YOGI VEMANA UNIVERSITY

M.Sc. BOTANY SYLLABUS
SEMESTER & CBCS PATTERN
(Effective from 2015-16)

DEPARTMENT OF BOTANY
VEMANAPURAM, KADAPA-516003,
ANDHRA PRADESH, INDIA

APRIL 2015

SEMESTER-I

Paper	Title of the paper	Instructions Hrs./Week	Internal Assessment Marks	End Semester Marks	Total Marks	Credits
15011	Biology and diversity of virus, bacteria, fungi and Plant Pathology	4	25	75	100	4
15012	Biology and diversity of Algae, Bryophytes, Pteridophytes, Gymnosperms	4	25	75	100	4
15013	Genetics and Cytogenetics	4	25	75	100	4
15014	Taxonomy of Angiosperms	4	25	75	100	4
15015 P	Corresponding to 15011 &15012	8	100		100	4
15016 P	Corresponding to 15013 & 15014	8	100		100	4
#	Field Trip/Botanical Tour for minimum of 5 days must for all students	Herbarium/Field note book will cover total of 20 marks (10 Marks in 15015 P & 10 marks in 15016 P)				

SEMESTER-II

25011	Plant Ecology & Environment	4	25	75	100	4
25012	Paleobotany and plant developmental biology	4	25	75	100	4
25013	Plant Reproduction and Tissue Culture	4	25	75	100	4
25014	Cell Biology of Plants	4	25	75	100	4
25015 P	Corresponding to 25011 & 25012	8	100		100	4
25016 P	Corresponding to 25013 & 25014	8	100		100	4
Elective-I	Plants and Society	4			100	4

SEMESTER-III

35011	Ethno botany & Pharmacognosy	4	25	75	100	4
35012	Plant Physiology	4	25	75	100	4
35013	Tools and Techniques in Plant Science	4	25	75	100	4
35014	Molecular Biology of Plants	4	25	75	100	4
35015 P	Corresponding to 35011 & 35012	8	100		100	4
35016 P	Corresponding to 35013 & 35014	8	100		100	4
Elective-II	Plant propagation	4			100	4

SEMESTER-IV

45011	Evolution and Plant Breeding	4	25	75	100	4
45012	Genetic Engineering of Plants	4	25	75	100	4
45013	Biodiversity Conservation and Management	4	25	75	100	4
45014	Plant Metabolism	4	25	75	100	4
45015 P	Corresponding to 45011 & 45012	6	100		100	4
45016 P	Corresponding to 45013 & 45014	6	100		100	4
	Total for Core Papers	**128**	**400**	**2000**	**2400**	**96**
	Total for Elective Papers	**8**	**50**	**150**	**200**	**8**
	Grand Total	**136**	**450**	**2150**	**2600**	**104**

15011- Biology and Diversity of Viruses, Bacteria, Fungi and Plant Pathology

Unit-I: Viruses

General characters, ultrastructure of virions, isolation and purification of viruses; chemical nature, replication and transmission of viruses; Economic importance. Viroids and Prions

Unit-II: Bacteria & Phytoplasma

General Account; Classification, ultrastructure, nutrition, reproduction [fission and genetic recombination (transformation, transduction and conjugation)] and economic importance. Phytoplasma; General characteristics and economic importance

Unit- III: Mycology

General characteristics of fungi, cell wall composition, nutrition (Saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual), heterothallism, Heterokaryosis; Para sexuality, recent trends in classification and Ainsworth's classification of fungi. General account of Myxomycota, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina; economic importance of fungi (in industry, as medicine and food, biocontrol agents), lichens, mycorrhizae and mushroom cultivation.

Unit –IV: Plant Pathology

Nature and classification of plant diseases, important plant diseases caused by fungi, bacteria and viruses and their control measures, mechanism (s) of pathogenesis and resistance, molecular detection of pathogens, plant-microbe beneficial interactions. Plant diseases-TMV, YBMV, little leaf disease, citrus canker, downy mildew of bajra, blight of paddy, club root of crucifers**,** rust of wheat, smut of sorghum, powdery mildew of grapes, red rot of sugarcane, leaf spot and tikka diseases of groundnut.

Suggested Practicals:

1. Preparation of stains and fixatives.
2. Staining of Bacteria: negative and Gram's staining.
3. Demonstration of motility in Bacteria.
4. Determination of microbial counts by using Heamocytometer.
5. Morphological study of fungi belonging to Myxomycota, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina
6. Study of symptomology of locally available diseased specimens.
7. Isolation of fungi from soil: media preparation, dilution plate technique.
8. Study of crustose and foliose lichens

Suggested Readings:

1. Ainsworth G.C., E.K.Sparrow & A.S.Sussman, 1973.The *Fungi-An advanced treatise*. Academic Press.
2. Alexopoulos, C.J., Mims, C.W. and Blackwel, M. 1996. Introductory Mycology. John Wiley & Sons Inc.
3. Bilgrami, K.S. & H.C. Dube (1990) : A Text Book of Plant Pathology, Vikas publishing House Pvt., Ltd.,New Delhi, India.
4. Burnett, J.H. (1968) : Fundamentals of Mycology. Edward Arnold (Publishers) Ltd., London.
5. Dube, H.C . (1992) : A Text Book of fungi, Bacteria & Virus, Vikas Publishing House (P) Ltd., New Delhi.
6. Mandahar, C.L. 1978. Introduction to Plant viruses. Chand & Co., Ltd., Delhi.
7. Mehrotra, R.S. and Aneja, K. R. 1998. An Introduction to Mycology. New Age International Press.
8. Mehrothra, R.S (1994) : Plant Pathology, Tata McGraw Hill Publishing Co., Ltd., New Delhi
9. Pandey, B.P. (1999) : Plant pathology-Pathogens & Plant Diseases, S. Chand & Co., New Delhi-492 pp.,
10. Pelczar, M.J., E.C.S.Chan & N.R.Krieg. 1986. *Microbiology*. Tata McGraw Hill, New Delhi.
11. Rangaswamy, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India (4^{th} Ed.) Prentice Hall of India Pvt. Ltd., New Delhi.
12. Sharma, P.D. 2000. Plant Pathology. Narosa Publishing House, India.
13. Singh, R.S. (2000) : Introduction to Principles of Plant pathology (3_{rd} Edition), Oxford & IBH Publishers, New Delhi.
14. Sullia, S.B. and Shantharam, S. 2000. General Microbiology. Oxford & IBH Publ. , New Delhi.
15. Webster, J. (1999) : Introduction to Fungi (2_{nd} edition), Cambridge University Press
16. R. Hall (2005). Plant Virology. Printice Hall

15012-Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms

Unit- I: Algae

Algae in diversified habits (terrestrial, freshwater, marine), thallus organization, cell structure; reproduction (vegetative, asexual, sexual), criteria for classification of algae: pigments, reserve food, flagella, classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta, algal blooms, algal fertilizers; algae as food, feed and uses in industry

Unit- II: Bryophytes

Morphology, structure, reproduction and life history; distribution; classification; General account of Marchantiales, Jungermanniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; economic and ecological importance.

Unit – III: Pteridophytes

Morphology, anatomy and reproduction, classification, evolution of stele, heterospory and origin of seed habit, Introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Unit – IV: Gymnosperms

General characters and classification; distribution in India, morphology, anatomy, reproduction and affinities of living gymnosperms: Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwithschiales and Gnetales; economic importance.

Suggested Practicals:

1. Observation of representatives of all groups in natural habitat in local forests area.
2. Morphological study of representative members of all groups using whole mount preparations and sections.
3. Study of morphology and anatomy of vegetative structures of Algae, Bryophytes, Pteridophytes and Gymnosperms.

Suggested Readings

Bhatnagar, S.P. & Alok Moitra (1997) : Gymnosperms, New Age International (P) Ltd., Publisher, New Delhi.
Bilgrami, K.S., & L.C. Saha (1996) : A text Book of Algae, CBS Publishers & Distributors (P) Ltd., New Delhi.
Bierhorst, D.W. (1971) : Morphology of Vascular Plants, The MacMillan Co., N.Y. & Collier-MacMillan Ltd., London.
Chapman, V.J., & Chapman, D.J., (1973) : The Algae (2nd Edition), ELBS & MacMillan
Chopra, R.N. & Kumara, P.K. (1988) : Biology of Bryophytes, Wiley Eastern Ltd., New Delhi.
Coulter, J.M.& C.J. Chamberlain (1964) : Morphology of Gymnosperms, Central Book Depot, Allahabad
Datta, S.C. (1984) : An Introduction to Gymnosperms, Kalyani Publishers, New Delhi

Eames, A.J. (1936) : Morphology of Vascular Plants (Lower Groups), McGraw Hill, N.Y.
Fritsch F.E. (1935, 1945). The Structure & Reproduction of Algae, Cambridge University Press, Cambridge, U.K. Vol. I & Vol. II
Kumar, H.D. (1990) : Introductory Phycology, Affiliated East West Press (P) Ltd., New Delhi.
Prem Puri (1981) : Bryophytes: Morphology, Growth and differentiation, Atma Ram & Sons., Delhi, Lucknow.
Parihar, N.S. (19) : An Introduction to Embryophyta Vol.II Pteridophyta, Central Book Depot., Allahabad.
Rashid, A. (1998) : An Introduction to Bryophyta, Vikas Publishing House (P) Ltd., New Delhi
Rashid, A. (1999) : An Introduction to Pteridophyta, Vikas Publishing Co., New Delhi,
Round, F.E. (1973) : Biology of the Algae (2nd Edition), Edward Arnold, London.
Sharma, O.P. (1990) : Textbook of Pteridophyta, MacMillan India Ltd., Delhi.
Sharma, O.P. (1990) : Text Book of Algae, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
Smith, G.M. (1955) : Cryptogamic Botany (Vol. I Algae, Fungi, & Lichens), McGraw-Hill Book Co., New York
Sporne, K.R. (1970) : The Morphology of Pteridophytes, (The Structure of Ferns and Allied Plants), Hutchinson University Library, London
Sporne, K.R. (1971) : The Morphology of Gymnosperms (The Structure and Evolution of Primitive seed Plants), Hutchinson University Library, London
Sundara Rajan, S. (1994) : Introduction to Pteridophyta, New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi
Venkateswarlu, V. (1970): A Text Book of Algae, Maruti Book Depot, Gunter, Hyderabad, India.
Wynne, M.J. (1978) : Introduction to the Algae: Structure & Reproduction, Prentice Hall of India, New Delhi.

