytochoria of the Indian subcontinent; Endemics: Neo and relics.

Geographical Information Systems: definition, fundamental concepts and components of GIS; developments and future trends in GIS.

References:

1. Avise, J. C. (2000). Phylogeography. The History and Formation of Species. Harvard University Press.

2. Brown, J. H. & M. V. Lomolino (1998). Biogeography. 2nd Edition. Sinauer Associates, Inc.

3. Cox, C. B., Healey, I. N. & Moore, P. D. (1976). Biogeography. An Ecological and Evolutionary Approach. 2nd Edition. Blackwell Scientific Publications.

4. MacDonald, G. (2003). Biogeography: Introduction to Space, Time and Life. John Wiley & Sons, Inc.

5. Simmons, I. G. (1979). Biogeography: Natural and Cultural. Edward Arnold Ltd.

PS3C08 Plant Breeding, Horticulture, Biostatistics

Module-1 Plant Breeding

1. Introduction – Objectives in Plant breeding, Floral Biology in relation to selfing and crossing techniques

2. Biological foundations of Plant breeding- Role of heredity and environment in character expression- Systems of reproduction in plants- Mating systems in sexually reproduced plants.

3. Plant propagation- sexual, pseudosexual and asexual methods- special methods of plant propagation- micropropagation.

4. Conventional methods of plant breeding- plant domestication, plant introduction, selection and hybridization.

5 Breeding Methods: Sources of plant germplasm. Centres of genetic diversity. Concepts of de-Candolle and Vavilov Primary, secondary and microcenters. Genetic erosion – causes threatened species. Plant genetic conservation – (in-situ and ex-situ).

6. Plant introduction: Types and procedures. Preservation and utilization of germplasm.

7. Selection: Principles – genetic basis and methods. Mass selection, pure line selection, clonal selection.

8. Hybridization : Objectives, choice of parents, problems and causes of failure of hybridization – Incompatibility and sterility – Methods of overcoming – genetic consequences of hybridization. Methods of handling segregating hybrids for isolation of superior strains – Bulk method and pedigree method of selection. Role of interspecific and intergeneric hybridization in plant improvement.

9. Back-cross breeding: Theory and procedure for transferring various types of characters. Inbreeding consequences. Heterosis theories – genetic and physiologic basis – Applications in plant breeding – steps in the production of single cross, double cross, three way cross and synthetic cross – use of male sterility in hybrid production – cytoplasmic – Genetic and cytoplasmic – Genetic sterility.

10. Polyploidy breeding induction of autopolyploidy and allopolyploidy, role of chromosome manipulation – chromosome addition and substitution lines achievements.

11. Mutation breeding: Situations suitable for mutation breeding. Materials needed for treatment. Physical and chemical mutagens. Handling of mutants. Evaluation of mutants in M1, M2 and M3 generations.

12. Breeding for special purposes- breeding for pest, disease and stress resistance.

References

1. Allard R. W. - Principles of Plant Breeding. John Wiley & Sons.

2. Jain H. K. and Kharkwal M. C. Plant Breeding. Narosa Publishing House.

3. Chahal G. S. and Gosal S. S. Principles and Procedures of Plant Breeding. Narosa Publishing House.

4. Roy D. Plant Breeding. Narosa Publishing House.

5. Hayward M. D., Bosemark N. O. and Romagosa I. Plant Breeding- Principles and prospects. Chapman and Hall.

6. Gupta S.K. Plant Breeding. Agrobios.

7. Khan M. A. Plant Breeding. Biotech Books.

8. Sharma J. R. Plant Breeding. Tata McGraw Hill.

Module-2 HORTICULTURE

1. Concept and scope of horticulture.
2. Basic requirements — land, water, soil, landscape, propagules, implements and practices — types of garden plants.
3. Plant growing structures – Green house, Glass house and Mist chamber.
4. Plant propagation – Cuttage, Layerage, Graftage and Budding.
5. Cultural practices – Thinning, Training, Trimming and Pruning.
6. Fertilizers – Biofertilizer, Green manure, NPK, Compost – Vermicompost
7. Out door horticulture – Gardens – Vegetable garden, Medicinal plant garden Roof garden, Fruit garden, Lawns and Landscapes.
8. Commercial horticulture – Nurseries, Indoor plants and flowers.
9. Arboriculture – Pruning, bracing, feeding and transplanting. Bonsai.
10. Floriculture – commercial floriculture – Production of cut flowers and home floriculture.
11. Disease and pest control in gardening- Fungicides and pesticides.
12. Plant growing problems and their control.

References

1.Hartmann H.T, Kester D.E., Davies F.T and Geneve R.L. 1997. Propagation and practicll6th Edn. Prentice Hall of lndia, Pvt. Ltd. New Delhi.

2.Lancaster P 1997. Gardening in India. Revised hy Bose T.K. and Mukherjee D.

3.Laurie A and Ries V. 1956. Floriculture: fundamentals and practices Mc Graw Hill Book Co. Inc. N.Y. Trinidad, London.

