



Shri Vishwanath P. G. College Kalan, Sultanpur

(Affiliated)

DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the Program: M.Sc.

Subject: **Botany**



Course Code		Course Title	Credits	T/P	Evaluation	
A	B				CIE	ETE
A	B	C	D	E	F	G
SEMESTER I (YEAR I)						
B040701T	CORE	Microbiology	5	T	25	75
B040702T	CORE	Fungi and Plant Pathology	5	T	25	75
B040703T	CORE	Algae and Bryophytes	5	T	25	75
B040705T	FIRST ELECTIVE	Environment and Plant Response	5	T	25	75
B040706P	SECOND ELECTIVE	Practical based on core / elective	5	P	50	50
SEMESTER II (YEAR I)						
B040801T	CORE	Pteridophyta, Gymnosperms & Palaeobotany	5	T	25	75
B040802T	CORE	Angiosperms: Taxonomy	5	T	25	75
B040803T	CORE	Angiosperm: Plant Development & Reproduction	5	T	25	75
B040805T	THIRD ELECTIVE	Plant Resource Utilization and applied Botany	5	T	25	75
B040806P	THIRD ELECTIVE	Practical based on core / Generic Elective Subjects	5	P	50	50
SEMESTER III (YEAR II)						
B040901T	CORE	Plant Physiology and Biochemistry	5	T	25	75
B040902T	CORE	Cytogenetics and Biostatistics	5	T	25	75
B040903T	CORE	Ecology, Soil Science and Phytogeography	5	T	25	75
B040905T	FIFTH ELECTIVE	Instrumentation and Analytical Technique	5	T	25	75
B040906P	SIXTH ELECTIVE	Practical based on Core / Elective Subject	5	P	50	50
SEMESTER IV (YEAR II)						
B041001T	CORE	Plant Molecular Biology and Molecular Techniques	5	T	25	75
B041002T	CORE	Plant Biotechnology and Bioinformatics	5	T	25	75
B041003T	SEVENTH ELECTIVE	Research Methodology and IPR	5	T	25	75
B041005P	RESEARCH PROJECT/ DISSERTATION	Major Research Project/ Dissertation	10	P	50	50

SEMESTER I

CORE Course Code: B040701T - Title: Microbiology

Unit I

Introduction to microbiology, history and scope of microbiology, Microbial evolution, Systematics and taxonomy of microorganisms. Primitive organisms, their metabolic strategies and molecular coding. Microbes of the extreme environment and their metabolic strategies.

The microbial cell: general organization of cell and cell wall of prokaryotes, eukaryotes and Archaea, prokaryotic and eukaryotic cell structure and function,

Unit II

Enrichment culture techniques, Isolation of Pure cultures, culture media (defined/synthetic, complex, selective, differential, enriched), Microbes and their preservation methods, Sterilization techniques, inoculation methods (spread-plate, streak-plate, pour plate), The definition of growth, growth curve, measurement of growth (batch and continuous culture), Culture collection and maintenance of cultures

Unit III

Microbiology of food, food spoilage and preservation processes, microbiology of fermented foods, oriental foods, dairy foods, wine, beer and other fermented alcoholic beverages, bread and other fermented plant products, Microbial production of organic acids, antibiotics, amino acids, vitamins, recombinant products, microorganisms as source of foods

Unit IV

Water-borne pathogenic microbes; role of microbes in wastewater treatment with special reference to activated sludge, Basic design of a fermentor; biosensors; bioremediation of hydrocarbon and metal polluted waters

Unit V

Rhizosphere, Phyllosphere, Mycorrhizae, Actinorrhizae, Tripartite associations, PGPRS, microbes in agriculture

Suggested readings:

1. Madigan, M.T., Martinko, J.M., Dunlap, P.V., Clark, D.P., 2011. Brock Biology of Microorganiss. 13th edition, Pearson Education Inc.
2. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., Painter, P.R., 1987. General Microbiology. Fifth edition, MacMillan.
3. Atlas, R.M. 1995. Principles of Microbiology. Mobsy.
4. Lim, D.V.: 2003. Microbiology. Kendall/Hunt.
5. Boundless. 2013. Microbiology. Boundless Learning, Incorporated.
6. Comelissen, C.N., Harvey, R.A and Fisher, R.D. 2012. Microbiology. Lippincott Williams & Wilkins.
7. Talaro, K.P., Chess, B. 2011, Foundations in Microbiology, 8th edition. McGraw-Hill.
8. Willey, J.M., Sherwood, L., Woolverton, C.J., 2010. Prescott's Microbiology. 8 edition, McGraw-Hill.
9. Agrios, G. N., 1988. Plant Pathology, Academic Press.
10. John A Lucas, 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press. And Laboratory Exercises, CRC Press.
11. Dickinson, C. M., 2003. Molecular Plant Pathology, Bios Scientific Publisher
12. Robert, N., Trigiano, Windham, M. T. and Windham, A.S., 2003. Plant Pathology: Concepts and Laboratory Exercises, CRC Press.
13. Bridge, P.D and Clarkson, J.M., 1998. Molecular Variability of Fungal Pathogens, CAB, International
14. Singh, R. S., 2008. Plant Diseases, Oxford and IBH Publishing Co. Pvt Ltd
15. Pelczar, J.M., Chan, E.C.S and Krieg, M.R. 1993. Microbiology. Tata McGraw Hill.