15013- Genetics and Cytogenetics

Unit- I: Classical Genetics

Mendelian Principles**:** Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles**:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit- II: Gene mapping methods and extra chromosomal inheritance

Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance:- Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Unit- III: Microbial and quantitative genetics

Methods of gene transfers, transformation, conjugation, transduction and sex duction, mapping genes by interrupted mating, fine structure analysis of genes. Quantitative genetics:- polygenic inheritance, heritability and its measurements, QTL mapping.

Unit- IV: Mutation, alterations of chromosomes and genetic recombination

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Alterations of chromosomes:-Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Genetic recombination:-Types, Molecular mechanism of recombination. Factors affecting recombination, homologous and non-homologous recombination including transposition.

Suggested Practical's:

1. Study of problems with specific examples in Genetics.
2. Study of Genetic variability.
3. Foliar spray of mutagens.
4. Genetic spotters.
5. Emasculation Techniques.
6. Pollination and Hybridization Experiments in Corn and Pennisetum

Suggested Readings:

1.Allard, R. W. 1960. Principles of plant Breeding, John Wiley & Sons
2.Atherly, A.C. Girton, J.R. and McDonald, J.F. 1999. The science of Genetics. Saunders College Publishing, Fort Worth, USA.
3.Burnham, C. R. 1962. Discussions in Cytogenetics, Burgess Publishing Co., Minnesota, USA.
4.Elrod, S. and Stansfield, W.2002. Genetics, Schaum's Outlines. Tata Mc Graw Hill, New Delhi.
5.Griffiths, A. J. F., Miller, J.H., Suzuki, D. T., Lewontin, R. C., and Galbert, W. M. 2000. An Introduction to Genetic Analysis. W. H. Freeman Publishers, New York.
6.Hard, D.L. and Jones, F.W. 1998. Genetics: Principles and Analysis (4th Ed.) Jones & Barlett Publ. Massachusetts, USA.
7.Khush, G.S. 1973. Cytogenetics of Aneuploids, Academic Press, New York.
8.Russel, P.J. 1998. Genetics (5th Ed.) The Benjamin / Cummings Publishing Co., Inc., USA
9.Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2nd Ed.) John Wiley & Sons Inc., USA.
10.Stebbins, G. L. 1971.Chromosomal Evolution in Higher Plants. Edward Arnold Ltd., London
11.Stickberger, M. W. 1990. Genetics. Macmillan Company, New York.
12.Sybenga, J. 1972.General Cytogenetics, Elsevier Publishing Co., USA.
13.Tamarin, R. H. 1999. Principles of Genetics. Mc Graw Hill, New Delhi

15014-Taxonomy of Angiosperms

Unit- I: Plant Classification and Phylogeny

Plant taxonomy-scope and significance; brief history of plant classifications-natural and phylogenetic; salient features and classifications of Bentham and Hooker, Cronquist and Angiosperm Phylogeny Group; APG classification-primitive angiosperms, magnolids commelinids, core eudicots; Phylogeny of angiosperms different theories on origin and evolution of angiosperms.

Unit- II: Identification and Nomenclature

Herbarium methodology-collection, processing and preservation of plant specimens; Botanical Survey of India (BSI), important world and Indian herbaria; process of identification-taxonomic keys; taxonomic literature-floras, journals and computer databases. International Code of Botanical Nomenclature-principles, rules and recommendations-ranks of taxa, typification, rule of priority, concept of names and author citation; effective and valid publication.

Unit- III: Study of Selected Families of Angiosperms

Systematic position (with reference to B&H, Cronquist and APG), key characters, representative taxa and economic importance of the angiosperm families: Magnoliaceae, Fabaceae (Faboideae, Caesalpinioideae and Mimosoideae), Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Amarnathaceae, Euphorbiaceae, Orchidaceae, Araceae, Poaceae. Modern trends in Taxonomy – Chemotaxonomy, Numerical Taxonomy and Molecular Taxonomy.

Unit- IV: Phytogeography

Principles of Phytogeography-static and dynamic; patterns of plant distribution-continental drift theory and endemism; endemic plants of India; biogeographical zones of India- climate and vegetation types in Himalayas, Western Ghats, Deccan Peninsula (Eastern Ghats) and North-East India; flora and vegetation types of Andhra Pradesh.

Suggested Practical's:

1. Study of about 25 wild taxa representing different families and identification to species level.
2. Study of flora of the college campus.
3. Field trips minimum of 3 each with 2-3 days to acquaint with local flora. Submission of a report on field trips.
4. Preparation of 50 herbarium specimens of common wild plant taxa.
5. Construction of taxonomic keys.
6. Nomenclatural exercise.

