BHARATHIAR UNIVERSITY, COIMBATORE: 641 046

M. Sc. BOTANY DEGREE COURSE *(AFFILIATED COLLEGES)*

(Restructured syllabi with effect from the academic Year 2017-2018 onwards)

SCHEME OF EXAMINATIONS – CBCS PATTERN

Sem.	Study Components	Course title	*Ins. hrs/week*	Examinations *Dur. Hrs.*	*CIA*	Mark	Total	*Credit*
I	Paper I	Phycology, Mycology and Lichenology	5	3	25	75	100	4
	Paper II	Bryophytes, Pteridophytes , Gymnosperms and Paleobotany	5	3	25	75	100	4
	Paper III	Environmental Botany and Conservation Biology	5	3	25	75	100	4
	Paper IV	Microbiology	5	3	25	75	100	4
	Elective I-	Phytopathology (Without practical Examination)	5	3	25	75	100	4
II	Paper V	Cell and Molecular biology	5	3	25	75	100	4
	Paper VI	Genetics, Evolution and Plant Breeding	5	3	25	75	100	4
	Paper VII	Anatomy, Embryology and Morphogenesis	5	3	25	75	100	4
	Paper VIII	Plant tissue culture	5	3	25	75	100	4
	Elective II –	Horticulture (Without practical Examination)	5	3	25	75	100	4
	Practical - I	(Papers I to IV)	5	3	40	60	100	4
	Practical - II	(Papers V to VIII)	5	3	40	60	100	4
III	Paper IX	Plant Taxonomy	5	3	25	75	100	4
	Paper X	Medicinal Botany	5	3	25	75	100	4
	Paper XI	Plant Physiology	5	3	25	75	100	4
	Paper XII	Phytochemistry	5	3	25	75	100	4
	Elective-III	Bioinstrumentation and Biological Techniques (Without practical Examination)	5	3	25	75	100	4
IV	Paper XIII	Biotechnology and Genetic Engineering	5	3	25	75	100	4
	Elective IV-	Bioinformatics and Biostatistics (Without practical Examination)	5	3	25	75	100	4
	Practical - III	(Papers IX & X)	5	3	40	60	100	4
	Practical - IV	(Papers XI, XII & XIII)	5	3	40	60	100	4
	*Project &Viva voce Examination		10	-	-	-	150	6
	Total						**2250**	**90**

*** Project report – 120 marks; Viva-voce – 30 marks**

Method of implementation and evaluation of Project

- Based on the strength, students will be allotted to staff members by lot in the first week after reopening the college.
- Student should present the proposed project work before department council to get approval within one of reopening the college.
- Students are permitted to collect relevant literature in the field concerned during working days without disturbing the normal classes.
- After making protocol, experiments in the respective fields will be conducted by the students in the laboratory and field according to their need.
- Periodical review meetings will be conducted with the students by the faculty to assess the progress of the work.
- After getting the data of findings students will be guided to write the dissertation.
- The dissertation will be corrected thoroughly by the respective guides and then permitted to submit in the first day of practical examination.
- It should be duly signed by the research guide and the head of the Department and submitted for evaluation. The dissertation to be submitted should include:
  - Introduction
  - Objectives of the study
  - Materials and methods
  - Results and discussion
  - Summery and conclusion
  - References
- The dissertations will be evaluated as follows :

1. Internal evaluation by guide - **60 marks**
2. External evaluation by external examiner - **60 marks**
3. Open viva-voce examination - **30 marks**

SEM.I

Paper I - PHYCOLOGY, MYCOLOGY AND LICHENOLOGY

UNIT-I:

Classification of Algae (Fritsch, 1945), Salient features of major classes: Prochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Phaeophyta and Rhodophyta. Ultrastructure of Prokaryotic and Eukaryotic algal cells and their components - cell wall, protoplasm, flagella, eye spots, chloroplast, pyrenoid, nucleus, pigments and reserve foods. Economic importance of algae - Food and feed - Single cell protein - Industrial products (Agar-Agar, Carrageenan, Iodine, Vitamins) - In medicine and industry.

UNIT-II:

Ecology of Algae: Freshwater algae, marine algae, soil algae, symbiotic algae and parasitic algae. Algae as pollution indicators, algal blooms, algicides culture and cultivation of fresh water and marine algae - Knop's solution and Chu-10 medium (1972).Range of thallus structure, origin and evolution of sex in algae, phylogeny and interrelationships of algae. Lifecycle patterns in algae and alternation of generations, Fossil algae.

UNIT-III:

Classification of Fungi (Alexopoulos and Mims, 1979), recent trends in the classification of fungi. General characters of major classes: Mastigomycotina, Zysomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.,Cell structure and fruit bodies. Phylogeny and interrelationships of major groups of fungi. Economic importance of fungi, in medicine and in industries.

UNIT-IV:

Thallus organization . Homothallism and Heterothallism in fungi. Homokaryon and Heterokaryon, Hormonal control in sex organ development in fungi. Physiological specialization and physiological races in fungi. Reproduction, life cycle types, parasexual cycles, reduction in sexuality in fungi. Spore dispersal mechanisms and fungal genetics, Fossil fungi.

UNIT-V:

Classification of Lichens (Hale, 1969). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens. Lichens as indicators of Pollution, Economic importance of Lichens.

REFERENCES:

1. Bold. H.C. and H.J. Wyne (1978) Introduction to the Algal structure and reproduction, Prentice Hall, Englewood Cliffs, New Jersey.
2. Chapman. V.J and P.J. Chapman (1973). The algae. The English language book society and Macmillen.
3. Fritsch, F.E. (1935-1945). Structure and reproduction of the Algae. Vol. II III & I.
4. Smith, G.M. (1971). Cryptogamic Botany Vol. Algae and Fungi.
5. Lee, R.E. (1987), Phycology, Cambridge University, London.
6. Round, F.E, (1973), The Biology of Algae.

7. Kumar, H.D, (1988), Introductory Phycology.
8. Alexopoulos, C.J. and C.W. Mims (1985). Introductory Mycology.
9. Anisworth, S.C., Sparrow, F.E. and A.D. Sussman. The fungi and advanced treatise. Vol. I, II, III, IV A & IV B.
10. Bessey, E.A. (1950), Morphology and Taxonomy of Fungi.
11. Webster, J. (1985), Introduction to Fungi.
12. Smith, K.M. (1974), Viruses, Cambridge University Press.
13. Power, C.B. and H.F. Daginawala. (1982), General Microbiology.
14. Michael, J. Pelczar, Jr. E.C.S. chan and N.R. Krief. (1995). Microbiology. Tata McGraw-Hill (Ed), New Delhi.
15. Singh, R.S.-Introduction to the Principles of plant pathology.
16. Mehrotra, R.S. (1985). Plant Pathology.
17. Rangaswamy, G. and Mahadevan, A. (1999). Diseases of crop plant in India 4th Edition.
18. Das Cupta M.K. (1958). Principles of Plant Pathology.
19. Hale, M.E. (1961). A Hand Book of Lichens.
20. Hale, M.E. (1970). The Biology of Lichens.

SEM.I

Paper II - BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

UNIT-I:
Classification of Bryophytes (Reimers-1954), Distribution, structure, reproduction and lifecycle of Marchantiales, Jungermanniales, Anthocerotales and Bryopsida. Fossil bryophytes, economic importance.

UNIT-II:
General features and origin of Pteridophytes. Classification of Pteridophytes (Reimer, 1954). Range of morphology, structure, reproduction and evolution of gametophytes and sporophytes of the following orders: Rhyniales, Psilophytales, Psilotales, Lycopodiales, Pterodales, Selaginellales, Isoetales, Calamitales and Equisetales.