CORE Course Code: B040702T - Title: Fungi and Plant Pathology

Unit I

General characteristics, Thallus organization and cell structure, Nutritional types of fungi: biotrophs, hemibiotrophs, symbionts and necrotrophs, Reproduction, hormonal mechanism of sexual reproduction, Heterothallism, Heterokaryosis, Physiological specialization parasexuality, Fungal systematics and phylogeny

Unit II

Systematic study of structure and reproduction, life cycle, phylogeny and affinities of main groups of fungi with special reference to following.

- i. Myxomycetes
- ii. Plasmodiophoromycetes-(Plasmodiophorales).
- iii. Oomycetes :Saprolegniales (Saprolegnia, Achlya) Perenosporales (Pythium, Phytophthora, Albugo, Peronospora).
- iv. Chytridiomycetes: Chytridiales, Mucorales (Pilobolus).
- v. Zygomycetes: Entomophthorales.
- vi. Ascomycetes: Protomycetales, (Protomyces), Endomycetales (Saccharomyces), Taphrinales (Taphrina), Urotiales (Aspergillus, Xylaria) Erysiphales (Erysiphae, Phyllactenia, Pezizales (Peziza, Morchella).
- vii. Basidiomycetes: Ustilaginales (Ustilago, Urocystis) Uredinales (Puccinia, Melampsora Uromyces).
- viii. Deuteromycetes: Melanconiales (Colletotrichum), Moniliales (Alternaria, Cercospora, Fusarium).

Unit III

General introduction to Plant Pathology, History of Plant Pathology, Classification of Plant Diseases, Plant disease diagnosis: Koch's postulates, chemical weapons of pathogens Enzymes and toxins; Role of growth hormones in plant diseases, Pre-existing structural and chemical defence, induced structural and chemical defence. Parasitism and disease development, symptoms, Effect of environmental factors on the plant disease development, plant disease epidemiology. Control of plant diseases, quarantines and inspection, physical, chemical, cultural and biological methods of disease control, integrated pest management.

Unit IV

Study of following diseases of principal crops of U.P.

(i) Rust: (Wheat, Linseed) (ii) Smut: (Wheat, Sugarcane) (iii) Bunt: (Rice, wheat) (iv) Blight: (Potatoes, cucurbits). (v) Wilt: (Sugarcane, Pigeon-pea) (vi) Leaf Spot: (Rice, ground-nut) (vii) Mildews: (Pea) (viii) Cankers: citrus, white rust of crucifers and stem gall of coriander (viii) Viral diseases of Potato, Tomato, Papaya and Bhindi (ix) Diseases caused by mycoplasma

Unit V

Rapid methods for diagnosis of plant diseases caused by Viruses, Bacteria and Fungi with reference to ELISA and PCR.)

Suggested readings:

1. Webster, John, 1980, Introduction to Fungi, Cambridge University Press
2. Alexopoulos, CL, Mims, CW. and Blackwell, M. 1996, Introductory Mycology, Wiley
3. Carlile, M.J., Watkinson S.C. and Booday, G.W., 2001, The Fungi, Academic Press
4. Deacon, J.W., Blackwell, M, 1997, Introduction to Modern Mycology, Oxford
5. Webster, John and Roland, W.S., 2007, Introduction to Fungi, Cambridge University Press.
6. Willey, J.M., Sherwood, L., Woolverton, C., 2010. Prescott's Microbiology. 8th edition, McGraw-Hill.
7. Agrios, G. N., 1988. Plant Pathology, Academic Press.
8. John A Lucas, 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press.

9. Dickinson, C. M., 2003. Molecular Plant Pathology, Bios Scientific Publisher
10. Bridge, P.D and Clarkson, J.M., 1998. Molecular Variability of Fungal Pathogens, CAB International
11. Singh, R. S., 2008. Principles of Plant Pathology, Oxford and IBH Publishing Co. Pvt Ltd.
12. Dhingra, O.D. and James, B. Sinclair, 1995. Basic Plant Pathology Methods, CRC Press
13. Pelczar, JM, Chan, ECS and Krieg, MR. 1993. Microbiology. Tata McGraw Hill.

CORE Course Code: B040703T- Title: Algae and Bryophytes

Unit I

Introduction to Phycology, Principles and systems of classification of algae, Comparative account of algal pigments, food reserves, cell wall, flagellation, chloroplasts and eye-spots, their phylogenetic and taxonomic importance

Unit II

Cyanophyceae: Cyanophyta: cell structure, heterocyst and akinete development, chromatic adaptation, thallus organization and reproduction, Salient features of Gloeocapsa, Microcystis, Anabaena, Gloeotrichia, Nostoc, Rivularia, Scytonema

A brief account of thallus organization, structure and reproduction in Chlorophyta, Phaeophyta and Rhodophyta; alternation of generation in Phaeophyta and post-fertilization development and site of meiosis in Rhodophyta.