4. Macmillan 1962. Tropical planting and gardening, 5th Edn. Macmillan Co. Ltd. London.

5. Northen TH. and Northen RT 1956. The complete book of green house gardening. The Ronald Press Co. New York.

6. Pearce S .A. 1961. Ornamental tree: For gardening and roadside planting: W. H & L Collingridge Ltd. London.

7. Prakash R Choudhary D. C. and N agi S.S. 1991. Propagation practice of important Indian trees. IntI. Book Distributors, Dehra Dun.

8. Radford A.E. 1986. Fundamentals of plant systematics. Harper & Row Publ. Inc.

9. Hay R.(Ed.) 1960. The modern garden. G. Arthur Pearson Ltd. London.

10. Shoemaker J.S. and Teskey BJ.E. 1965. Practical Horticulture. John Wiley & Sons. Inc. London.

Module-3 Biostatistics:

1. Quantitative methods in biology- introduction
2. Methods of data collection- primary and secondary data- census and sampling methods.
3. Tabulation and presentation of numerical data- diagrammatic and graphical presentation.
4. Measures of central tendencies- mean, median and mode. Skewness and curtosis.
5. Measures of variations- range, quartile deviation, mean deviation- variance and standard deviation. Standard error and Coefficient of variation.
6. Tests of significance- z, t and χ^2 tests.
7. Analysis of variance.
8. Correlation and regression analysis.
9. Factor and cluster analysis.
10 Experimental designs.

References:

1. Pagano M. and Gauvreau K. Principles of Biostatistics. Duxbury.

2. Sharma J. R. Statistical and biometrical techniques in Plant Breeding. New Age International Publishers.

3. Panse V. G. and Sukhatme, P. V. Statistical Methods for Agricultural Workers. ICAR.

4. Rangaswamy R. A Text Book of Agricultural Statistics. New Age International Publishers.

5. Jasra P. K. Biostatistics. Krishna Prakashan Media (P) Ltd.

PS3C09 Cell & Molecular Biology, Genetics, Evolution

Module-1 Genetics

1. Mendelism- Mendelian factors- segregation of mendelian factors- dominance, codominance and incomplete dominance of mendelian factors.

2. Independent assortment- interaction of genes- multiple allelism.

3. Linkage and joint segregation- Linkage analysis- mapping of genes- linkage and recombination in eukaryotes and prokaryotes- Mapping by different methods.

4. Quantitative genetics- Multiple factors- continuous variation- continuous and threshold traits- QTL- Heritability- transgressive variation.

5. Plasmagenes- cytoplasmic inheritance- chloroplast genes and mitochontrial genes- maternal inheritance- informosomes- Applications of extranuclear inheritance.

6. Genetics of sex determination- sex linkage- sex linked, sex influenced and sex limited characters- sex linked lethal mutations.

7. Genetics of photosynthesis

8. Genetics of Nitrogen fixation

9. Biometrical genetics- probability and genetics- prediction of genetic behaviour- statistical tools in genetic analysis.

10. Genetics of prokaryotes- genetic organization of bacteria and viruses- bacterial mutants- transformation, conjugation and transduction.

11. Developmental genetics- genetic control of development in plants- genetic control of cell lineages.

12. Behavioural genetics- Genetics of biorhythms- genetics of mammalian clock- genetics of behaviour.

13. Applied genetics- Eugenics, euphenics and euthenics. Immunogenetics.

14. Regulation of gene action in prokaryotes and eukaryotes.

15. Genetic structure of populations and its change - Hardy–Weinberg equilibrium – Sewall Wright effect - changes in genetic structure, causes and consequences – speciation and evolution.

References

1. Kowles R. Solving Problems in Genetics. Springer.

2. Sambamurthy A. V. S. S. Genetics. Narosa Publishing House.

3. Brooker R. J. Genetics: Analysis and Principles Addison Wesley Longman Inc.

4. Hedrick P. W. Genetics of Populations. Jones and Bartlett Publishers.

5. Griffiths A. J. F., Gelbbart W. M., Lewontin R. C., Miller J. H. Modern Genetic Analysis. WH Freeman & Company.

6. Dabholkar A. R. Elements of Biometrical Genetics. Concept Publishing Company.

7. Frankel O. H. and Bennet E. Genetic Resources in Plants. Blackwell.

8. Hotter P. Text book of Genetics. Ivy Publishing House.

9. Satpathy G. C. Genetics. Kalpaz Publications.

Module-2 Cell & Molecular Biology

1. Cells & Their Environment: Ultra structure, composition & functions of cellular junctions, cell wall, cell membrane, detailed study of membrane-spanning helices, membrane fluidity, membrane potential & membrane transport.

2. Ultra structure, composition & functions of mitochondria, plastids, GERL complex; detailed study of mitochondrial Import, Structure of ATP Synthase, Chaperones & Chaperonins, Kinetoplast; Mitochondrial Heterosis, Mitochondrial Abnormalities of Plants & Mitochondrial Diseases. Organisation of Thylakoids & chloroplast Membranes, Chloroplast Import, Photosynthetic Domains, Chlorophyll Binding Proteins; Chlorosomes & Chromatophores, Cell Vacuoles, Endocytosis & Exocytosis.