UNIT-III:
Range of morphology, structure, reproduction and evolution of gametophytes and sporophytes of the following orders: Ophioglossales, Marattiales, Osmnndales, Filicales and Salviniales. Stelar evolution in pteridophytes, Heterospory and origin of seed habit. Structure, development and evolution of sorus in Filicales. Phyletic slide, spore germination patterns. Phylogenetic trends-Evolution of stele, sorus evolution, heterospory and seed habit, Affinities of various classes of Pteridophytes. Economic importance of Pteridophytes.

UNIT-IV:
Classification of Gymnosperms (Pilger and Melchoir) General account of Pteridospermales, Cycadales, Coniferales, Bennettitales, Pentoxylales and Ginkgoales.
General account of Cordaitales, Taxales, Gnetales, Phylogenetic trends and affinities of various classes. Evolution of angiosperms. Economic importance of Gymnosperms.

UNIT-V:
Concepts of Paleobotany, A general account on Geological Time Scale. Techniques for paleobotanical study. Fossil types: Compressions, incrustation, casts, molds, petrifactions, coalballs and compactions. Age determination and methods of study of fossils. Systematic and Nomenclature of fossil plants. Paloclimates and fossil plants. Role of fossil in oil exploration and coal excavation, Paleopalynology. Geological time scale, Different types of fossils, Radio carbon dating.

REFERENCES:

1. Arnold, C.D. 1947, An introduction to Palaeobotany.
2. Coulter, J.M. and C.J. Chamberlain 1917. Morphology of gymnosperms.
3. Foster, A.S. and E.R. Gifford 1959. Comparative morphology and vascular plants.
4. Parihar, N.S. 1967. An introduction to embryophytes Vol III.
5. Seward, A.C. Fossil plants.

6. Smith, G.M. Cryptogamic Botany II
7. Sporne, K.R. 1966. The morphology of Pteridophytes.
8. Sporne, K.R. 1967. The Morphology of Gymnosperms.
9. Vashishta, P.C. 1971, Botany for degree students.
10. Nikias, K. J. (1981). Paleobotany, Paleoecology and Evolution. Praeger Publishers, USA.
11. Seward, A. C. (1919). Fossil Plants. Vol. I, II, III and IV. Cambridge University Press,London.
12. Seward, A. C. (1931). Plant Life through the Ages. Cambridge University Press, London.
13. Shukla, A. C. and Mishra, S. P. (1982). Essentials of Paleobotany. 2nd ed. Vikas Publishing House Pvt. Ltd., New Delhi.
14. Bower, F. O. (1939). The Ferns (Vol. I, II, III). Today and Tomorrow's Printers, New Delhi.
15. Eames, A. J. (1936). Morphology of Vascular Plants - Lower Groups. Tata McGraw Hill, New Delhi.
16. Ingold, C. T. (1939). Spore Discharge in Land Plants. Oxford, UK.
17. Parihar, N. S. (1985). The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
18. Rashid, A. (1986). An Introduction to Pteridophyta. Vani Educational Books, New Delhi.
19. Sharma, O. P. (1990). Text Book of Pteridophyta. Macmillan India Ltd., India.
20. Smith, G. M. (1971). Cryptogamic Botany. Vol. II. Bryophytes and Pteridophytes. Tata McGraw Hill, New Delhi.
21. Sporne, K. R. (1972). The Morphology of Pteridophytes. B. I. Publications, Madras.
22. Sundararajan, S. (2007). Introduction to Pteridophyta. New Age International Publishers, New Delhi.
23. Vashishta, P. C. *et al*. (2008). Botany for Degree Students: Pteridophyta. S. Chand and Co. Ltd., New Delhi.
24. Chamberlain, C. J. (1957). Gymnosperms Structure and Evolution. University Chicago Press, New York.
25. Coultar, J. M. and Chamberlin, C. J. (1967). Morphology of Gymnosperms. Central Book Depot, Allahabad.
26. Foster, A. S. and Gifford, E. M. (1965). Morphology and Evolution of Vascular Plants. W. H. Freeman & Co.
27. Maheswari, P. and Vasil, V. 1960. Gnetum: A Monograph. CSIR Publication, New Delhi.
28. Sporne, K. R. (1974). The Morphology of Gymnosperm. B.I. Publications, New Delhi.
29. Vasishta, P. C. *et al*. (2006). Botany for Degree Students: Gymnosperms. S. Chand and Co. Ltd., New Delhi.

SEM.I

Paper III - ENVIRONMENTAL BOTANY AND CONSERVATION BIOLOGY

UNIT-I:

History and scope of ecology, Concept of ecosystem. Synecology – Basic concept of population ecology. Modern concept of biotic community. Major and Minor communities. Methods of studying plant community. Biogeochemical cycling. Reserve and cycling pattern in tropical and temperate regions. Ecological indicators. Genecology - ecological amplitude, ecads, ecotypes, ecospecies, coenospecies, k-selection and r- selection populations.

UNIT-II:

Environmental pollution. Scope, sources of air, water and soil pollution. Plant Indicators of Pollution**:** Bioindicators, Biomonitoring, Bioremediation, Biofilm and Biocorrosion. Radiation and noise pollution-effects and control measures. Environmental management and legislation. Environmental education- Principles, Environmental education programmes. Environmental education in India. Environmental organization and agencies, MAB national organization.

UNIT-III:

Current practices in conservation – Ecosystem approaches - Species based approaches - Social approaches - Chipko movement. *In situ* conservation (Afforestation, Social Forestry, Agro Forestry, Botanical Gardens, Biosphere Reserves, National Parks, Sanctuaries, Sacred Groves and Sthalavrikshas) and *ex situ* conservation (Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks. Forest conservation through laws, world conservation strategy (WCS) and national conservation strategy (NCS). Application of Remote sensing and GIS in Ecological Science.

UNIT-IV:

Basic principles of resource management, definition and classification of resources, problems of resource depletion, preservation, conservation and restoration. Sources of germplasm. Centres of genetic diversity. Concepts of de Candolle and Vavilov. Primary, secondary and microcenters. Current biodiversity loss - concept of endemism, rare, endangered and threatened species (RET), keystone species, IUCN account of biodiversity, red data book and hot spots, reasons to stop extinction, methods to save species. Ecotourism - positive and negative impacts.

UNIT-V:

Germplasm maintenance of Rice and Sugarcane. The role of IBPGR (Rome, Italy) and NBPGR (New Delhi), in germplasm conservation. Plant germplasm resources-plantation, horticultural and field crops. Intellectual Property Rights – Intellectual Property Protection Patent Systems – Sources of patent Information – Patenting Methods – Patenting of higher plants, genes and DNA sequences – Plant Breeders Rights and Farmers Rights – A brief account on Geographical Indication (GI).