Unit III

A brief account of Protochlorophyta, Chlorophyta, Xanthophyta, Bacillariophyta

Phaeophyta: Ectocarpales (Ectocarpus); Laminariales (Laminaria); Dictyotales (Dictyota, Padina); Fucales (Fucus and Sargassum)

Rhodophyta: Bangioideae (Porphyra); Florideae (Batrachospermum, Polysiphonia)

Economic Importance of algae (Algae as food, biofertilizers and source of phycocolloids.)

Unit IV

Classification of Bryophytes, Comparative account of gametophyte structure, Sporophytic structure and evolution; Peristome structure and its significance in the classification of Mosses

Unit V

Morphology, structure reproduction, life history, distribution and phylogeny of bryophytes based on following:

(A) Hepaticopsida (i) Sphaerocarpales (Sphaerocarpus.), (ii) Marchantiales (Riccia, Marchantia, Cyathodium, Plagiochasma, Lunularia, Asterella), (III) Monocleales (Monoclea) (iv) Jungermaniales (Pellia, Porella, Fossombronia), (v) Calobryales (Calabryum): (vi) Takakiales (Takakia).

(B) Anthocerotopsida: Anthocerotales (Anthoceros and Notothylias).

(C) Bryopsida: Sphagnales (Sphagnum), Andreales (Andreaea), Bryales (Funaria)

Buxbaumiales(Buxbaumia).

Suggested Readings:

1. Phycology, 5th Ed., Robert Edward Lee, Publisher-Cambridge University Press, 2018.
2. Introduction to the Algae, 2 Ed., Bold and Wynne, 1984.
3. Introductory Phycology, H. D. Kumar, 1990.
4. Algae, 1st Ed, O. P. Sharma, 2011.
5. Principles and Techniques of Biochemistry and Molecular Biology, 8 Ed., Wilson and Walker, 2018
6. Biology of Bryophytes. -R.N. Chopra and P.K. Kumra. New Age International (P) Limited, New Delhi
7. An Introduction to Bryophyta. (Diversity, Development and Differentiation). - A.Rashid. Vikas Publication House Pvt. Ltd., 1998.
8. Bryophytes-A Broad Perspective. - Prem Puri. Atma Ram & Sons, Delhi & Lucknow, 1985.
9. Cryptogamic Botany. Bryophytes and Pteridophytes. Vol..G.M. Smith. Tata McGraw-Hill Publishing Company Limited, New Delhi, 1972.
10. The Structure and Life of Bryophytes.-E.V. Watson, BI publications, 1964.

ELECTIV I Course Code: B040705T - Title: Environment and Plant Response

Unit I

Soil Environment: Soil composition, organic matter input and decomposition, soil nutrient storage and accumulation in plants, agrochemical residues and their pollutive effect.

Unit II

Water Environment: Hydrological cycle, primary production and productivity of different aquatic weeds, distribution, adaptation and dynamics of fresh water and wetland plant communities. water pollution due to sewage, agrochemicals, industrial wastes and urban solid wastes,

Unit III

Air environment and its ecological perspective with reference to rural, urban and industrial areas. Effect of air pollutants e.g. SO, Fluride, photo-chemical, suspended particulates on vegetation of local area.

Unit IV

Indexing of sensitivity and resistance to pollutants of plants.
Nuclear power-energy and its environmental effect.

Unit V

Environmental planning strategies criteria for environmental standard, monitoring techniques, control of air pollution through plants and microbes. Control of pollution of water bodies.

SEMESTER II

CORE Course Code: B040801T - Title: Pteridophyta, Gymnosperms & Palaeobotany

Unit I

Morphology, anatomy and reproduction, phylogenetic relationships with emphasis on detailed study of following:

- I. Psilopsida - (Psilophytales, Psilotales)
- II. Lycopsidea-(Lycopodiales, Sellagenales, Lepidodendrales, Isoetales, Pleuromiales)
- III. Sphenopsida- (Equisetales, Hyeniales, Sphenophyllales and Calamitales).
- IV. Pteropsida- (A general account)
- V. Filicinae- A general account
- VI. Eusporangiate ferns- (Ophioglossales, Marattiales).
- VII. Leptosporangiate ferns-Filicales.

Unit II

Telome concept, apogamy and apospory, Sex organs and embryogeny in Pteridophytes.

Ecology of pteridophytes, Economic importance of the pteridophytes, Cytogenetics of pteridophytes.; heterospory and seed habit Evolution of stele in pteridophytes. Classification and economic importance of Pteridophytes.

Unit III

General introduction of gymnosperms with special reference to its salient features, similarities and dissimilarities with other groups like pteridophytes and angiosperms.

Classifications of gymnosperms. Origin and Evolution of gymnosperms with special reference to Progymnosperms, Devonian pre ovules and origin of seed.