Suggested Readings:

1. Gamble & Fischer 1915-1935. *Flora of Presidency of Madras*. 3 vols.BSMS, Dehradun.
2. Heywood, V.H., RK Brummitt, A. Culham, O. Seberg 2007. *Flowering Plant Families of the World.* Firefly books Ltd. New York.
3. Judd, W.S, Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens, and Michael J. Donoghue. 2007. *Plant Systematics: A Phylogenetic Approach*, 3rd ed. Sinauer.
4. Lawrence, G.H.M 1951. *Taxonomy of vascular plants.* McMillan, New York.
5. Naik, V.N. 1992. *Taxonomy of Angiosperms*. 2nd Edn. Tata Mc.Graw Hill.
6. Pullaiah, T. 2005. *Taxonomy of Angiosperms*. Regency publications, New Delhi.
7. Pullaiah, T. et al 1997. *Flora of Andhra Pradesh*. 4 vols. Scientific Publishers, Jodhpur.
8. Radford. A.E.et.al., 1974. *Vascular plant systematics*. Harper & Row. New York.
9. Ravi Prasad Rao, B. 2007. *Plant Name Directory.* ABCD, Planographers. Hyderabad.
10. Simpson, Michael G. 2006. *Plant Systematics*. Elseiver& Academic Press.
11. Singh, Gurucharan. 2005. *Plant Systematics*. Oxford & IBH. New Delhi.

Sivarajan, V.V.1991. *Introduction to principles of Plant Taxonomy.* Oxford & IBH.

25011-Plant Ecology and Environment

Unit- I: Ecology and Environment

Definition, Scope and History of Ecology; physical environment and plant life- light, temperature and fire factors and biotic environment; Ecosystem-structure and function; energy flow in ecosystems-concept of productivity, types of food chains; Biogeochemical cycling- global carbon cycle, sulphur and water cycle; Ecosystems of the world-terrestrial (tropical forests-seasonal and rainforests; grasslands) and aquatic ecosystems.

Unit- II: Plant Communities

Characteristics of plant communities; analytic-qualitative (life forms, phenology), and quantitative (abundance, density, frequency, basal area); synthetic-species dominance and species diversity. Methods of study of plant communities- quadrats and transects; Importance Value Index, dominance index, similarity index, species diversity indices; community succession-process and modeling; concept of climax.

Unit- III: Populations and Individuals

Characteristics of plant populations-density, dispersion, natality, mortality and survival, age structure and biotic potential; population growth patterns; population regulation; concept of metapopulation; life history strategies-*r* and *K* selection; key factor analysis. Species interactions: plant-plant (inter-specific competition) and plant-animal (pollination ecology and plant defense against herbivores); concept of ecological niche.

Unit- IV: Applied Ecology

Classification of natural resources; non-conventional energy resources-solar energy and bio energy. Atmospheric pollution-types and sources, impacts and control; global warming-green house gases, impacts on global environment and biodiversity; Ozone layer depletion; El Nino Southern Oscillation, La Nino; Water pollution-sources and control; Chemical pollution-types and effects; Bioremediation. Earth Summit – 1992 and its outcome. Environmental Impact Assessment (EIA)

Suggested Practical's:

1. Determination of texture of different soil samples.
2. Determination of organic matter in soil samples.
3. Determination of salinity in soil and water samples.
4. Estimation of dissolved oxygen in water samples.
5. Determination of minimum size of quadrates.
6. Determination of minimum number of quadrates.
7. Determination of quantitative characters of plant community.
8. Determination of species-wise IVI in plant community.
9. Determination of species diversity indices of plant communities.

Suggested Readings:

1. Alan beebay & Anne-Maria Brennan. 2008. *First Ecology. 3rd ed. Oxford University Press.*
2. Begon Michael, Colin Townsend & John L. Harper. *2005. Ecology, From Individuals to Ecosystems*. 4th ed.Black well Publishing, Oxford.
3. Brower, J., Jerold Zar and Carl von Ende. 1989. *Field and laboratory methods for General Ecology*. Wm. C. Brown Publishers.
4. Chapman, J.I. & M.J. Reiss. 1992. *Ecology-Principles and applications.* OUP.
5. Cunningham, W.P. & M.A.Cunningham 2007. *Principles of Environmental Science-Inquiry and applications.* Tata Mc GrawHill Pub.New Delhi.
6. Dash, M.C.2009. Fundementals of Ecology. Tata Mc GrawHill Pub.New Delhi.
7. Girard, James. 2005.*Principles of Environmental Chemistry*. Jones & Barlett. Sudbury.MA, USA.
8. Harborne, H.B. 1998. *Introduction to Ecological Biochemistry*. Academic Press.
9. Kormondy, E.J.1996. *Concepts of Ecology*. PHI. New Delhi.
10. Mackenzie, A., A.S. Ball & S.R.Virdee. 2001. *Instant Notes in Ecology.* Viva Books.New Delhi.
11. Molles, M.C. 2005. *Ecology-concepts and applications*. Mc GrawHill. Boston
12. Moore, P.D. & S.H.Chapman. 1986. *Methods in Plant Ecology*. Blackwell, Oxford.
13. Odum.E.P. 1971. *Fundamentals of Ecology*. W.B.Saunders, Phiadelphia.
14. Odum.E.P. & Gary W.Barrett. 2005. Ecology.Tomson Brooks/Cole, Singapore.