REFERENCES:

1. Ambasht, R.S. (1988). A text books of plant ecology. Students, Friends & Co., Varanasi.

2. Edward J. Kormondy, (1996). Concept of Ecology, Prentice Hill of India Pvt, Ltd. New Delhi.
3. Emil T. Charlett. Environmental protection Tata Mc graw Hill New Delhi.
4. George L. Clarke (1954). Elements of Ecology. John Wiley & sons. Inc.,
5. New york.
6. Joseph M. Moran, Micheal D. Morgan and jances H. Wiersing. Introduction to environmental science W.H. Freemar & Sam Francisco. U.S.A.
7. Misra K.C. (1980). Manual of plant ecology (second edition) Oxford and IBH Publishing Co., New Delhi.
8. Odum E.P. (1971). Fundamentals of ecology, W.B. Saunders Co., Philadephia, London.
9. Perkins H.C. (1974). Air pollution, Mc Graw Hill Kongotusta Ltd, Tokyo.
10. Robert Smith, (1977). Elements of ecology and field biology, Harper and Raw Publishers, New York, Londan.
11. Sharma, P.D. (1991). Ecology and Environment, Rastogi Publishers, Meerut.
12. Micheal. P. (1984). Ecological methods for field and laboratory investigations, Tata Mc Graw Hill publishing company Ltd., New Delhi.
13. Misra, R. (1986). Ecology work book, Oxford and IBH publishing company, New Delhi.
14. Frankel, O. H., Brown, A. H. D. and Burdon, J. J. (1995). The Conservation of Plant Diversity. Cambridge University Press, London.
15. Heywood, V. H. (1995). Global Biodiversity Assessment. UNEP, Cambridge University Press, London.
16. Krishnamurthy, K. V. (2004). An Advanced Textbook on Biodiversity: Principles and Practice. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
17. Leakey, R. E., Bynum, W. F. and Barrett, J. A. (1979). The Illustrated Origin Species. Charles Darwin Hill & Wang, New York.
18. Meffe, G. K. and Carroll, C. R. (1994). Principles of Conservation Biology. Sinauer Associates. Sunderland, Mass, USA.

SEM. I

Paper IV. MICROBIOLOGY

Unit-I

Five kingdom classification by Whittaker (1969) - Prokaryotic and Eukaryotic microbes - General features of Viruses - Classification, characteristics and ultrastructure, isolation, purification, chemical nature, replication, transmission, economic importance. Virions and prions, phytoplasma and mycoplasma.

Unit-II

Bergey's system of Bacterial classification (1984-1991). Molecular taxonomy of bacteria. Species concept in bacteria.- Eubacteria, Archaebacteria, Cyanobacteria and Actinomycetes. General account, ultrastructure, nutrition, growth, reproduction, bacterial culture technique and economic importance.

Unit- III

History and scope of industrial microbiology, concepts, Importance of microbial enzymes in industry. Commercial use of microbial enzymes. Methods of industrial production of enzymes. Manufacture of vitamins - riboflavin and vitamin B.

UNIT - IV

Fermentation techniques. Products of microbial metabolism,SCP. Use of microbes in textile and cottage industries, cellulolytic and pectolytic enzymes obtained from microbes. Microbiology of soil and water, rhizosphere and mycorrhizae. Development of industrial fermentation process, screening, detection and assay of fermentation products, stock culture, fermentation. Media, industrial preparation, scale up of fermentation downstream processing.

UNIT- V

Source of important antibiotics, their chemistry and efficacy in controlling diseases of human beings and plants, industrial production of amino acids, organic acids, lactic acid, citric and acid and glutamic acid, manufacture of vinegar by microbial oxidation transformations. Petroleum microbiology-petroleum formation, petroleum recovery, oil spills. Deterioration of materials – paper, textiles, and cordage. Painted surfaces prevention of microbial deterioration, immobilized cell technology.

REFERENCES:

1. Carpenter, P. L. (1967). Microbiology. Saunders Co., Philadelphia, USA.
2. Davis, B. D., Dulbecco, R., Eiser, H. N. and Grinsberg, H. S. (1980). Microbiology.Harper & Row, New York.
3. Dubey, R. C. and Maheshwari, D. K. (2007). A Textbook of Microbiology. S. Chand and Co. Ltd., New Delhi.
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7. Postage, J. (1975). Microbes and Man. Penguin Book, Baltimore.
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10. Schegal, H. E. (1986). General Microbiology. Cambridge University, London.
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14. Casida, IC, 1968. Industrial microbiology Wiley Eastern Ltd.
15. Chahal D.S. 1991. Food feed and fuel from Biomass, IBH. New Delhi.
16. Paul. A. Ketchum 1968. Micro biology, John Wiley & Sons USA.
17. Pelezer M.J.(Jr)., Chan, E.C.S. and Kreig, N.R, 1993. Microbiology 3rd Edn. Tata McGraw Hill, New Delhi.
18. Stanier, Dounduroff and Adelbergi – General Microbi ology.
19. Alexander, M – Soil Microbiology.
20. Frobischer – Microbiology.

PRACTICAL - I

(Theory Papers I, II, III & IV)

Paper I - Phycology, Mycology And Lichenology

1. Phycology: Gloeocapsa, Lyngbya, Pediastrum, Pithophora, Bulbochaete, Nitella, Padina, Turbenaria, Batrachospermum, Ceramium, Amphiroa and Gelidium.
2. Mycology: Albugo, Saprolegnia, Phyllochora, Alternaria and Puccinia. Slide culture technique, fungal spore count using Haemocytometer.
3. Microscopical analysis of a) Spoiled food stuffs b) Spoiled vegetables c) Spoiled fruits
4. Bacteriology, Virology and Lichenology: Bacteriophage-Books / Photographs TMV Viruses-Books/ Photographs. Antibiotic disc assay.
5. Isolation of soil microbes (Bacteria and Fungi) by dilution plating method using selective media and plate counting. Gram staining. Usnea.

Paper II - Bryophytes, Pteridophytes, Gymnosperms And Paleobotany

1. Bryophytes: *Lunularia, Reboulia, Targonia, Aneura, Sphagnum, Bryum.*
2. Pteridophytes: *Psilotum, Selaginella, Angiopteris, Osmunda, Dicranopteris, Lygodium, Trichamanes, Alsophila, Nephrolepis, Salvinia, Azolla.*
3. Gymnosperms: *Cupressus, Podocarpus, Araucaria, Pinus, Ephedra*.
4. Fossils: *Rhynia, Asteroxylon, Sphenophyllum, Ankyropteris, Botryopteris, Heterangium, Lagenostoma, Pentoxylon, Medulosa, Cycadeoidea, Cordaites*.
5. *Paleobotany: Lepidodendron, Stigmaria, Calamostachys, Lyginopteris, Lagenostoma* and *Cordaites*

Paper III - Environmental Botany and Conservation Biology

1. Ecological studies on forest soil analysis, soil texture, water holding capacity and pH.
2. Biomass studies – based on number, fresh and dry weight.
3. Identification of family of given forest plants (minimum 20).
4. Preparation of quadrats and counting.
5. Estimation of Alpha diversity, evenness index and Beta diversity.
6. Germination studies – percentage, competition.
7. Water demand, collection and evaporation in selected forest areas.
8. Forest covers monitoring, forest map reading and surveying of forest area.

Paper IV. Microbiology

1. Isolation of microbes from soil - Serial dilution and Plating - Isolation of Microbes from food, fruits and vegetables - Gram's staining of Bacteria found in milk, curd, root – nodule-
2. Effect of different antibodies on bacterial growth (antibiotic sensitivity) – Microbial analysis of milk by methylene - blue reduction test.
3. Media preparation – solid, liquid.
4. Isolation and identification of bacteria, yeast and fungi from different sources.
5. Inoculation of fungi and bacteria on selected media and maintenance of cultures.
6. Hanging drops differential staining.
7. Isolation and identification of different types of fungi and bacteria from curd, rotten fruits and vegetables.
8. Soil microbiology – dilution and plating – estimation of microbial content of the soil.
9. Preparation of spawn for cultivation of edible mushrooms.
10. Micrometry- Measure the average length of bacteria and fungal spores.

SEM. I

Elective I. PHYTOPATHOLOGY

UNIT-I:
Plant pathology; its scope and relationships to other sciences. Concept of plant diseases; saprophytes and parasitism (heterotropic organisms and mode of nutrition), pathogenicity. Classification of plant diseases plant diseases control. Principles and methods. Legislative methods, cultural methods, soil and sand treatment, biological, control, chemical control, Control through resistant varieties, quarantine. Plant disease forecasting.