Unit IV

Brief Account of the families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae, and Glossopteridaceae). Comparative study of Cycadales, Ginkgoales, Coniferales (Pinaceae, Cupressaceae, Araucariaceae, Podocarpaceae, Cephalotaxaceae, Taxodiaceae), Taxales and Gnetales (Gnetaceae, Ephedraceae and Welwitschiaceae) etc.

Global distribution of gymnosperms with special reference to Indian plants. Endangered gymnosperms, their conservation and present status. Cytogenetics of Gymnosperms; Economic importance and biotechnology of gymnosperms.

Unit V

Study of fossils: Methods of preservation, investigation and importance in stratigraphy. Continental drift and geological time scale.

Suggested readings:

1. Rashid, A, 2011, An Introduction to Pteridophyta, 2nd edition, (Reprint), Pub. Vikas Publishing House Pvt. Ltd., Noida.
2. Gifford, Ernest, M., Foster, Adriance.S., 1989, Morphology and Evolution of vascular plant. W. H. Freeman; Third Edition.
3. Ogura, Yuzuru., 1972, Comparative Anatomy of Vegetative Organs of The Pteridophytes. Gebr. Borntraeger; 2nd edition.
4. Rashid, A.1999, An Introduction to Pteridophyta: Diversity, Development, Differentiation. Vikas Publishing House Pt Ltd.
5. Parihar, Narayan Singh., 1977, The Biology and Morphology of The Pteridophyte. Central Book Depot.
6. Eames, A.J. (1936) Morphology of Vascular plant-lower group. Tata McGraw Hill, New Delhi.
7. Chamberlain, Charles Joseph, b.(1863), Gymnosperm; Structure and Evolution. Chicago, Ill., The University of Chicago Press

8. Chhaya Biswas and B.M.Johri. The Gymnosperm. Springer; 1997, edition (16 April 2014) Bhatnagar, S.P. Moitra, Alok. (1996). Gymnosperms. New Age International.
9. Pant DD. (2002), An Introduction to Gymnosperms, Cycas, and Cycadales, Birbal Sahni Institute of Palaeobotany,
10. Steward W.N., Paleobotany and evolution of plant. Cambridge University Press, New York.405 p.
11. Stewart, W.N., and G.W.Rothwell. (1993) Paleobotany and the evolution of plant. 2nd ed. Cambridge University Press, New York.521 p.(1)
12. Andrews,H.N.jr.1974 Palacobotany (1947-1972) Annals of the Missouri Botanical Garden 61:179-202.(8)

CORE Course Code: B040802T - Title: Angiosperms : Taxonomy

Unit I

Latin diagnosis, definition and use of Taxonomic terms, History of Plant Taxonomy in India, History of Plant Classification, Need and aim of classification, Units of classification, delimitations of taxa and their practical consideration, Artificial, Natural and Phylogenetic system of classification, a critical study of Takhtajan, Modern system of classification, An introduction of angiosperm Phylogeny Group (APG), Characteristics and phylogeny of orders

Unit II

Need and aim of nomenclatures, International rules of Botanical Nomenclature, Concept of species, genus and family with special reference to the type concept

Unit III

Interrelationship of plant taxonomy with morphology, anatomy, embryology, palynology, cytology, genetics, Biosystematics, biochemical and molecular systematics, Numerical taxonomy, Phytogeography and phytochemistry

Unit IV

A general knowledge of Herbarium, and Botanical garden of the world and India, BS and Identification keys

Unit V

General knowledge of distinguishing features of important families with special reference to local flora.

(a) Dicotyledons: Magnoliaceae, Ranunculaceae, Papaveraceae, Anacardiaceae, Fabaceae, Rosaceae, Myrtaceae, Apiaceae, Rubiaceae, Cucurbitaceae, Capparidaceae, Caryophyllaceae, Malvaceae, Rutaceae, Meliaceae, Asteraceae, Scrophulariaceae, Primulaceae, Asclepiadaceae, Convolvulaceae, Verbenaceae, Bignoniaceae, Lamiaceae, Acanthaceae, Polygonaceae, Euphorbiaceae.

(b) Monocotyledons: Orchidaceae, Liliaeae, Musaceae, Palmae, Cyperaceae, Graminae (Poaceae) etc.

Suggested Readings:

1. J. Harborne, B.L. Turner and D. Boulter- Chemotaxonomy of Leguminosae, Academic Press, London, 1971.
2. John Firminger Duthie- Flora of Upper Gangetic Plains, Shiva offset Press, vol. I, 1903, vol. II, 1911.
3. John Hutchinson- The Families of Flowering Plants, Clarendon Press, 1959.
4. Arthur John Cronquist- The Evolution and Classification of Flowering Plants, Shiva offset Press, 1981.
5. P.H. Davis and B.H. Heywood- Principles of Angiosperm Taxonomy, Princeton Press, 1963.
6. Alfred Barton Randle- The Classification of Flowering Plants, Harvard University, 1904.
7. Gurcharan Singh- Plant Systematic, Oxford & IBH Publishing Company Pvt. Ltd., 1999.
8. Tod F. Stuessy- Plant Taxonomy, Shiva offset Press, 2002.
9. Peter H.A. Sneath and Robert R. Sokal- Numerical Taxonomy, Wayne State University Press, 1973.
10. T. Pullaiah- Taxonomy of Angiosperms, Regency Publications, New Delhi, 1998.