25012-Paleobotany & Plant Developmental Biology

Unit-I: **Paleobotany**

Principles of Paleobotany-geological time scale, determination of age of plant fossils; process of fossilization, types of fossils; brief account on fossil algae, bryophytes and pteridophytes. Salient structural features and affinities of fossil gymnosperms-Pteridospermales, Cycadeoidales (Bennettitales) and Cordaitales.

Unit- II: Basic Concepts Of Development

Unique features of plant development, Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients, cell fate and cell linages; stem cells in plants, genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenic in analysis of development.

Unit- III: Morphogenesis and organogenesis in plants

Organization of Shoot Apical Meristem (SAM) and Root Apical Meristem (RAM), Shoot and root development; Leaf development and phyllotaxy; Dermal tissue system- types of trichomes and stomata; Primary growth, secondary growth, anomalous secondary growth, Wood anatomy, wood development in relation to environmental factors; structure, function and mechanism of action of phytochrome, cryptochrome and phototropins.

Unit-IV: Senescence and Programmed Cell Death

Types of cell death observed in plants, PCD in the life cycle of plants, overview of plant senescence, Protein, pigment, nucleic acid and oxidative metabolisms during senescence, Endogenous plant growth regulators and senescence, environmental influences on senescence.

Suggested Practical's:

1. Study of important fossil (pteridophytes and gymnosperms) from prepared slides and specimens.
2. Study of T.S. of stem and root and secondary growth of angiosperms
3. Study of Anomalous structure
4. Dermal tissue system
5. Wood anatomy, T.S, T.L.S, and R.L.S

Note: Every student has to submit at least five permanent slides at the time of practical examination.

Suggested Reading:

1. Arnold, C.A. (1947) : An Introduction to Paleobotany, McGraw Hill Book Co., N.Y.
2. Buchanan BB, Grissem W, Jones RL (2000): Biochemistry and molecular biology of plants, I.K. International Pvt. Ltd, New Delhi.
3. Cutter, E.G. (1978) : Plant Anatomy Part: I: Cells & Tissues (2nd Edn.) Plant Anatomy Part II: Experiments & Interpretations Edward Arnold, London-1
4. Delavoryas, T. (1962) : Morphology and Evolution of Fossil Plants, Holt, Rinehart & Winston, N.Y.
5. Eames, A.J., & Mc Daniels, L.H. (1979) : An Introduction to Plant anatomy, Tata-McGraw-Hill Publishing Co., (P) Ltd., Bombay
6. Esau. K. (1980) : Plant Anatomy, (2nd Edition), Wiley Eastern Ltd., New Delhi.
7. Fahn, A. (1997) : Plant Anatomy, Pergamon Press, Oxford
8. Foster, A.S. (1960) : Practical Plant anatomy, Van Nostrand & East –West Press, New Delhi.
9. Krishnamurthy, K.V. (1980): Wood, Tetrahedron Publications, Trichy, India
10. Pandey, B.P. (1989): Plant anatomy, S. Chand & Co., New Delhi
11. Scott, D.H. (1962): Studies in Fossil Botany (Vol.I & Vol.II), Hafner Publishing Co., N.Y.
12. Seward, A.C. (1959): Plant Life through the Ages, Hafner Publishing Co.,N.Y.
13. Shukla, A.C. & Misra, S.P. (1975): Essentials of Paleobotany, Vikas Publishing House (P) Ltd., Delhi.
14. Singh, V., Pandey, P.C. & Jain, D.K. (1987): Anatomy of Seed Plants, Rastogi Publications, Meerut, India
15. Stewart, W. N. and Rathwell, G. W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
16. Taiz L., Zeiger E (2003). Plant Physiology, Panima Publishing Corporation, Bangalore.
17. Venkatachala, B.S., Shukla , M.& Sharma, M. (1992) : Plant Fossils-a Link with the Past (A Birbal Sahni Birth Centenary Tribute), Birbal Sahni Institute of Paleobotany, Lucknow, India

25013-Plant Reproduction and Tissue Culture

Unit- I: Reproductive developement

Flower evocation, floral meristems and floral organ development, shoot apex and phase change, Genetic and molecular analysis of flower development, homeotic mutants in plants (maize, tomato, *Arabidopsis* and *Anthurium),* biochemical mechanisms involved in flowering, circadian rhythms, endogenous clock and its regulation, role of phytochromes and cryptochromes on flowering process, photoperiodism, vernalization, sex determination in plants.

Unit –II: Embryology of plants

Structure of anthers, microsporogenesis, pollen development, elements of palynology, ovule development, megasporogenesis, mutations affecting male and female gametophyte development, Types and organization of embryo sacs, structure of the embryo sac cells, germination of pollen, pollen-stigma interactions, double fertilization, seed formation, structure and development of endosperm, endosperm haustoria; embryogenesis and types of embryos, seed germination, establishment of symmetry in plants, Polyembryony- types and causes, Apomixes- causes and applications.