UNIT-II:
Symptoms, causal organism, disease cycle and control of pathogenic diseases caused by pathogenic fungi with special reference to the following diseases. Club root of crucifers, Black wart of potato, Powdery mildews wheat, Brown spot of Rice, Early blight of Potato, Angular leaf spot and Black arm of Cotton, Bacterial blight of Paddy, Sandal spike. Grassy shoot disease of Sugarcane.

UNIT-III:
Pathogenesis penetration and entry, colonization of the host, factors affecting in infection, enzymes in plant diseases – Cell wall degrading enzymes. Toxins in relation to plant diseases: a general account, mode of action and types.

UNIT-IV:
Plant responses to post inflectional agents; alteration in growth photosynthesis, respiration, nitrogen metabolism, aromatic compounds, and growth regulators-vascular transport.

UNIT - V:
Defence mechanism; Genetics of plant-pathogen interaction. Effect of environment on Diseases development. Plant diseases, epidemiology, forms of epidemics and conditions governing some of the important crop diseases.

REFERENCES:
1. Agrios, Gergon, n 1988, Plant pathology academic press London.

2. Anega, KG, 1993, Experiments in microbiology, plant pathology, and tissue culture. Wishwz prakasam (willey esternlimited).

3. Boicer, F and Cook RJ 1974 Biological control of plant pathogens, Sanfrancisco.

4. Braual NK and others 1980, Text book of plant pathology. Oxford publishing company New Delhi.

5. Bilgrani, KG and Dubey HC 1980 a Text book of modern plant pathology.
6. Butler EJ Jones 1986 Plant pathology periodical book agency, Delhi.

7. Ganulco HC and KAR, AK 1986 College botany volume11. central book depot, Calcutta.

8. Holliday, P, 1980 Fungal diseases of tropical crops. Cambridge University.

9. Manners JG 1982 Principles of plant pathology Cambridge University Press Cambridge.

10. Mehrotra, RS 1979, Plant pathology 2nd Edition. Tata McGraw hill Publi. New Delhi.

11. Manibushanrao K (ed) 1994 Fecent advancement in the biocontrol of plant pathogens.

12. Puthak vn 1984 Laboratory manual of the plant Pathology, 2nd. Oxford and Ibh Publishing company, New Delhi.

SEM.II

Paper V- CELL AND MOLECULAR BIOLOGY

UNIT- I:

Structural organization and function of intracellular organelles- Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure and function of cytoskeleton and its role in motility. Membrane structure and function- model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

UNIT- II:

Molecular organization of chromosomes and genes. Centromere. Kinetochore.Nucleolar organizing region. Histone and non histone proteins in chromosomes. Nucleosome, Chromatosome. Heterochromatin, euchromatin. Cell division- Mitosis mitotic apparatus and its physiochemical characteristics and biochemical composition. Meiosis- process of meiosis in detail, theories on crossing over and chiasma formation, synaptonemal complex, significance of meiosis. Cell cycle- Steps in cell cycle, regulation and control of cell cycle. Chromosomal aberrations. deficiencies, duplications, inversions (paracentric and pericentric) and translocation.

UNIT- III:

Nucleic acid- physical and chemical structure of DNA, Types of DNA- B form, Z form Watson and crick model of DNA, viral DNA, bacterial DNA, Mitochondrial and chloroplast DNA. DNA as genetic material. DNA replication in prokaryotes and eukaryotes.

Semi conservative mode of replication. Messelson – Stahl experiment. System of replication. DNA templates, Deoxy nucleotide triphosphate pool, enzymes and protein factors. Mechanism of DNA replication, unidirectional and bidirectional replication. Molecular assembly at the replication fork, leading and lagging strands, Okasaki fragments. DNA polymerases of prokaryotes and eukaryotes, topoisomerases, gyrases, ligases and nucleases. DNA polymerase function, proof reading and repair. Comparison of eukaryotic and prokaryotic DNA replication Replication of organelle DNA. Inhibitors of prokaryotic and eukaryotic DNA replication.

UNIT-IV:

Transcription of DNA. Transcription in prokaryotes and eukaryotes.

Organization of transcriptional units. RNA polymerases in prokaryotes and eukaryotes. RNA synthesis and processing. TATA box. Pribnow box. Role of DNA binding by transcription factors. Sigma factor. Promoters – important features of class I, II, & III promoters. Enhancers and silencers. Britten and Davidson model for eukaryotic gene regulation. Formation of transcription initiation complex, transcription activator and repressor. Inhibitors of transcription. Post transcriptional regulation. RNA processing. split genes, hn RNA, introns and exons, mRNAcapping, polyadenylation, splicing, snRNAs and spliceosomes. Post transcriptional silencing, RNA editing, MicroRNAs, RNA inhibition.

UNIT-V:

Translation: Important features of mRNA – ORF, RBS . Fine structure, composition and assembly of procaryotic and eukaryotic ribosomes. tRNA charging, initiator tRNA. Stages in translation: Initiation – formation of initiation complex in procaryotes and eucaryotes,

Initiation factors in procaryotes and eucaryotes. Kozak sequence. Elongation – process of polypeptide synthesis, active centers in ribosome - 3-site model. Shine Dalgarno sequence. peptidyl transferase, elongation factors. Termination – process of termination, release factors ribosome recycling . Inhibitors of protein synthesis. Genetic code: Cracking the genetic code – simulation synthetic polynucleotides and mixed copolymers, synthetic triplets. Important features of the genetic code. Proof for the triplet nature of genetic code . Exceptions to the standard cod. Protein sorting and translocation: Cotranslational and posttranslational – signal sequences, SRP. Translocon. and membrane insertion of proteins. Post-translational modification of proteins. Protein folding – self assembly, role of chaperones in protein assembly.

REFERENCES:

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SEM.II

Paper VI- GENETICS, EVOLUTION AND PLANT BREEDING

18.

UNIT-I:

Mendals Law of inheritance. Interaction of genes, quantitative inheritance, sex determination in plants and theories of sex determination. Sex linked characters-primary, secondary and permanent, non-disjunction of sex chromosomes in Drosophila. Sex influenced and sex limited characters. Chromosome theory of inheritance. Multiple alleles and pseudoalleles. Extrachromosomal inheritance. Uniparental inheritance in Chlamydomonas. Male sterility. Population genetics - gene frequencies, mutation, selection, migration, genetic drift, genetic disorder of chromosomal and genetic origin.

UNIT-II:

Gene concept– Factor concept of Mendel, One gene -One enzyme hypothesis. Benzer's concepts of Cistron, muton and recon. Brief description of the following types of genes-smart genes, housekeeping genes, transposons overlapping genes, split genes, homeotic genes, pseudogenes, orphan genes, selfish genes, gene cluster, gene families. Fine structure of the gene. Benzer's experiment in the rII locus of T4 phage Gene mutation-Detection of mutation by CLB Method. Molecular basis of mutation, physical and chemical mutagens and their mode of action.

UNIT-III

Bateson's concept of coupling and repulsion. Morgan's concept of linkage, linear arrangement of genes, linkage groups, complete and partial linkage, linkage maps, three point test crosses, interference coefficient of coincidence and negative interference. Molecular mechanism of recombination. Molecular markers and construction of linkage maps. Correlation of genetic and physical maps. QTL mapping. Bacterial recombination - Conjugation mapping in bacteria. Recombination in fungi (tetrad analysis in *Neurospora*) Complementation tests.

UNIT-IV

Lamarck- Darwin–concepts of variation, adaptation, struggle, fitness and natural selection. Mendelism, Spontaneity of mutations. The evolutionary synthesis. Origin of basic biological molecules, Abiotic synthesis of organic monomers and polymers, Concept of Oparin and Haldane, Experiment of Miller (1953), The first cell, Evolution of prokaryotes, Origin of eukaryotic cells, Evolution of unicellular eukaryotes, Anaerobic metabolism, photosynthesis and aerobic metabolism**.** Concepts of neutral evolution, molecular divergence and molecular clocks. Origin of new genes and proteins; Gene duplication and divergence.Homology, orthology, paralogy and xenology.