CORE Course Code: B040803T - Title: Angiosperm : Plant Development & Reproduction

Unit I

introduction of morphology and anatomy including brief historical account; External and internal organization of higher plants; Morphology of root and stem and their modifications, Ergastic substances; Microscopic and sub-microscopic structure and organization of cell wall Meristems: Organization of root apical meristem (RAM) and shoot apical meristem (SAM) differentiation; Quiescent center, Xylem and phloem: Ontogeny and structure of components and phylogeny, transfer cells. Secretary and excretory structures; Primary structure of root and stem, Origin of lateral roots, root-stem transition, nodal anatomy and its evolutionary significance; Leaf -structure and function with special reference to epidermis. Systematic significance of trichomes and stomata;

Unit II

Vascular cambium and its derivatives, Primary anomalies in stem and anomalous secondary growth, Floral morphology and anatomy, fruits and seeds Periderm, Wood structure, Sapwood and Heartwood, Growth rings

Unit III

Experimental and applied embryology Morphogenetic Phenomenon-Symmetry, Polarity, Correlation, Differentiation, Totipotency and Regeneration and Phyllotaxy Factors affecting Morphogenetic Phenomenon: Genetic, Physical and Chemical

Unit IV

Introduction to life history of angiosperms, brief history of plant embryology; Anther: Structure and development wall layers and their role; Microsporogenesis; Cytoplasmic reorganization during microsporogenesis, Pollen wall morphogenesis and anther dehiscence; Pollen morphogenesis, Development of male gametophyte, ultrastructure, abnormal male gametophyte, Pollen germination

Unit V

Pollen-pistil interaction: Role of pollen wall proteins and stigma surface proteins, pollen tube growth in pistil, fertilization and apomixis: Endosperm: Major types, ultrastructure and histochemistry; Embryo: major types, polyembryony Embryology in relation to Taxonomy

Suggested readings:

1. Carlquist, S. (1961), Comparative Plant Anatomy, Holt, Rinehart and Winston, New York Press
2. Cutter, Elizabeth (1969), Plant Anatomy part -I Cells and Tissues IInd edition, Edward Arnold, London
3. Cutter, Elizabeth (1971), Plant Anatomy Part-II Organs, Edward Arnold London
4. Dickson William C. (2000), Integrative Plant Anatomy. Academic Press
5. Eames, A. J. & Mac Daniels Laurence H. (1951), An Introduction To Plant Anatomy, Mc Graw Hin.
6. Eames A.J (1961), Morphology of Angiosperms, Mc Graw-Hill, New York.
7. Esau, Katherine (1965), Plant Anatomy, John Wiley and Sons. Inc, New York.
8. Esau, Katherine, Anatomy of seed Plants (1960), Wiley, New York.
9. Evert, Ray.F.(1960), Esau's Plant Anatomy. John Wiley & Sons.
10. Fahn,A. (1982), Plant Anatomy Vol I and Vol II Pergamon Press. Oxford New York
11. Mauseth, James D. (1988) Plant Anatomy, Benjamin/Cummings.
12. Bhojwani, S.. and Bhatnagar, S.P.(1985), Embryology of Angiosperms, Vikash Publishing House, New Delhi
13. Johri, B.M (1984) Embryology of Angiosperms.Springer-Verlag Berlin Heidelberg.
14. Maheshwari, P. (1950) An Introduction to the Embryology of Angiosperms. Tata McGraw Hill.

ELECTIVE III Course Code: B040805T - Title: Plant Resource Utilization and applied Botany

Unit I

Plant diversity and sustainable development: basic concepts and status in India.

Unit II

Cultivation and uses of economically important plants (with special reference to origin, evolution, cultivation and uses).

Food, forage and fodder crops: Cereals, legumes, nuts and general account of fodder crops.

Fibre yielding crops: Textile fibre plants and their products, its uses and cultivation In India.

Medicinal Plants and Aromatic plants: Plants of medicinal importance and general account of aromatic plants as source of essential oil.

Important fire wood and timber yielding plants: A general account.

Non-wood forest products (NWFPs): Bamboo, rattans, raw material of paper industry, gums, tannins, dyes, resins, rubber and latex-products: A general account.

Fumigatories and masticatories: A general account.

Unit III

Green revolution: Benefits and adverse conditions, innovation for meeting world food demands.

Unit IV

Conservation Biology: Principles of conservation, strategies for conservation In situ conservation (a general account of sanctuaries, national parks, biosphere reserves, wetlands, mangroves, for conservation of wild biodiversity), Ex-situ conservation (Principle and practices, A general account of the activities of B.S., National Bureau of Plant Genetic resource (NBPGR), Indian Council of Agricultural research (ICAR) for conservation of plants and non-formal conservation efforts.