Unit- III: Basics of plant tissue culture technique

General introduction, history and scope, concept of cellular totipotency, organogenesis (from root, stem, leaf, meristems and callus), somatic embryogenesis and gametic embryogenesis (androgenesis and gynogenesis), mechanisms, techniques and utility, ovary, ovule, nucellus, embryo cultures, embryo rescue, triploid production, *in vitro* fertilization, somatic hybridization; protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplast regenerants.

Unit- IV: Application of Plant Tissue Culture

Clonal propagation, artificial seeds, somaclonal variation, suspension culture of isolated single cells, plant cell reactors, production of secondary metabolites/natural products, elicitors, role of tissue culture in gene transfer, cryopreservation and germplasm storage.

Suggested Practical's:

Reproduction:

1) Study of microsporogenesis and gametogenesis in anther sections
2) Examinations of anthers dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotalaria, Tradescantia, Brassica, Petunia, Solanam melongene* etc..)
3) Tests for pollen viability using stains and *in vitro* germination-pollen germination using hanging drop and sitting drop culture, suspension cultures and surface culture.
4) Study of pollen grains by acetolysis
5) Study of ovules in cleared preparations. Study monosporic, bisporic and tetrasporic embryo sac development through examination of permanent stained serial sections.

6) Dissection and mounting of endosperm and embryo showing developmental stages and haustoria.

Plant tissue culture:

1. Preparation of different types of Media
2. Callus induction from carrot cambial explants or any other source. Callus cytological studies
3. Induction of Somatic Embryogenesis
4. Suspension Cultures
5. *In vitro* rooting of cultures
6. Culture of anthers for production of haploids
7. Induction of multiple shoots
8. Preparation of artificial seeds by sodium alginate.

Suggested Readings

1. Mahswari, P. An Introduction to Embryology of Angiosperms, 1950.
2. Shivanna, K.R. and Johri, B.M. The Angiosperm Pollen structure and Function, Wiley Eastern Ltd., Publications, 1989.
3. Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. Comparative Embryology of Angiosperms, Vol. I & II, SpringerVerlag.
4. Bhojwani, S. and Bhatnagar, S.P. Embryology of Angiosperms (4 th Revised and enlarged Edition), 2000.
5. Raghavan, V. Molecular Embryology of Flowering Plants Cambridge: Univ. Press, 1997.
1. Bhojwani, S.S. 1990. *Plant Tissue Culture Applications and Limitations:* Elsevier, New York
2. Bhojwani, S.S. and M.K.Razdan 1996. *Plant Tissue Culture. Theory and practice* (rev. ed) Elsevier Science Publishers, New York.
3. Collins, H.A. and S. Edwards 1998. *Plant Cell Culture.* Bios Scientific Publishers Oxford, UK
4. Kalyan Kumar De. 1997. *Plant Tissue Culture*. NCB Agency, Kolkata.
5. Pullaiah, T. 2009. Plant Tissue Culture. Scientific Publishers, Jodhpur.
6. Pullaiah, T., K. Lakshminarayana and B. Hanumantha Rao 2001. *Textbook of Embryology of Angiosperms*. Regency Publications, New Delhi
7. Pullaiah T., K.Lakshminarayana and B. Hanumantha Rao 2009. Plant Reproduction. Scientific Publishers, Jodhpur. .
8. Raghavan, A. 1986. *Embryogenesis in Angiosperms A developmental and Experimental study*. CUP, New York
9. Razdan, M.K. 2003. *An Introduction to Plant Tissue Culture*. Oxford & IBH, New Delhi
10. Vasil, I.K and T.A. Thorpe 1994. *Plant Cell and Tissue Culture.* Kluwer.
11. Buchanan BB, Grissem W, Jones RL (2000): Biochemistry and molecular biology of plants, I.K. International Pvt. Ltd, New Delhi.
12. Taiz L., Zeiger E (2003). Plant Physiology, Panima Publishing Corporation, Bangalore.

25014-Cell Biology of Plants

Unit- I: Membrane structure and function

An Overview of Eukaryotic and Prokaryotic Cells and their compartmentalization, Cell Membrane: Historical models of membrane structure. Functions of Cell Membrane-Protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, and electrical properties of the membrane. Plasmodesmata: Structure, role in macro molecule transport.

Unit-II: Structural organization and function of intracellular organelles

Plant Cell wall (structure-primary and secondary cell walls, function and biogenesis), nucleus (structure of nuclear envelope, nuclear pore complex, nucleolus and functions of nucleus), mitochondria (structure, genome, organization, functions and biogenesis), Golgi bodies (structure and functions), lysosomes (structure and functions), endoplasmic reticulum (structure and functions), peroxisomes (structure and functions), plastids (proplastids, and plastid development), chloroplast (structure, genome organization and functions), significance of vacuoles in plants, cytoskeleton (structure and functions of microtubules, microfilaments and intermediate filaments) and its role in motility.