UNIT- V

Methods of plant breeding self-fertilized, cross fertilized and vegetatively propagated plants. Breeding plants for improving yield, quality and resistant to diseases and pests. Plant breeding work in India with special reference to Rice, cotton and Sugar cane. Role of polyploidy and distant hybridization in plant improvement. Induced mutations in crop improvement. Breeding in plants, including marker assisted selection. QTL mapping.

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SEM.II

Paper VII – ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

UNIT – I:

General account and theories of organisation of apical meristems of shoot apex and root apex, quiescent centre. Structural diversity and phylogenetic trends of specialization of xylem and phloem. Cambium - origin ,cellular structure, cell division, stories and nonstoried types. Cambium in budding and grafting - wound healing role. Trichomes, periderm and lenticels.

UNIT-II:

Anatomical characteristics and vascular differentiation in primary and secondary structure of root and stem in Dicot and Monocot. Origin of lateral roots - Root stem transition. Anatomy of Dicot and Monocot leaves. Leaf abscission, stomatal types, nodal anatomy, petiole anatomy, vascularisation of flower and seedling.

UNIT-III:

Microsporangium - Microsporogenesis, Microspores – arrangement, morphology and ultrastructure. Microgametogenesis - Pollen Stigma Incompatibiligy. Methods to overcome incompatibility. Megasporangium, Megagametogenesis. Female gametophyte - Monosporic - Bisporic and Tetrasporic - Nutrition of embryo sac and fertilization

UNIT-IV:

Endosperm - Types - Endosperm haustoria - Cytology and physiology of endosperms, functions of endosperms - Embryo development in Dicot and Monocot, Nutrition of embryo - Polyembryony - Causes, Apomixis - Causes, Apospory - Their role in plant improvement programmes and seed development.

UNIT-V:

Definition - Morphogenesis and its relation to morphology - Turing's diffusion reaction theory - Morphogenetic factors - growth regulators - genetic and environment - polarity. Molecular basis of morphogenesis - Cytosol and cytoskeleton, microtubules and microfilaments - Cellular level morphogenesis - Nuclear transplantation experiments with *Acetabularia* - Sach's and Errer's laws - Asymmetric divisions and their significance. Morphogenesis at tissue level - Differentiation, dedifferentiation and redifferentiation of vascular tissue *in vivo, in vitro* and in wounds. Plant galls and their importance in morphogenesis. Leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*

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Morphogenesis

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SEM.II

Paper VIII- PLANT TISSUE CULTURE

UNIT-I

Introduction - History, Scope and Concepts of basic techniques in plant tissue culture. Laboratory requirements and organisation. Sterilization-filter, heat and chemical. Media preparation - inorganic nutrients, organic supplements, carbon source, gelling agents, growth regulators and composition of important culture media (MS, Whites and Gamborg's media).

UNIT-II

Cell, tissue and organ culture - Isolation of single cells, selection and types of cells, tissue explants and organs for culture - Paper, raft nurse technique, Plating method, Microchamber techniques, cell suspension cultures - batch, continuous, chemostat culture - Synchronization of suspension culture, cellular totipotency, Cytological, cytochemical and vascular differentiations - Totipotency of epidermal and crown – gall cells.

UNIT-III

Micropropagation - Clonal propagation of elite germplasm, factors affecting morphogenesis and proliferation rate, technical problems in micropropagation. Organogenesis - formation of shoots and roots - Role of growth regulators and other factors, somaclonal and gametoclonal variations. Somatic embryogenesis - Process of somatic embryogenesis, structure, stages of embryo development, factors affecting embryogenesis, synthetic seeds.

UNIT-IV

Haploid production - Androgenesis, gynogenesis - Techniques of anther culture - segmentation pattern in microspore - isolated pollen culture - plantlets from haploids - diploidisation - factors influencing androgenesis, haploidy through gynogenesis, haploid mutants, utilization of haploids in plant breeding. *In vitro* pollination - ovule and ovary culture, importance, techniques overcoming incompatibility barriers, embryo rescue. Protoplast culture: Isolation of protoplasts - mechanical and enzymatic sources, culture of protoplasts, viability. Protoplast fusion - Spontaneous, mechanical, induced electrofusion, selection of somatic hybrids, cybrids, importance.

UNIT-V

In vitro production of secondary metabolities - Classification of secondary metabolites, biosynthetic pathways, cell suspension cultures, immobilized cell cultures and biotransformation, elicitors and hairy root culture. Cryopreservation and gene bank - Modes of preservation, preparation of materials for deep freezing, cryopotectors, storage strategies, assessment of successful cryopreservation, application and limitations. Application of tissue culture in forestry, horticulture, agriculture and pharmaceutical industry.

REFERENCES

1. Bhojwani, S. S. and Razdan, M. K. (1983). Plant Tissue Culture: Theory and Practice. Elsevier Science Publishers, Netherlands.
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PRACTICAL - II

(Theory Papers V, VI, VII & VIII)

Paper V- Cell and Molecular Biology

1. Study of mitosis and meiosis using squashes and smears.
2. Interpretation of micrographs from standard purchased materials or from transparencies.
3. Karyotyping and chromosome banding techniques.

Paper VI- Genetics, Evolution and Plant Breeding

Solving problems involving

1. Dihybrid cross
2. Interactions of factors
3. Incomplete dominance
4. Chromosome mapping from test cross data. Calculation of interference.
5. Multiple alleles and blood group inheritance
6. Sex linked inheritance
7. Quantitative inheritance
8. Population genetics
9. Calculation of gene frequencies
10. Allelomorphic pair, multiple alleles (classical blood Groups), sex linked alleles
11. Training in hybridization techniques.

Paper VII – Anatomy, Embryology and Morphogenesis

Anatomy:

Study of suitable examples to illustrate features in Anatomy theory syllabus, with the help of section, peelings and mace rations.
Submission of double stained 5 hand section slides.
Dissection of shoot apex in *Hydrilla* and whole mount.
Examination of LS of shoot and root apices
Study of origin of lateral roots.
Examination of different types of pits - secondary wall thickening - annular, helical and scalariform and pitted thickening.
Wood structure - TS, TLS and RLS - showing variations in vessel elements, fibres axial parenchyma and ray parenchyma.
Identification of different types of stomata - Monocot and Dicot types.

Embryology:

Stages in the development of microsporangium and male gametophyte. Configuration of ovules, 2,4 nucleate embryosac, mature embryosac. Types of endosperm. Stages in embryogeny globular proembryos. Mature embryos of monocot and dicot. Interpretation of embryological drawings. In vitro pollen germination.
Slides showing developmental stages of anther, embryosac, endosperm and embryo.
Study of different types of pollen grains.
Dissection of endosperm haustoria - *Cassia, Cucumis, Peltophorum*
Dissection of Embryo - *Abelmoschus, Cyamopsis, Tridax*

Morphogenesis

Superficial 'V' shaped wounding of young stem and studying the wound healing response in Dicot and Monocot stems.
Bisecting shoot and aerial root apices and studying their further behaviour.
Study of one fungal gall (Club - Root of Cabbage) and insect gall (*Pongamia* leaf -gall).

Paper VIII- Plant Tissue Culture

Preparation of stock solutions for tissue culture
Preparation of solid and liquid media for test tube cultures and petri plate culture
Induction of callus culture and suspension culture
Encapsulation of embryos using sodium alginate
Techniques of hardening
Visit to commercial tissue culture R&D green houses.