Unit V

Organisms of conservation concern: Rare, endangered species. Bioremediation, phytoremediation, and biosensor

SEMESTER III

CORE Course Code: B040901T - Title: Plant Physiology and Biochemistry

Unit I

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways.

Respiration and photorespiration: glycolysis, Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Nitrogen metabolism: Nitrogen cycle and biological nitrogen fixation, nitrate and ammonium assimilation, amino acid biosynthesis.

Metabolism of lipids, amino acids, nucleotides.

Unit II

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Growth and Development Aspects: Metabolic changes during seed germination, factors affecting seed germination and dormancy, breaking of dormancy, biochemistry of flowering: initiation and development of flower, induction of flowering- vernalization, physiology and biochemistry of leaf abscission and senescence.

Unit III

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.

Sensory photobiology: Phytochromes and cryptochromes and their photochemical and biochemical properties, photo physiology of light-induced responses, cellular localization, molecular mechanism of action of photoreceptor receptors, signaling and gene expression Secondary metabolites: Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Programmed Cell Death (PCD)

Unit IV

Bioenergetics: Law of thermodynamics, concept of enthalpy and entropy and their significance in biological systems, Water biochemistry, high energy molecules, redox potential; Amino acids and proteins: Structure and physicochemical properties of amino acids;

Proteins: Primary, secondary, tertiary and quaternary structure of proteins, physical and chemical properties of proteins and biological significance. Enzymes: Classification, physicochemical nature, enzyme kinetics, mechanism of action and regulation, allosteric enzyme, isoenzyme, zymogen

Unit V

Carbohydrates: Structure and physico-chemical properties of carbohydrates, biological significance, important glycoprotein,

Lipids: Classification, structure and properties of important lipids, biological significance of glycolipids, fatty acid biosynthesis and storage lipids and their catabolism, Vitamins and Coenzymes: Structure and general biochemistry.

Suggested readings:

1. Taiz and Zeiger, 2010, Plant Physiology, 5th Edition. Sinauer Associates
2. Hopkins, W.G. and Huner N.P.A., 2009, Introduction to Plant Physiology, 4* Edition Wiley International Edition, John Wiley & Sons, USA
3. Jones, Russell L. Buchanan, Bob B. Guissem, Wilhelm., 2002, Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists.
4. Peter Scott, Physiology and Behaviour of Plants. Wiley-Blackwell.
5. Frank Boyer Salisbury and Cleon Ross, 1991, Plant Physiology, CA
6. Wilson, K. and Walker, J., 2000, Practical Biochemistry: principles & techniques Cambridge University Press. ISBN 0521799651.
7. Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of PlantBiologists, USA.
8. Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, M and Richard, L. 2008. Molecular Biology of the Gene. Pearson Education Inc.
9. Nelson, D.L and Cox, M.M., 2008, Lehninger Principles of Biochemistry, W. H. Freeman & Co, New York, USA
10. Murray, R, Murray, RK, Bender, D, Gotham, KM, Kennelly, PJ, Rodwell, V and Weil, PA. 2012. Harper's Illustrated Biochemistry McGraw Hill
11. Wilhelm Gruissem, Russell L.Jones, 2000, Biochemistry and molecular biology of plants. American Society of Plant Physiologists,
12. Berg, J.M., Tymoczko, J.L. & Stryer, L. 2011, Biochemistry, Freeman & Co., New York, USA.
13. Weil, J.H., 1990, General Biochemistry, Wiley Eastern Limited, New Age international Limited. New Delhi.
14. Lea P.J. and Leegood R.C., 1999, Plant Biochemistry & Molecular Biology, John Wiley & Sons, NewYork,

CORE Course Code: B040902T - Title: Cytogenetic and Biostatistics

Unit I

Basic concept and organization: Chromosome structure, special type of chromosomes- Polytene chromosomes, lamp brush chromosomes, B chromosomes. Gene concept; allele concept, multiple alleles, isoalleles, Pseudoalleles, Cell division,

Unit II

Inheritance Genetics: Principles of Mendelian Inheritance, Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex determination in plants and sex linkage, sex limited and sex influenced characters.

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers.

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Unit III

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Population genetics: Populations, Gene pool, Gene frequency; Hardy Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.

Unit IV

Mutation: Types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, physical and chemical mutagens, insertional mutagenesis. DNA damage and repair mechanism.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Unit V

Biostatistics: General Concept of statistics and biometry.

Measurement of central tendencies (mean, mode, median), measurement of deviation (standard deviation, standard error).

Significance test (chi square test & t-test),

Diagrammatic representation of statistical data.