3. Microbodies: Glyoxisomes, Peroxisomes, Oxalosomes, Glycosomes, Hydrogenosomes; Ribosomes: Different Types (Prokaryotic, Eukaryotic, Cytoplasmic, Organellar, etc.), Structure, Components & Ribosomal Active Sites; Ribosomal Dimers, Polysomes.

4. Nucleus: Ultra Structure, Nuclear Membrane, Nuclear Pore Complex, Euchromatin, Heterochromatin, Prochromatin, Antichromatin, Nucleolus, Nuclear Matrix, Nuclear Lamina & Chromatin Assembly Factor (CAF).

5. Chromosomes: Structure, Chemistry and Organization, Kinetochore, Satellites, Chromomeres, Chromosome Knobs, Chromosome Coiling, Chromosome Compaction, Chromosome Core & Chromosome Scaffold; Special types of Chromosomes: Polytene Chromosomes & Lamp Brush Chromosomes, Structure & Significance of Giant Chromosomes in Plants, B-Chromosomes, Micro & Mega Chromosomes, Neocentric & Holocentric Chromosomes.

6. Cytoskeleton, Cell Motility & Cell Cycle – Molecular Motors, Microfilaments & Microtubules, Actins & Tubulins, Microtubule Associated proteins (MAP) - Dynein, Dynactin, Kinesin, Kinectin; Intra-cellular & Inter-cellular Kinetics. Progression & Regulation, Mitosis & Meiosis – Chromosome Mechanisms and Events, Ultra Structure of Synaptonemal Complex & Spindle Apparatus, Centrosome & Spindle Pole Body.

7. Molecular Structure of DNA: Topology of DNA, Forms & types of DNA (Super Helical- Circular, Nicked-Circular, Linear, Satellite, selfish,), Types of DNA - A, B, C, D, E, H, Z, RL Helix & Triple Helix; Organellar DNA (ct DNA & mt DNA); DNA Bending & Binding, DNA Binding Protein Domains; Replication of DNA: DNA Replication In Vivo, Types of DNA Replication (Conservative, Semiconservative & Dispersive), Replication Apparatus, Mechanism of Replication, Concurrent & Simultaneous Replication, Bidirectional Replication, Rolling Circle Model of DNA Replication; DNA Synthesis *In Vitro*.

8. Gene Expression & Gene Regulation: Transcription in Prokaryotes, Transcription & RNA Processing in Eukaryotes, RNA Splicing & Spliceosomes, Introns, Intron Homing, Exons, Exon Shuffling, RNA Editing; Structure & Composition of RNA - rRNA, mRNA, tRNA (Clover Leaf Model & 'L'- Shaped Tertiary Conformation) & snRNA; Genetic Code & Exceptional Codon Meanings; Protein Synthesis & Protein Synthesis Inhibitors; Genetic regulation in Prokaryotes, Operon Concept (lac Operon, trp Operon, ara Operon, his Operon, etc.), Gene Expression in Eukaryotes, Coordinate & Environmental Regulation of Gene Expression.

9. Mutation & DNA Repair Mechanisms: Somatic & Germinal Mutations, Spontaneous & Induced Mutations, Environmental Mutagens, Molecular Basis of Mutation, DNA Repair Mechanisms (Light-Dependant-, Excision-, Mismatch-, Post Replication- & SOS Repair).

References:

1. Pon, L. A. & Schon, E. A. 2001. Mitochondria. Academic Press.
2. Scicchitano, D. 1998. Molecular Cell Biology W. H. Freeman & Co.
3. Karp, G. 2004. Cell and Molecular Biology: Concepts and Experiments. Fourth Edition. Wiley.
4. Alberts, B. et al. 2007. Molecular Biology of the Cell. Taylor & Francis Inc.
5. Morris, K. V. 2008. RNA and the regulation of gene expression: A hidden layer of complexity. Caister Academic Press.
6. De Robertis, E. D. P. & De Robertis, E. M. F. 1987. Cell and Molecular Biology. Lea & Febiger.
7. Turner, B. M. 2002. Chromatin and Gene Regulation. Blackwell Publishing Co.
8. Allison, L. 2007. Fundamental Molecular Biology. Blackwell Publishing Co.
9. Carroll, S. 2004. From DNA to Diversity. Blackwell Publishing Co.
10. Glick, B. R. & Thompson, J. E. 1993. Methods in Plant Molecular Biology and Biotechnology, Promega.

Module-3 EVOLUTION

1. Origin and evolution of life
2. Classical and synthetic theories of evolution
3. Forces of evolution, Mechanism of evolution
4. Species concept, Speciation
5. Isolation mechanisms
6. Evolution above species level
7. Molecular evolution

References

Barton, N. H. et al. 2007. Evolution. Cold Spring Harbor Laboratory Press.
Kardong, K. V. 2007. An Introduction to Biological Evolution. McGraw-Hill.
Ridley, M. 2004. Evolution. Oxford University Press.