Unit-III: Organization of genes and chromosomes

Structure and molecular organization of chromatin, heterochromatin and euchromatin, transposons, ultra structure of centromere, kinetochore complex and telomere, unique and repetitive DNA, interrupted genes, gene families,

Unit-IV: Cell division and Cell cycle

Mitosis (process and stages, mitotic apparatus, chromosome alignment and separation, cytokinesis), meiosis, (process and stages, chromosome pairing, chiasma formation, mechanisms of recombination and gene conversion, synaptonemal complex), regulation of mitosis and meiosis, comparison of mitosis and meiosis, steps in cell cycle, regulation and control of cell cycle

Suggested Practical's:

1. Determination of mitotic index.
2. Study of Chromosomal Behavior during Mitosis in root tips of Onion.
3. Study of chromosomal behavior during meiosis with special emphasis on Prophase –I using flower buds of Onion.
4. Study on the effect of Colchicine on Mitosis.
5. Study of Polygene chromosomes using *Chiranomus* larvae.
6. Study on Structural hybrids in *Rhoeo discolor*.

Suggested Readings:

1. Cooper Geoffrey,M. 2000. *The Cell-a molecular approach.* 2nd Edn. ASM Press. Washington.
2. Sharma AK & A Sharma. 1980. *Chromosome techniques: Theory & Practice*. Batterworth.
3. Alberts A et al. 1994. *Molecular biology of the cell*. Garland publ.New York
4. De Robertis EDP & EMF De Robertis. 2001. *Cell and Molecular biology.* Lippincott Williams & Wilkins. Bombay.
5. Freifelder D. 1990. *Molecular biology*. Narosa publication house, New Delhi
6. Harvey Lodish et al , Molecular Cell Biology, (W. H. Freeman; Sixth Edition edition)

SEMESTER-II: ELECTIVE-I: PLANTS AND SOCIETY

Unit-I: Plants and Society

The botanical connection to our lives

Unit-II: Introduction to Plant Life

Botanical Principles: plant cell, plant body, plant physiology, plant life cycle (flowers, fruits & seeds), genetics, plant systemics and evolution, diversity of plant life.

Unit-III: Role of Plants in Human Welfare

Plants as source of food (human nutrition, origins of agriculture, the grasses, legumes, starchy staples, feeding a hungry world), commercial products (stimulating beverages, herbs and spices, materials: cloth, paper and wood) and human health (medicinal plants, psychoactive plants, poisonous and allergy plants)

Unit-IV: Plants and the Environment

The principles of ecology, the ecosystem, niche, food chains, biogeochemical cycles, and ecological succession, Projected scenario of Plant Biodiversity loss, Organizations associated with biodiversity management-IUCN, UNEP, UNESCO, WWF, NBPGR, Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programs, Sustainable development.

Suggested Reading:

Hill.,A.W. (1952) : Economic Botany, McGraw Hill Book Co., New York.
Ashok Bendre & Ashok Kumar (1998-99) : Economic Botany, Rastogi Publications, Meerut, India
Pandey, B.P. (2000) : Economic Botany, S. Chand & Co., New Delhi
Krishnamurthy, K.V. (2004). An advanced text book of biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
Ambasht, R.S. (1974) : Text book of Plant Ecology (3rd Edn.,), Students & Friends Co., Varanasi -
Odum E.P. (1975) : Ecology, Holt, Rinert & Winston- pp.,
Kormandy, E.J. (1978) : Concepts of ecology(2nd Edition), Prentice Hall of India (P) Ltd., New Delhi.
Sharma, P.D. (2000) : Ecology & Environment, Rastogi Publications, Meerut, India.

35011- Ethnobotany and Pharmacognosy

Unit- I: Ethnobotany

Ethnobotany-Introduction, history, scope and importance. Different aspects related to tribes of Andhra Pradesh. Wild medicinal plants and their therapeutic values with reference to tribes of Eastern Ghats. The centers of ethnobotanical studies in the World.

Unit- II: Phytomedicine and other systems of Medicine

Different systems of indigenous medicine - Ayurveda, Siddha, Unani and Homeopathy. Phytopharmaceuticals: inventory, taxonomic validation and evaluation of sources.

Unit- III: Analytical Pharmacognosy

Introduction, history, scope and applications of Pharmcognosy. Phytopharmacy: constitution, identification of different constituents; Classification of drugs; analytical methods-drug adulteration, drug evaluation; phytochemical analysis of crude drugs: preliminary screening.

Unit- IV: Pharmacological analysis and Utilization

Drugs of alkaloids, coumarins, tannins, terpinoides and glycosides; Natural pesticides, antibiotics, and poisonous plants. Antimicrobial assay: antibacterial and antifungal screening. Potential drug yielding plants and their marketing avenues. IPR and patenting of active principles.