Correlation

Types of statistical software and their application in analysis of data

Suggested reading:

1. Clark, M.S. and Wall, W.J. 1996, Chromosomes: The Complex Code. Chapman & Hall, London.
2. Stebbins, G.L. 1950, Variation and Evolution in Plants. Columbia Univ. Press, New York.
3. Swanson, C. P., Mertz, T.F. and Young, W.J. Cytogenetics: The Chromosomes in Division, Inheritance and Evolution (2nd Ed). Englewood Cliff, Prentice-Hall, New Jersey.
4. Sharma, A.. and Sharma, Archana. 1985. Advances in Chromosome and Cell Genetics. Oxford & IBH Publishing Co., Calcutta.
5. Schnedl, W.. Banding patterns in chromosomes. In: International Review of Cytology (Suppl. 4).
6. Lewine, Benjamin, Jones and Bartlet, Genes X, Sudbury, Massachusetts
7. Gupta, P.K., Cytogenetics, Rastogi Publication, Meerut
8. Peter, D, Snustand and Simmons, M.J., John Wiley and Sons Inc.

CORE Course Code: B040903T - Title: Ecology, Soil Science and Phytogeography

Unit I

Introduction to ecology, and environmental terminology, population dynamics, vegetation organization and development: population characteristics, population growth forms, density dependent and density independent controls, population structure (distribution, aggregation, isolation territoriality) energy partitioning, r- and k-selection, concept of carrying capacity: Wild life sanctuaries, botanical gardens

Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, competition, ecological niche, succession, mechanism of ecological succession (relay floristic and initial floristic composition facilitation, tolerance and inhibition models), concept of climax

Unit II

Ecosystem organization, structure and function: primary production (methods of measurement), energy dynamics (tropic organization, energy flow pathway, energy quality, ecological efficiencies), biogeochemical cycles

Unit III

Pollution and climate change: kinds, sources and effects of pollution, heavy metals (Pb, Cd, Hg), greenhouse gases (CO₂, CH₄, NO, CFCs), Green-house effect and global warming, ozone layer depletion and ozone hole, acid rain

Unit IV

Soil types, soil profile, soil formation (gleization, Podzolization and Laterization), soil texture, soil humans.

Soil moisture constants.

Soil erosion and conservation.

Unit V

Phytogeography: Distribution pattern, barriers, endemism and age- area hypothesis.

Environmental impact assessment, threatened and endangered plant species, role of diversity in ecosystem stability, general account of remote sensing and its application, sustainable development. Major terrestrial biomes, biogeographical area of India, major vegetations

Suggested reading:

1. Odum, E. P. and Barret G. W. 2005. Fundamentals of Ecology. engage publication
2. Odum, E.P., 1983. Basic Ecology, Saunders College Publishing
3. Singh, J.S., Singh S.P. and Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers
4. The nature and properties of soils, Nyle C. Brady and Ray R. Weil, Pearson Education Pvt. Ltd., 2002

ELETIVE V Course Code: B040905T - Title: Instrumentation and Analytical Technique

Unit I

Techniques of Collection, fixation, embedding, dehydration and Staining.

Unit II

Microscopy: Simple, Compound, Phase-contrast, Fluorescence, Electron (SEM and TEM) microscopy, Micrometry and Camera lucida

Unit III

Centrifugation:-Rotors, Benchtop, Low speed, High speed, Cooling, Ultracentrifuge.

Electrophoresis:-Native, Denaturing, Isoelectric focusing, 2-D Electrophoresis;

Spectroscopy:- UV, Visible, IR, Raman, Spectro fluometry, Mass, AAS, NMR

Unit IV

ESR Radioactivity- GM counting, Scintillation counting, Autoradiography;

Chromatography:- Paper, TLC, Column, Gel Filtration, Ion Exchange, HPLC, GC.

Unit V

Microtomy; DNA Chip technology and Microarrays, Mass Spectrometry for genome and proteome analysis

SEMESTER IV

CORE Course Code: B041001T - Title: Plant Molecular Biology and Molecular Techniques

Unit I

Structure and conformation of nucleic acids; Replication of DNA; DNA damage and repair, Gene structure; Transcription of gene; Structure of mRNA, rRNA and tRNA, Regulation of transcription, Post-transcriptional modification of RNA, RNA editing; Transport of RNA

Unit II

Protein synthesis: Genetic code, Mechanism of translation (initiation, elongation and termination); Post-translational modification; Protein sorting in the cell, Regulation of protein synthesis in prokaryotes and eukaryotes.

Unit III

Signal transduction: Overview of receptors and G-proteins, phospholipids signifying role of cyclic nucleotides, calcium calmodulin cascade diversity in protein kinase and phosphates specific signalling mechanism, Secondary messengers; Gene silencing mechanisms, Epigenetics

Unit IV

Isolation and Purification of Nucleic Acids, Electrophoresis and quantification of nucleic acids, DNA Sequencing Sanger's Dideoxy Method, Maxam and Gilbert Method. High throughput sequencing, Nuclear run-on assay, Nuclei acid blotting techniques, DNA Synthesis, Chromatin remodelling

Unit V

Isolation and purification of protein, Electrophoresis and quantification of proteins, Western Blotting. Protein-nucleic acid interaction analysis, Protein-protein interaction analysis; ELISA, RIA; Protein immunoprecipitation, Protein sequencing strategies, Radioactive isotope labelling, Mass spectrometry

Suggested Readings:

1. Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.
2. Lodish, Harvey, Berk, Arnold, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony
3. Bretscher, Hidde Ploegh, Paul Matsudaira Molecular Cell Biology, 6th Ed. W.H. Freeman and Comp., New York
4. Bourton E. Tropp, Molecular Biology, 4th Ed., Jones & Barlett learning
5. Brown, T.A., DNA Cloning and Gene Sequencing Willey-Blackwell, Oxford
6. Genes 1X by Benjamin Lewin, Jones and Barlett
7. Y Gerald Karp, Cell and Molecular Biology 6th Ed., John Willey & Sons
8. Nelson, D.L and Cox, M.M., 2008, Lehninger Principles of Biochemistry, Fifth Edition, W. H. Freeman & Co, New York, USA.
9. Cooper, G.M. and Robert, E. Hausman The Cell: A Molecular Approach 5th Ed. (Co published by ASM Press and Sinauer Assoc. Inc.)
10. Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, M and Richard, L. 2008. Molecular Biology of the Gene. Pearson Education Inc.

CORE Course Code: B041002T - Title: Plant Biotechnology and Bioinformatics

Unit I

A brief introduction to Biotechnology; Recombinant DNA technology: Restriction endonucleases, DNA Modifying enzymes, DNA polymerases; Vectors, Markers and reporter genes, Cloning, Screening of recombinant clone; Polymerase chain reaction: Principle, method, variants and practical applications.

Unit II

Gene cloning and identification: Genomic and cDNA library, Hybridization techniques: Southern, northern and western hybridization; FISH; Molecular markers: RFLP, RAPD, AFLP, SSR, SNP; Functional genomics: Quantitative Real Time PC, Microarray, RNA interference, Mutagenesis and Genome editing, Protein Production strategies in Expression System; Metagenomics

Unit III

Methods of gene transfer, Agrobacterium mediated genetic transformation of plants, Regeneration methodologies and Screening of transformants; Genetic engineering and its applications in Agriculture: Genetic manipulation of pest resistance, abiotic and biotic stress tolerance, Molecular farming; Transformation of chloroplast genome and its advantage; Biosafety concerns in Plant Biotechnology

Unit IV

Bioinformatics: Introduction, Databases (Genomic and Protein Database), Similarity Searching: BLAST and FASTA; Tools for DNA, RNA and Protein sequence analysis, ExPASy. PROSITE, Sequence Retrieval Methods, Primer Designing tools, Gene Prediction, Restriction Site Annotation, OF Finder, Sequence Alignment; Molecular evolution and analysis methods

Unit V

Bio fertilizers, organic farming, Biotechnology in pollution control and phytoremediation, Ethics in biotechnological research.

Suggested readings:

1. J.D. Watson, T. A. Baker, S. P. Bell, A. Gann, M. Levine & R. Losick Molecular Biology of the Gene, Cold Spring Harbor Laboratory
2. Bernard R. Glick and Jack J. Pasternak, Molecular Biotechnology: Principles and application of recombinant DNA ASM Press, Washington, D.C
3. T. A. Brown, Genomes - Garland Science (Taylor & Francis Group), New York & London
4. Alberts Bruce, Johnson Alexander, Lewis Julian, Raff Martin, Roberts Keith and Walter Peter Molecular Biology of the Cell - Garland Science
5. Lodish, Harvey, Berk Arnold, et. al.,-Molecular Cell Biology.
6. Introduction to plant biotechnology by H S Chawla

ELECTIVE VII Course Code: B041003T - Title: Research Methodology and IPR

Unit-I

Meaning, Object & Basic Principles of Research Legal Research in India, Evaluation and Development, Problems & Challenges

Unit II

Tools and Techniques of Legal Research Doctrine and Empirical Research, Interview Techniques, Scaling Techniques of Socio Legal Research Research Design, Sampling Designs, Data Collection and Analysis Creativity, Innovation, Originality and Advancement of Knowledge and Application to the Society

Unit III

Report writing and the writing of research papers; Lay out, chaptering, preparation of Introduction and Conclusion, Methods of citation, Bibliography and Abbreviations Communication Skills, review of published research, seminar, presentation etc.

Unit IV

Computer application for research, Word Processing, Data Processing, Graphical Processing, Use of Web-2 tools for research, use of Graphical Software, Use of Multimedia Tools, Ethics in Research

Unit V

Concept of bioethics, benefits and harm, consent, privacy and confidentiality, sharing of benefits; Intellectual Property Right: Definition of IPR, World Intellectual Property Organization (WIPO) and its role; Patent: kinds of patent classification, patent criteria, Procedure of obtaining patent, copy right and trade mark, Organization of patent offices in India

Course Code: B041005P - Title: Major Research Project/ Dissertation

The topic would be decided by the candidate in consultation with the respective supervisor. Major Research Project/ Dissertation will be based on existing branches of botany and the title will be decided keeping the view on the modern aspect in the related discipline. It will be the part of semester IV; however, the title of Major Research Project/Dissertation will be assigned by concerned faculty member/board in the beginning of semester III to provide sufficient time to complete Major Research Project /Dissertation.