PS3P05 Angiosperm Morphology, Angiosperms Taxonomy, Phytogeography, Plant Breeding

Practicals

Module-1 Angiosperm Morphology

I. Preparation of cleared whole mounts of floral parts to show vasculature.

2. With the help of dissections and hand sections, examine

a) Transmitting tissue/canals in style and stigma.

b) Different types of ovaries.

e) Different types of placentation.

d) Vasculature of androecium and gynoecium in special types of flowers.

Module-2 Angiosperm Taxonomy and Phytogeography

1. During the course of this study, the student shall get familiar with the local flora.

2. The students should get familiar with the method of dissecting and studying plants in the laboratory, describing them in technical terms, preparing scientific illustrations, constructing artificial keys and identify them based on Bentham and Hooker's system of classification. For this purpose, each student shall work out at least 2 members of each of the following families of angiosperms available in the area: Menispermaceae, Annonaceae, Polygalaceae, Caryophyllaceae, Tiliaceae, Rutaceae, Rhizophoraceae, Melastomataceae, Aizoaceae, Rubiaceae, Asteraceae, Oleaceae, Apocynaceae, Asclepiadaceae, Gentianaceae, Boraginaceae, Scrophulariaceae, Lentibulariaceae, Pedaliaceae, Acanthaceae, Lauraceae, Loranthaceae, Euphorbiaceae, Urticaceae, Commelinaceae, Zingiberaceae, Araceae, and Poaceae.

3. During the course of this study, each student shall undertake a field study tour for at least 3 days, under the guidance and supervision of a teacher, at a place ecologically and floristically different from their place of regular study. Each one shall also collect plant specimens for herbarium preparation and shall submit at least fifty, well preserved, correctly identified and labeled herbarium specimens along with the field book and report for evaluation during the course of their practical examination.

4. Interpretation of maps, charts, landsat imageries, etc. pertaining to the vegetation distribution, continental drift etc.

Module-3 Plant Breeding:

1. Floral biology of rice, legumes, cashew, Capsicum and Solanum.

2. Emasculation and hybridization in plants like rice, legumes, cashew, Capsicum and Solanum.

PS3P06 Horticulture, Biometry, Cell &Mol. Biology, Genetics,

Module-1 Genetics:

1. Problems based on independent assortment, gene interaction and multiple allelism.

2. Problems based on linkage and chromosome mapping.

3. Problems based on quantitative genetics

4. Problems based on population genetics.

Module-2 Cell & Molecular Biology

1. Study of mitotic index of the specimen supplied.

2. Camera Lucida drawings of Karyotype from a permanent slide.

3. Study of meiosis in Datura/Rhoeo/Chlorophytum by smear preparation of PMCs.

4. Study of giant chromosomes in Drosophila.

5. Exercises related to the theory parts have to be worked out.

6. Extraction of DNA/RNA from plant tissues.

7. Isolation and staining of DNA/RNA from plant tissues.

8. Colorimetric estimation of DNA by Diphenylamine method.

9. Colorimetric estimation of RNA by Orcinol method.

10. Extraction and isolation of nucleic acid from leaf tissue.

Module-3 Horticulture

1. Budding – 'T' Budding and Patch Budding

2. Layering – Any two methods.

3. Grafting – Any two methods.

4. Tools and Implements.

5. Determination of soil pH

Module-5 Biostatistics:

1. Diagramatic and graphic representation of data using programmes like MS Excel, Open office Calc or Statistica.

2. Analysis of numerical data for mean, median, mode, variance, standard deviation, standard error and coefficient of variation.

3. Analysis of variance between data from different samples using MS Excel.

4. Calculation of correlation coefficient between groups of data and calculation of critical difference.

IV SEMESTER

PS4E01 Agrobiotechnology

Credit: 4

1. Introduction

2. Microbial inoculants: microbial consortium or mixed inoculants

3. Agrobacterium and Plant Genetic Engineering: Agrobacterium mediated gene transfer and cloning. Types of plant vectors and their use in gene manipulation. Selectable markers for plant transformation Agrobacterium mediated gene trasfer Molecular mechanism of T-DNA transfer - based on vector and Ti plasmid; protocol for Agrobacterium-mediated genetic transformation of plants; its success in monocots and dicots with specific examples

4. Plant Viruses: Classification, diagnosis, remedy, molecular mechanism of multiplication, viruses as a tool to deliver foreign DNA.

5. Molecular biology of *Arabidopsis thaliana*.

6. Developmental Aspects of Rhizobium: Biological Nitrogen Fixation- nif genes- structure, transfer prospects. Nitrogenase biochemistry, function Legume Symbiosis, Symbiotic Nitrogen Fixation, Regulation of nif and nod genes, biochemistry of leg-haemoglobin. Biofertilizers- significance.

7. Green manuring: algae and other biofertilizers; mass cultivation of cyanobcteria biofertilizers; mass cultivation of azolla; endophytic nitrogen fixers.

8. Molecular Aspects of Disease Susceptibility and Resistance: Transposable elements in plants, factors influencing disease resistance and susceptibility. Bar-coding.

9. Transgenics: Stress tolerance - Biotic and abiotic - temperature, salinity, drought etc. Pests and insects resistance – viral resistance – development of disease resistant plants by introducing Bacillus thuringiensis genes, Bt-cotton.