SEM.II

Elective II- HORTICULTURE

UNIT-I

Importance of scope of horticulture; Divisions of horticulture- Climate, soil and nutritional needs; Water irrigation; Chemical fertilizers – Nitrogen, phosphorous, potassium, mixed fertilizers, organic fertilizers and bio fertilizers. Plant propagation method - Cutting, layering, grafting, budding. Stock - scion relationship, micropropagation by induction of rooting.

UNIT-II

Principles and methods of designing outdoor garden - hedges, edges, fences, trees, climbers, rockeries, arches, terrace garden; Lawn making and maintenance; Water garden - cultivation of water plants. Layout for a model college garden. Indoor gardening - Foliage plants, flowering plants, hanging basket, Bonsai plants - Training and pruning.

UNIT-III

Floriculture - Cultivation of commercial flower crops - Rose, Jasmine and Chrysanthemum, Flower decoration - Dry and wet decoration. Pomology – cultivation fruit crops– Mango, Grapes, spacing, irrigation, field disease control. Olericulture – cultivation of vegetables – Tomato, Ginger, Potato planting; Erosion control.

UNIT-IV

Classification of vegetables, cultivation of important vegetable - Tomato, potato, onion, cabbage and snake guard. Layout for a model kitchen garden. Fruit crops - Induction of flowering, flower thinning, fruit setting, fruit development. Cultivation of important fruit crops - Mango, Grapes and Guava. Cultivation of tree species - Eucalyptus and Teak.

UNIT-V

Pest and weed management – historical, theoretical, philosophical and biological insect pest suppression. Weed problem and ecological perspective, biological control of weeds in Indian region. A preliminary knowledge about glass houses – growth regulators in horticulture, growth retarders, sex modification, flower induction, parthenocarpy, harvesting seed storage, preservation of fruits and vegetables.

References

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7. Al David – A complete guide to gardens.
8. Manibushan Rao – Horticulture.

9. Nanda and Kochar – Vegetative propagation of plants .
10. Randhava G. S. – Floriculture in India.
11. Subba Rao – Bio fertilizers in India.
12. Vishnu Swarup – Garden flowers
13. Readers digest – Complete library of gardens (3 volumes) Kissan world.
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SEM III

Paper IX – PLANT TAXONOMY

UNIT-I:

A brief historical account of the classification of angiosperms. Systems of plant classification.Classification based on habit by John Ray. Detailed study of Bentham and Hooker system of classification. Classification based on phylogeny by Engler and Prantl. Recent system of classification by Takhtajan. General evolutionary trends in flowering plants: With reference to habit and habitat, leaf structure, nodal anatomy, xylem and phloem, inflorescence, flower, androecium, pollen grains, gynoecium, placentation, ovules, seeds, seedlings and fruits. Field and Herbarium techniques. Flora, Monograph, Botanical gardens. Source of taxonomic information.

UNIT-II:

International code of Botanical Nomenclature - A brief history of International Code of Botanical Nomenclature [ICBN]. Divisions; Principles; Nomenclatural terminology-Type method (typification)-holotype, isotype, syntype, lectotype, paratype, neotype; Effective and Valid publication; Priority; Scientific names-Correct name, Autonym, Basionym, Homonym, Synonym, Tautonym; alternative, ambiguous, illegitimate, naked, rejected and superfluous names.. Familiarity with botanical literature - Monographs, periodicals and floras. Construction of taxonomic keys (indented and bracketed) and the utilization Herbarium preparation and management - A brief account of BSI and its role.

UNIT-III:

Biosystematic- its aim and scope. Biosystematic categories, Phenotypic plasticity. Turrreson's work. Population concept. Species and genus concepts, Genecology, ecological differentiation. Modern concepts and trends in plant taxonomy. Cytotaxonomy, Chemotaxonomy, Numerical taxonomy (taximetrics), Molecular taxonomy – DNA Bar-coding and molecular phylogeny. Phenetic methods in taxonomy. principles, construction of taxonomic groups, OUTs, unit characters, character coding, measurement of resemblances, cluster analysis, phenons and ranks, discrimination, nomenclature and numerical taxonomy, applications, merits and demerits. Cladastics and cladogram, parsimony analysis, cladastics.

UNIT-IV:

Morphological variations, systematic position, Interelationships, phylogeny and economic Importance of following families:

Menispermaceae, Polygalaceae, Caryophyllaceae, Portulacaceae, Oxalidaceae, Tiliaceae, Combretaceae, Caesalpinaceae, Mimosaceae, Onagraceae, Lythraceae, Aizoaceae.

UNIT-V:

Morphological variations, systematic position, Interelationships, phylogeny and economic Importance of following families:

Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Verbanaceae, Sapotaceae, Nyctaginaceae, Chenopodiaceae, Loranthaceae, Moraceae, Commelinaceae, Aroideae, Cyperaceae, Economic importance of families mentioned. Special emphasis should be given on morphological and phylogenetic interrelationships, recent revisions and rearrangements between and within the families, and its critical analysis.

REFERENCES:

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10. Introduction to Principles of Plant Taxonomy Sivarajan Oxford & IBH Pvt. Company.
11. A hand book of field and Herbarium methods Jain S.K. and Rao R.R. Today and Tomorrow Publications.
12. Plant Taxonomy and Biosystematics. Stace Clive. A Edward Arnold.
13. Plant Systematics. Gurucharan Singh. Oxford & IBH Pvt. Company.
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SEM.III

Paper X. MEDICINAL BOTANY

UNIT-I

Historical background, Present status, Scope of medicinal botany. Indigenous medicinal system – Bioprospecting, Indigenous knowledge system, Ayurveda, Siddha, Unani, Homeopathy. Traditional and Folklore system of medicine. Need to preserve knowledge system. Ethnobotany – definition, its significance within the limits of the state and nation. Conservation of rare heritage from global point of view.

UNIT-II

Landmarks in history of ethnobiology – relation between geology, phytogeography and ethnobotany. Linkage of Ethnobotany with other sciences and disciplines in biology – food and nutrition, medicine, sociological and cultural practices, religions and social costumes and economic relations, archaeology, history and politics. Major tribes of South India and their ethnobotanical and ethno-biological heritage – Parayar, Kurichiar, Paniyar, Mulla, Karuman, Kanikkars, Naikas, Shola Naikas, Thodas, Kothas, Kurumbas, Irullas, Kattu Naikas.

UNIT – III

Introduction and History of Pharmacognosy. Natural source of Drugs- Crude drugs, Classification of Crude drugs, Collection and Processing of Crude drugs. Phytoconstituents of therapeutic value, Histochemical tests for phytochemicals. Analytical Pharmacognosy – Anatomical features of selected medicinal plants (Senna leaf, Datura leaf, Cinchona bark, Nuxvomica seed). General methods of phytochemicals and biological screening, Natural sources, Extraction, isolation and purification of Primary and Secondary metabolites. Study of some herbal formulation techniques as drug cosmetics.

UNIT- IV

Post harvest technology of medicinal plants. Importance of post harvest technology in medicinal crops. Factors responsible for deterioration of medicinal plants. Pre and post harvest factors. Maturity indicates for harvesting medicinal plants and pre harvest treatments. Systems of storage of harvested produce, packing principles and method of processing. Important medicinal products- Essential oils, volatile and non-volatile oils, oleo resins-active principles.

UNIT –V

Distribution of Indian medicinal plants; Introduction and important of medicinal plants, ecodistribution , mapping distribution in different biogeographic zones. Ethnobotany and

conservation of plants with special reference to India. Conservation of ecosystems, sacred groves, forestry and unique ecosystems and their ethnobiolgical values, plants and animals in art, tradition and ethnography: methodologies in ethno-botanical research. Conservation of medicinal plants- in-situ and ex-situ conservation. Centers of medicinal plant conservation in India- IBPGRI, CIMAP, CDRI, NBPGR, MSSRF, KFRI, TAMPCOL, TBGRI, TKDL and FRLHT.