10. Crop protection: microbial herbicides, bacterial insecticides, bacterial species as bacterial insecticides; virus insecticides; entomopathogenic fungi.

11. Crop Improvement in India through Biotechnology: Rice, wheat, oil seed crops, forage crops, commercial crops, plantation crops, beverages crops, spices and condiments, tuber crops, fruit crops.

12. Biodiesel and biofuel: potent crops for biofuel production, mechanism, transesterification reaction.

References:

1. Purohit S. S. Biotechnology: Fundamentals and application. Agrobios.
2. Lewin B. Genes. Pearson Educational International.
3. Peter KV. Horticulture Science Series. New India Publishing Agency.
4. Nelson DL & Cox MM.Lehninger Principles of Biochemistry, WH Freeman and Company.
5. Channarayappa. Molecular Biotechnology: Principles and Practices. Universities Press (India) P.Ltd.
6. Sudhir M. Applied Biotechnology and Plant Genetics. Dominant Publishers & Distributors.
7. Gilmartin PM & Bowler C. Molecular Plant Biology. Oxford University Press.
8. Karanth B. Selected Readings in Plant Genetics and Biotechnology. Book Enclave.
9. Ranjan R. Transgenic Plants. Agrobios.
10. Jha TB & Ghosh B. Plant Tissue Culture: Basic and Applied. Universities Press (India) P.Ltd.
11. Piramal V. Molecular Biotechnology. Dominant Publishers & Distributors.
12. Sudhir M. Plant Biotechnology. Dominant Publishers & Distributors.
13. Das H. K. Text Book of Biotechnolgy. (ed). Wiley Dreamtech India P.Ltd.

PS4E01 Environmental Biotechnology

Credit: 4

1. Introduction

2. Classification and characterization of wastes.

3. Scientific aspects of biological wastes; treatment for biofuel production

4. Design of bioreactors for liquid waste treatment.

5. Concept of waste management - Waste minimization, Recycling of industrial wastes, Treatment of hazardous wastes, Effects of improper waste disposal.

6. Cleaner technologies: Fermentation. Bioremediation - need and scope, Applications - Removal of toxic chemicals from industrial waste water. Biological gas treatment systems (biofilters, biofilms, bioscrubbers). Japanese global applications of bioremediation technology – Replacement of petrochemicals, Reversal of global warming, Biodegradable plastics, Reversal of desert formation. Microbial conversion of CO2 to alcohol.

Hyper-accumulators: definition, important hyper accumulators, significance.

Phytoremediation: definition, types: Phytoextraction, phytostebilization, rhizofiltration; significance

7. Biofertilizers- significance. Biological Nitrogen Fixation- nif genes- structure, transfer prospects. Nitrogenase biochemistry, function.

8. Biosensors. Biochips.

9. Economic and social aspects of waste treatment

10. Prospects of remote sensing in environmental studies.

11. Environmental issues of Kerala Industrialisation.

Reference

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1. Jha TB & Ghosh B. Plant Tissue Culture: Basic and Applied. Universities Press (India) P.Ltd.

2. Slater A, Scott N, Fowler M. Plant Biotechnology: The Genetic manipulation of Plants. Oxford University Press

3. Sudhir M. Plant Biotechnology. Dominant Publishers & Distributors.

4. Smith RH. Plant Tissue Culture: Techniques and Experiments. Academic Press.

5. Ambasht, R.S. and Ambasht, N.K., 1996. A Text book of Plant Ecology. Students Friends and Co. Varanasi.

6. Park, C. 1997. The Environment. Principles and Applications. Routledge London and New York.

7. Aaradhana P.S. (ed.)1998, Environmental Management. Rajat Publications, Delhi.

8. Jeffrey D.W. 1987. Soil Plant Relationship an ecological approach. Croom Helm.

9. Jones H.G. 1983. Plants and microclimate: a quantitative approach to environmental Plant Physiology. Cambridge University Press.

10. Karanth B. Selected Readings in Plant Genetics and Biotechnology. Book Enclave.

11. Trivedi, R.K., Goel P.K. and Trisal C.L. 1987. Practical Methods in Ecology and Environmental Science. Enviro Media Publications, Karad (India)

12. Mohan, I., 1989. Environmental Pollution and Management. Ashish Publishing House, New Delhi.

13. Reeve R.N., 1994. Environmental Analysis. John Wiley and Sons, New York.

PS4E02 Plant Tissue Culture

Credit: 4

1. Plant cell and tissue culture: introduction, history, scope.

2. Basic aspects of plant tissue culture; totipotency, morphogenesis, differentiation and polarity; different culture media; components; growth

regulators; growth retardants; undefined supplements; explants; sterilization;

Inoculation; subculturing, etc.

3. Different types of cultures: callus- different types; cell culture; suspension culture-different types; culture methods of single cells; testing of viability of cells; application of cell and callus culture with special reference to medicinal and aromatic plants. *In vitro* morphogenesis; differentiation.

4. Organogenesis- different types; factors effecting; problems related to micropropagation of woody (Medicinal) plants. Different stages of micropropagation, Somaclonal variation and its importance with special reference to medicinal and aromatic plants.

5. Somatic embryogenesis: direct and indirect; Factors effecting; embryo maturation; application. Synseeds and its significance.

6. Production of Pathogen free plants: Different methods; Meristem culture and its importance in commercialization especially of Medicinal and Aromatic plants.

7. Protoplast: Isolation and culture methods; Factors effecting; Somatic hybridization:

Different types; Fusion methods. Application with special reference to Medicinal and Aromatic plants.

8. Haploids: Different types: Androgenesis and gynogenesis, Advantages; Significance in crop improvement with special emphasis on Medicinal and Aromatic plants.

9. Ovary, ovule, endosperm and embryo culture; importance. *In vitro* fertilization (recent advances) and its significance.

10. Secondary metabolites: Different classes; methods of production- factors effecting yield. Biotransformation; Different types with examples. Immobilization: Different approaches: Advantages.

11. Tissue culture in lndia with special reference to Kerala. Exploitation of medicinal plants of Kerala by Tissue culture.

12. Application of Plant Tissue Culture: Clonal propagation, artificial seed production of hybrids and somaclones, drugs, products, cryopreservation and germplasm storage.

References:

1. Bhojwani, S. S. and Razdan, M. K. 1996. Plant Tissue culture: Theory and Practice. Elsevier.

2. Doods, J. H. and Roberts, L. W. 1985. Experiments in Plant Tissue culture, Cambridge University Press.

3. George, E. F. 1993-96. Plant propagation by Tissue culture-2 vols. Exegetics Ltd.

4. Narayanaswamy, S. 1994. Plant cell and Tissue culture. Tata McGraw Hill Ltd.

5. De, K. K. 1995. Plant Tissue Culture. New Central Book Agency.

6. Razdan, M. K. 1995. An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co. Pvt. Ltd.

PS4E02 ECOPHYSIOLOGY OF PLANTS

Credit: 4

1. Water relations – transpiration as an inevitable consequence of photosynthesis, water availability and field capacity of different soils, water movement towards rooting profiles as dependent on soil moisture content, roots sense moisture gradients and grow towards moist patches, effect of soil and drying on leaf conductance, effect of vapour pressure difference on transpiration rate of leaf, effect of irradiance and CO_2 on leaf conductance, cuticular conductance and the boundary layer conductance, compromise between carbon gain and water loss, water storage in leaves of aquatic angiosperms, adaptations to drought and dessication, avoidance – annuals and deciduous species, desiccation tolerance-evergreen shrubs, resurrection plants, winter water relations and freezing tolerance, salt tolerance.

2. Mineral nutrition – nutrients in the soil, nutrient movement to the root surface, root trails that determine nutrient acquisition, acclimation and adaptation of nutrient uptake kinetics, response to nutrient supply, acquisition of phosphate solubilising compounds, changes in the chemistry and $_{P}H$ in the rhizosphere, exertion of organic chelates, root proliferation in nutrient rich patches, biotic influences – symbiotic association, mycorrhiza and actinomycetes, mechanics of enhanced uptake of phosphorus, carbon cost of micorrhizal symbiosis, agricultural and ecological perspectives, association with nitrogen fixing organism, symbiotic, legume-rhizobium association, carbon costs of legume-rhizobium symbiosis at low $_{P}H$ and in the presence of large supply of combined nitrogen, endosymbiosis, ecological effects of non symbiotic association with nitrogen fixing organisms.

3. Photosynthesis - carbon cycle and ecosystems, supply and demand of CO_2 in the photosynthetic process, stomatal and boundary layer conductance, the internal conductance. Physiological and anatomical differences between sun and shade leaves, light response curve of sun and shade leaves, environmental signal for shade acclimation in chloroplasts, effect of excess irradiance, photo inhibition-protection by carotinoids of xanthophylls, chloroplast movement in response to changes in irradiation, photosynthesis under high activation of rubisco, post illumination CO_2 assimilation and sunfleck utilization efficiency. Partitioning of photo assimilate, regulation of the rate of photosynthesis by feed-back mechanism, glucose repression of genes encoding Calvin cycle enzymes, ecological impacts mediated by source sink interactions, effect of soil nutrient supply on photosynthesis, interaction of nitrogen with light and water, effect and adaptations of high temperature on photosynthesis, heat shock protein mediated thermotolerance.

4. Respiration: Role of respiration in plant carbon balance, ecological aspect and concern of plant respiration, ATP production in isolated mitochondria and *in vivo* oxidative phosphorylation, regulation of electron transfer via cytochrome and alternative pathways, ecological functions of alternative pathway, heat production.

5. Transport of assimilates: major transport compounds. Long distance transport of assimilates: symplastic and apoplastic; ecological distribution of assimilates, phloem structure, loading and unloading transport problems of climbers.

6. Ecology in relation to growth and development: Seed development– influences and adaptations, seed germination and dormancy,-hard seed coat, ecological aspects of dormancy and germination, seedling development-juvenile phase, delayed flowering, delayed greening during leaf development in tropical trees, reproductive phase – timing of development by sensing day length, short day and long day plants (photoperiodism) in relation with flowering, spring and autumn timing of flowering by sensing temperature (vernalization), effect of temperature on pollination.