REFERENCES:

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PRACTICAL - III

(Theory Papers IX & X)

Paper IX – Plant Taxonomy

1. Study the characters of the above mentioned families and their Economic importance.
2. Preparation of artificial key for any 5 families mentioned in the syllabus.
3. Submission of 50 herbarium sheets.
4. Identification of binomial of the plants with the help of Gamble Flora.
5. Submission of 30 herbarium specimens with field note book and tour report.
6. The students should undertake as part of their course a tour and field study of botanical gardens, research institutes and natural vegetation under the guidance of the staff for three to five days within the state and neighboring states.
7. Students who have not undertaken the above activities shall forfeit the appropriate marks allotted for this purpose (10 marks) for practical examination.

Paper X. Medicinal Botany

1. Collection and identification of 100 plant species of ethno-botanical importance in South India.
2. Knowledge of making use of 20 plants – parts of the above 100 for various medicinal purposes. The mode of application, the efficiency and superstitions, if any, associated with them. The student may prepare a case study report, preferably, by direct contact with the Tribe or the community concerned who are known to possess with the knowledge of the same.
3. Visit to sacred grove or sacred forest or a particular ecosystem to prepare a field report on the ecosystem.
4. Collection and identification of ethnobotanical specimens – preparations of the following categories (4 each) – medicines for asthma, skin diseases, diarrhea, diabetes and envenomation.

SEM.III

Paper XI- PLANT PHYSIOLOGY

UNIT - I

Diffusion, Osmosis, Physicochemical properties of water, chemical potential and water potential in the plant, bulk movement of water, Imbibition, soil-plant atmosphere continuum, Transpiration, stomatal mechanism and regulation. A General account of absorption and translocation of water - assimilates. Modern concepts of mineral absorption and translocation.

UNIT – II

Photosynthesis- Photosynthetic pigments - Mechanism of Photosynthesis : Light reaction – two pigment systems. Electron carriers – photophosphorylation - Carbon fixation in C_3 and C_4 plants - CAM pathway. Photorespiration Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase. Respiration- Photorespiration and dark respiration. Cycles of respiration, Glycolysis - outline of pentose phosphate pathway - Pyruvate metabolism - TCA cycle - electron transport system coupled with Oxidative phosphorylation.

UNIT-III

Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Mechanism of nitrogen fixation, Nitrogen uptake and assimilation. Plant growth regulators, their mode of action and effects. Phytochrome and hormones in movements and flowering. Auxin, Gibberellins, Cytokinin, Ethylene, ABA – structure, distribution, physiological effects. Physiology of Dormancy break. Senescence and aging. Effect of water and salt stress on crop production.

UNIT – IV

Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism, seed dormancy and biological clocks. Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

UNIT – V

Physiology of seed/ grain development-phases of growth and growth curves- role of flag leaf in grain-filling and role of pericarp and seed coats in seed development. Synthesis and accumulation of starches in developing cereal grains- synthesis and accumulation of proteins in developing legume seeds- synthesis and accumulation of fatty acids, lipids/ oils in developing oily seeds. Physiology of seed dormancy and germination, types of seed

dormancy; physical and chemical methods to overcome seed dormancy. Physiology of seed germination- role of hydrolytic enzymes in degradation of starches, storage protein and lipids/oils in storage organs/Tissue and translocation of hydrolysed products to the developing embryonal Axis- role of phytohormones in regulation of the synthesis and, activity of hydrolytic enzymes.

REFERENCE

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SEM.III

Paper XII- PHYTOCHEMISTRY

UNIT –I

Structure of atoms, molecules and chemical bonds. Chemical bonds: Ionic bond, Covalent bond, Vander Vaal's forces, hydrogen bonding and hydrophobic interactions. Bonding in organic molecules. Effect of bonding on reactivity. Polarity of bonds. Bond length. Bond angle. Dissociation and association constant. Bioenergetics: Concepts of free energy, Thermodynamic principles in Biology. Energy rich bonds. Coupled reactions and group transfers. Biological energy transducers. Chemistry of biological molecules. Carbohydrates: Classification, structure of monosaccharide, disaccharides, oligosaccharides and polysaccharides.

UNIT- II

Amino acids- Classification, structure and composition, Metabolism of amino acid. Proteins: Classification, structure (Primary structures – Peptide bond, N and C terminals), secondary (types of Bonding in secondary structures) and tertiary structures (types of bonding in tertiary structure). Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). Physical and chemical properties of proteins.

UNIT –III

Nomenclature, classification and properties of Enzymes. Mechanism of enzyme action (Lock and key & induced fit model) and factors affecting enzyme activity (substrate, pH and temperature). Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.

UNIT –IV

Classification of lipids, saturated and unsaturated lipids. Structure of simple lipids (Fats and Oils), compound Lipids (Phospholipids) and derived Lipids (carotenoids). Oxidation and biosynthesis of any one fatty acid. Structure, composition and metabolism of Nucleic acids. Structure, importance, source, deficiency and symptoms of water soluble and fat soluble vitamins.

UNIT - V

Secondary metabolites- A general account. Biosynthesis and function of lignins, suberins, terpenes, phenols, alkaloids, flavonoids. Biologically important phenolic compounds (phenols, tannins & flavonoids), terpenoids (essential oils, gibberellins and steroids), alkaloids and glycosides. Integration of metabolic pathways.

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SEM. III

Elective –III BIOINSTRUMENTATION AND BIOLOGICAL TECHNIQUES

UNIT – I

Microscopy- Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy. Fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Fixation of plant materials: Fixation - Fixative - Dehydration - Clearing reagents - Embedding with wax - resins - sectioning. Stains and staining mechanisms - Natural and synthetic stains - Mountants. Microtome - rotary, wood and cryo types.

UNIT- II

Principle and applications of pH meter , Centrifugation (Clinical, High speed, Micro and Ultra centrifuges), Colorimetry - UV visible - Spectrophotometer , Photometry - Flame photometer, Infrared Spectrophotometry (IR), Atomic Absorption Spectroscopy (AAS), Nuclear Magnetic Resonance (NMR) and MASS. Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

UNIT – III

Chromatography - principles and applications of Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC), Column Chromatography, Adsorption Chromatography, Ion-Exchange Chromatography, Affinity Chromatography, Gel Permeation Chromatography or Gel Filtration, Gas Chromatography (GC), Liquid Chromatography (LC), Liquid Chromatography and Mass Spectrum (LC-MS), Gas Chromatography and Mass Spectrum (GC-MS), High Performance Liquid Chromatography (HPLC).

UNIT-IV

Principles and applications of Moving Boundary Electrophoresis, Zone Electrophoresis, Paper Electrophoresis, Gel Electrophoresis (Starch gel Electrophoresis, Agar Gel Electrophoresis, Agarose Gel Electrophoresis, Submarine Gel Electrophoresis, Preparative Electrophoresis, Pulse Field Electrophoresis, Field Inversion Gel Electrophoresis, Polyacrylamide Gel Electrophoresis, Isoelectric Focusing, Continuous Flow Electrophoresis, Capillary Electrophoresis, Immuno Electrophoresis, Analysis of Bands, Direct Photometric Scanning, Staining methods, Gel Documentation System, Autoradiography, Enzyme assay, Immunological methods and Blotting techniques.