7. Ecological biochemistry: allelopathy and defense mechanism, defense against herbivores, qualitative and quantitative defense compounds, mode of mechanism for plants not being killed by their own poisons, environmental effect on the production of secondary plant metabolites, induced defense and communication between neighboring plants, chemical defense and secondary metabolites.

8. Ecosystem global process: decomposition of litter, link between decomposition rate and nutrients mineralization, root exudation and rhizosphere effects, ecophysiological controls, ecosystem and biomass productivity, scaling from plants to ecosystem, physiological basis of productivity, net carbon balance of ecosystems, and global carbon cycle.

References:

1. Shaw, A.J. 1990. Heavy Metal Tolerance in Plants: Evolutionary Aspects. CRC Press.

2. Chakraborty, U. and Chakraborty B. 2005. Stress Biology. Narosa Publishing House.

3. Orcutt, D.M. and Nilsen, E.T. 2000. Physiology of Plants under Stress: Soil and Biotic Factors. John Wiley & Sons, Inc.

4. Prasad, M.N.V. 1997. Plant Ecophysiology. John Wiley & Sons, Inc.

5. Prasad, M.N.V. and Strzalka, K. 2002. Physiology and Biochemistry of Heavy Metal Detoxification and Tolerance in Plants. Kluwer Academic Publishers.

6. Lecrec, J.C. 2003. Plant Ecophysiology. Science publishers Inc.

7. Prasad, M.N.V. 2004. Heavy Metal Stress in Plants: From Biomolecules to Ecosystems. IInd Ed. Springer-Verlag.

8. Kvesitadze, G., Khatisashvili, G., Sadunishvili, T. and Ramsden, J.J. 2006. Biochemical Mechanisms of Detoxification in Higher Plants: Basis of Phytoremediation. Springer-Verlag.

9. Madhava Rao, K.V., Raghavendra, A.S. and Janardhan Reddy, K. 2006. Physiology and Molecular Biology of Stress Tolerance in Plants. Springer.

PS4E03 PRINCIPLES AND PRACTICES OF HORTICULTURE AND GARDEN MANAGEMENT

1. Concept and scope: Definitions of different types gardens, concept behind each, brief history, familiarization of famous gardens in the world and in India, economic - educational - hygienic - and aesthetic values, scope of the study and further researches on gardening.

2. Basic requirements: Land, water, soil, landscape, on-scape and off-scape, seeds and seedling materials, propagules, traditional implements and practices - factors taken care in growing nurseries and plants, ornamentalsannuals - perennials - flowering trees - climbers - bulbous plants, varietal collections,germ plasm collection and specialized collections.

3. Classification of gardens and horticultural taxonomy: aesthetic gardens, home gardens, public parks, gardens associated with buildings, offices, schools and colleges, rock gardens, bog gardens, roof gardens, container gardens, bonsai, vegetable gardens, kitchen gardens, fruit gardens (orchards), medicinal plant gardens, forest nurseries, social forestry.

4. Specialized features associated with gardens: Garden walks, paths, pavements, terraces, lawns, hedges, horders, arches, pergolas, fountains, benches, ponds, bridges, umbrellas, statues, dwarfing. pruning. topiery, tree surgery, avenues, green house, cold frames, hot beds, nurseries.

5. Propagation methods related to different types of gardens: Seed propagation, seed biology, seed testing, seed storage, germination, dormancy, orthodox and recalcitrant seeds. Propagation by cutting, grafting, budding, layering, polarity in grafting, graft incompatibility, scion-stock relationships, propagation by specialized stems and roots, methods of micropropagation.

6. Implements, tools, small-scale machineries and their uses: Ploughs, power tillers, conventional/traditional agricultural tools; specialized tools- pruning knife, budding knife, secatures, lawn mower, sprayers, metal label, name boards,

7. Diseases, pests, control measures.

8. Fertilizers: manures, growth promoters, other chemicals - their uses. Biofertilizers, green manure, mulching, cover crops. Insecticides, pesticides, fungicides and weedicides. Flower hormones, root hormones, ethylene.

9. Sources of pollution and prevention by suitable garden practices. Pollution , what, where and why? Pollution by pesticides, feed lots, fertilizer run-off. soil erotion, plant residues, etc.

10. Planning and management of gardens: Budget making, pricing, sales promotion and marketing, labour management, master rolls, accounting.

References

1.Hartmann H.T, Kester D.E., Davies F.T and Geneve R.L. 1997. Propagation and practicll6th Edn. Prentice Hall of lndia, Pvt. Ltd. New Delhi.

2.Lancaster P 1997. Gardening in India. Revised hy Bose T.K. and Mukherjee D.

3.Laurie A and Ries V. 1956. Floriculture: fundamentals and practices Mc Graw Hill Book Co. Inc. N.Y. Trinidad, London.

4. Macmillan 1962. Tropical planting and gardening, 5th Edn. Macmillan Co. Ltd. London.

5. Northen TH. and Northen RT 1956. The complete book of green house gardening. The Ronald Press Co. New York.

6. Pearce S .A. 1961. Ornamental tree: For gardening and roadside planting: W. H & L Collingridge Ltd. London.
7. Prakash R Choudhary D. C. and N agi S.S. 1991. Propagation practice of important Indian trees. IntI. Book Distributors, Dehra Dun.
8. Radford A.E. 1986. Fundamentals of plant systematics. Harper & Row Publ. Inc.
9. Hay R.(Ed.) 1960. The modern garden. G. Arthur Pearson Ltd. London.
10. Shoemaker J.S. and Teskey BJ.E. 1965. Practical Horticulture. John Wiley & Sons. Inc. London.

PS4E03 Principles & Applications of Ethnobotany
Credit: 4

1. Ethnobotany: Definitions, Scope, and functions.
2. History and development of Ethnobotany: Development of Ethnobotany in Asia with special reference to that in India, Ethnobotany outside Asia.
3. Traditional Scientific knowledge: Indigenous technical knowledge (ITK): Indigenous Agricultural knowledge (IAK), Traditional ecological knowledge (TEK), Rural people's knowledge (RPK), Traditional botanical knowledge (TBK), Integrated knowledge system (IKS).
4. Documentation and interpretation of Traditional Botanical Knowledge: Basic approaches to the study of Traditional Botanical Knowledge - Utilitarian, Cognitive, and Ecological.
5. Scientific validation of traditional plant use: Nutritional quality, Pharmacological properties. Insect repellent activity.
6. Collecting Ethnobotanical Evidence: The dynamics and distribution of traditional botanical knowledge.
7. Sources of knowledge: The dissemination of traditional botanical knowledge, differential distribution of traditional botanical knowledge: Socio-cultural influence on knowledge distribution - Intercultural influences (Mode of production. Biological environment. Level of external contact (acculturation), Ethnicity, Religion), Intracultural influences - Gender, Age, Class, Place of birth, Literacy, Occupation, Migration for work or marriage. Age at marriage. Kinship and marriage relations. Number of children, Number of generations in the household. Language ability.
8. Protection of Traditional Botanical Knowledge.
9. Major tribes of Kerala and their dependence on plants.
10. Methods in ethnobotanical study: General ethnobotanical techniques-Anthropological field methods. Quantitative approach (Open-ended and semi-structured interviews, 'Hands on' learning of traditional techniques) and Qualitative approach (Structured interviews and questionnaires, Free-listing, Pile sorting and preference ranking: triadic and paired, Systematic surveys -e.g., of transects or hectare plots); Quantification and verification: Free-listing, Preference ranking. Direct matrix ranking. Utilization surveys.
11. Interview techniques and elicitation methods: Choosing participants. Linguistic and other symbolic analyses - Symbolic and Empirical analysis of Myths and Folklore; Plant labels and cultural significance.

12. Archaeobotanical data: Observation of archaeobotanical remains and collection of data. Evidences from specialized archaeological contexts. Dating methods and data presentation

13. Practical applications of Ethnobotanical data: External benefits - National and Global interests in ethnobotany: Ethno-directed sampling in Biodiversity Prospecting: Plant derived drugs used in orthodox medical practice; Traditional Plant management and Environmental conservation ; Traditional germplasm management : in situ and ex situ conservation; Local benefits: Cultural survival and community development: Ethnomedicine and Primary health care; Renewable plant products: Sustainable source of income; Protecting local resources.

14. Commercialization and conservation: Sustainable development - Economic growth and resource conservation.

References:

1. Chaudhuri, Rai, H. N., Guha, A., Roychowdhury, E. & Pal, D. C. 1980. Ethnobotanical uses of Herbaria-II. J. Econ. Tax. Bot. 1:163-168.

2. Chaudhuri, Rai, H. N., Banerjee, D. K. & Guha, A. 1977. Ethnobotanical uses of herbaria. Bull. Bot.Surv. India19:256-261.

3. Faulks, P.J. 1958. An Introduction to Ethnobotany. Moredale Publications Ltd., London.

4. Ford, R. I.(Ed.). 1978. The Nature and Status of Ethnobotany. Anthropological Paper no.67. Museum of Anthrop., Univ.of Michigan.

5. Harshberger, J. W. 1896. The Purpose of Ethnobotany. Bot. Gazette 31 : 146-154.

6. Jain, S. K. & Rao, R. R. 1983. Ethnobotany in India-An Overview. Botanical Survey of India.

7. Jain, S. K. (Ed.). 1981. Glimpses of Indian Ethnobotany. Oxford & IBH Publishing Co.

8. Jain, S. K. 1964. The role of a Botanist in folklore Research. Folklore 5:145-150

9. Jain, S. K. 1967a. Ethnobotany – Its scope and study. Indian Museum Bull. 2:39-43.

10. Jain, S. K. 1995. A Manual of Ethnobotany. Scientific Publishers.

11. Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. & Das, D.1984. Bibliography of Ethnobotany. Botanical Survey of India.

12. Ranfrew, J. 1973. Paleoethnobotany. Columbia University Press.