UNIT-V

Radiolabeling techniques- Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines. Definition, history, components and types of Biosensors

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SEM.IV

Paper XIII- BIOTECHNOLOGY AND GENETIC ENGINEERING

UNIT-I:

Scope and importance of Biotechnology and genetic engineering. Isolation of RNA, DNA (genomic and plasmid). Quantification of isolated nucleic acids. Radiolabelling of nucleic acids- End labelling, nick translation, Isolation of specific genes from plant tissue. Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing. Gene cloning vectors. General characteristics of vectors. Brief account of naturally occurring plasmids. Promoter, MCS, Ori, and marker genes-lac Z. Construction of pBR 322 and pUC 18 vectors. Expression vectors. E.coli promoters, lac promoter, trp promoter. Lambda based vectors, Cosmids, Phagemids, BACs, YACs, Shuttle vectors.

UNIT-II:

Cloning of eukaryotic genes in prokaryotic vectors. Synthesis of cDNA. Cloning cDNA in plasmid vectors, cloning cDNA in bacteriophage vectors.. Polymerase Chain Reaction (PCR) - methodology, essential features of PCR, primers, Taq polymerases, reverse transcriptase-PCR, types of PCR-Nested, inverse, RT-PCR (real time PCR), Applications of PCR. Sequencing of genes- Sanger's method and Maxam and Gilbert method and automatic DNA sequencing. Artificial synthesis of DNA fragments. Phosphodiester, phosphotriester and Phosphite ester methods, principles and strategies. Oligonucleotide syntesis and application, synthesis of complete gene.

UNIT-III:

Purification of vector DNA, restriction digestion, end modification, cloning of foreign genes from mRNA, genomic DNA, synthetic DNA. Transformation and transfection techniques, preparation of competent cells of bacteria, chemical methods- calcium phosphate precipitation method, liposome mediated method, physical methods- Electroporation, gene gun method. Agrobacterium mediated gene transfer in plants. Cloning and transfer of Nod gene, nif gene and Hup genes to Eukaryotes. In vitro mutagenesis and deletion techniques. Gene silencing techniques; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing, gene knock out in bacterial and eukaryotic organisms. CRISPR-Cas9 technique.

UNIT-IV:

Screening of recombinant clones. Direct antibiotic resistance screening. Blue white colour screening. Identification of the clone from a gene library by Nucleic acid hybridization. Functional screening methods. Colony immunoassay. Reporter gene based screening. Positive selection vector method. Diagnostic restriction digest method. Colony PCR method. Sequencing method.

UNIT-V:

Chloroplast and Mitochondrion engineering. Transgenic plants, Genetically modified (GM) plants (Bt cotton, Bt Brinjal) Edible vaccines from plants. Plants as bioreactor. Molecular breeding. Ethical issues associated with GM crops and GM food; labeling of GM plants and products. RNAi and antisense RNA technology for extending shelf life of fruits and

flowers (ACC synthase gene and polygalactoronase); delay of softening and ripening of fleshy fruits (tomato, banana, watermelons). Gene pollution. Environmental impact of herbicide resistance crops and super weeds.

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PRACTICAL - IV

(Theory Papers XI, XII & XIII)

Paper XI- Plant Physiology

1. Calculate OP of cell sap by plasmolytic method.
2. Find out DPD of plant tissue by weight change method.
3. Measure the rate of transpiration using simple potometer.
4. Determine the rate of photosynthesis under different CO_2 concentrations.
5. Find out the rate of photosynthesis under different light conditions.
6. Hill reaction of ptotosynthesis.
7. Determine the rate respiration in germinating seeds and flower buds with respiroscope.
8. Find out seed viability by tetrazolium chloride method.
9. Seed viability by permeability test (in at least two samples) stored for different periods of time.
10. Determination of electrical conductivity of seed leachates.
11. Extraction and estimation of
    (a). Total soluble carbohydrates by anthrone reagent method.
    (b). Total free amino acids by ninhydrin reagent method.
12. Seed quality evaluation by starch- agar- iodine assay method.
13. Simple assay for L-amylase from germinating seeds of wheat or paddy.
14. Simple assay for protease from germinating green gram or pea seeds.
15. Simple assay for lipase from germinating seeds or castor bean.
16. Effect of thermal changes magnetism and electric shock on seed germination.

Paper XII- Phytochemistry

1. Quantitative estimation of starch in the given material by Iodine method.
2. Quantitative estimation of total protein in plant material by Biurete test.
3. Quantitative estimation of lipid.
4. Quantitative estimation of amino acids by Ninhydrin method.
5. Separation of plant pigments by Paper Chromatography.
6. Separation of aminoacids by Paper Chromatography.
7. Determination of enzyme activities – Amylase and peroxidase.
8. Qualitative estimation of phenols, terpenoids and alkaloids.

Paper XIII- Biotechnology and Genetic Engineering

1.Isolation of genomic DNA from plant leaf.
2.Estimate quantity of DNA spectrophotometric method.
3. Agarose gel electrophoresis of genomic DNA.
4. Restriction digestion of genomic DNA.
5. Isolation of plasmid DNA from bacteria.
6. Agarose gel electrophoresis of plasmid DNA.
7. Identify transgenes in fruits and vegetables from photomicrographs.
8. PCR amplification of DNA from two cultivars with RAPD primers.

SEM.IV

Elective IV- BIOINFORMATICS AND BIOSTATISTICS

UNIT-I:

Introduction to Bioinformatics: Definition and History of Bioinformatics. Computational Biology and Bioinformatics. Biological databases- Types of data and databases, Nucleotide sequence database (EMBL, GENBANK, DDBJ)- Protein sequence database (PIR, SWISS-PROT, TrEMBEL), Secendary Databases (PROSITE, PRINTS, BLOCKS), Protein Structure Database (PDB) . Information retrieval from databases – search concepts, Tools for searching, homology searching, finding Domain and Functional site homologies.

UNIT-II:

Structural Bioinformatics – Molecular Structure viewing tool –Rasmol. Protein Structure Prediction – Secondary Structure prediction by Chou Fasman method and Tertiary structure prediction by Comparative modeling, Abinitio prediction, Homology modeling. Prediction of domains, motifs and profiles of proteins. Sequence alignment- global vs local alignment. Substitution matrics: BLOSUM and PAM. Scoring methods: gap introduction in alignment and gap penalties. Similarity searching tools: FASTA and BLAST. Multiple sequence alignment and phylogenetic analysis: Tools of multiple sequence alignment. Importance of multiple sequence alignment. Phylogenetic analysis. Phylogenetic Trees. Cladogram.

UNIT-III:

Genomics - Types (Structural and Functional), Gene Finding in prokaryotes and eukaryotes. Genome Annotation, Comparative genomics, Single nucleotide Polymorphisn Gen-SNIP. Proteomics – Protein expression analysis, Mass spectrometry in protein identification, Protein Sorting, Metabolomics, Systems Biology.

UNIT- IV:

Drug discovery process. Target identification and validation, lead optimization and validation. Methods and Tools in Computer-aided molecular Design, Analog Based drug design:- Pharmacophores . QSAR. Structure based drug design:- Docking, De Novo Drug Design. Virtual screening.

UNIT-V:

Methods of collection and classification of data; Primary and secondary data, qualitative and quantitative data. Frequency distribution, graphical representation, normal distribution.
Measures of central tendency- Mean, Median and Mode.Measures of dispersion- Mean deviation, Standard deviation, variance, standard error, co-efficient of variation.
Probability - Definition, mutually exclusive events, independent events – product rule.Tests of significance. Statistical inference – estimation - testing of hypothesis - t-test, Chi square test (goodness of fit, independence or association, detection of linkages), F-test, ANOVA. Correlation and Regression Linear regression and correlation (simple and multiple).. Design of experiments- Experimental designs: Principles - replication and randomization.Common designs in biological experiments: Completely randomized design, randomized block design, Latin square design, Factorial design.

REFERENCES:

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