Suggested Practicals:

1. Recording Medicinal Practices and Herbal Formulations of Tribal Medicine.
2. Study of important medicinal plants used in drugs.
3. Field trip to study and identify locally occurring Medicinal plants.
4. Qualitative analysis of crude drugs for different phytochemicals
5. Quantitative estimation of secondary metabolites: Phenolic compounds and alkaloids.
6. Antimicrobial studies to determine MIC and MBC of different solvent extracts

Suggested Readings:

1. Cotton, CM. 1996. *Ethnobotany: principles and applications*.
2. Dey, A.C.1988. *Indian Medicinal Plants and Ayurvedic preparations,* Bishen Singh, M. Singh.
3. Gibbs, R.D. 1974. *Chemotaxonomy of flowering plants*. Montreal & London.
4. Kokate, CK., AP. Purohit & SB. Gokhale. 2000. *Pharmacognosy*. Nirali Prakashan Publ.
5. Kokate,CK, Khandelwal, SB Gokhale 1996. *Practical Pharmacgnosy*. Nirali Prakashan, Pune.
6. Manitto, P. 1981. *The biosynthesis of natural products*. Ellis Horwood, Chichester.
7. Martin, G.J. 1996. *Ethnobotany. A methods manual*. Chapman&Hall. London
8. Ramachandran, S.P. 1991. *Recent Advances in Medicinal, aromatic and spice crops.*
9. Trease, GE and WC Evans. 2002. Pharmacognosy. Saunders. New York.
10. Tyler, V.E., Brandy, L.R. and Robbers, J.E. 1988. *Pharmacognosy*. 9th edition. Lea and Febiger.Philadelphia. USA.

35012-Plant Physiology

Unit- I: Transport and translocation of water, ions and solutes

Uptake, transport and translocation of water, ions, solutes (active and passive transport) and macromolecules from soil, through cells (protein sorting and vesicle traffic), across membranes (pumps, carriers, ion channels, aquaporins), through xylem and phloem, mechanism of loading and unloading of photoassimilates, SPAC concept; transpiration; mechanism of stomatal movement, antitranspirants,

Unit .II: Mineral Nutrition, nitrogen and sulfate assimilation

Mineral nutrition; essential elements, deficiency symptoms and plant disorders, treating nutritional disorders.

Nitrogen: Overview of nitrogen in the biosphere and in plants, overview of nitrogen fixation, Biological nitrogen fixation: Symbiotic and asymbiotic; legume rhizobium symbiosis, nodule formation; mechanism of nitrogen fixation; ammonia uptake and transport, nitrate uptake and reduction, nitrate and nitrite reductions. Sulfur: overview, sulfur chemistry and function, Sulfate uptake, transport and assimilation.

Unit-IV: Plant growth regulators and Signal Transduction:

Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid, hormone receptors. Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanisms, e.g. two-component sensor-regulator system in plants, sucrose-sensing mechanism.

Unit-IV: Stress Physiology

Kinds of Environmental stresses, responses of plants to biotic (pathogen and insects) and abiotic stresses (water, temperature and salt), stresses involving water deficit, osmotic adjustment and its role in drought and salinity, stress proteins and genes induced by water stress (LEAs, Osmotins, dehydrins). Impact of salinity on transport across plant membranes, role of membrane lipids and HSPs in high temperature tolerance; chilling and freezing stress, Heavy metal stress and role of phytochelatins, Phytoremediation

Suggested Practicals:

1. Determination of cell permeability by using Beet root tissues.
2. Determination of stomatal index and frequency in leaves.
3. Determination of the water potential of the tissue.
4. Estimation of calcium
5. Extraction and Estimation of Chlorophyll pigments.
6. Determination of viability of different seed material.
7. Estimation of IAA by Solkowski's method.
8. Determination of membrane stability and chlorophyll stability index of stressed plants
9. Estimation of free Proline in stressed plants sample

Suggested Readings:

Buchannan et al 2001. *Biochemistry and Molecular Biology of Plants.*
C. M. Wiltmer & M. Fricker. 1996. *Stomata*. 2nd Ed. Chapman Hall. U. K.
Delvin, R. M. 1969. *Plant Physiology*. Affiliated East West, New York.L.
Taiz & E. Zeiger. 1998. *Plant Physiology*. Second Edition. Sinauer Associates Inc, Publishers, Massachusetts, USA.
Salisbury F. B. & C. W. Ross 1992 *Plant Physiology*. 4 th Edn. Wadsworth Publishing Co., Belmout, California.
Thomas C. Moore.1992. *Biochemistry and Physiology of Hormones*.Narosa.
Hopkins, W. 1998. *Introduction to Plant Physiology*. ELBS & Longman, Essex., England.

35013-Tools and Techniques in Plant Science

Unit-I: Microscopic, histochemical and Immuno techniques

Visualization 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, Freez-etch and freeze fracture methods for EM, image processing methods in microscopy, Microtomy and double staining of plant sections. Antibody generation, detection of molecules using ELISA, RIA, immunoprecepitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by FISH and GISH techniques.

Unit-II: Electrophoresis and blotting Techniques

General principles and definitions, PAGE: Native-PAGE, SDS-PAGE, Isoelectricfocusing, 2D electrophoresis, capillary electrophoresis. Agarose gel electrophoresis - Preparation, separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications, recovery of DNA from agarose gels.Blotting methods- Southern, Northern and Western blotting.

Unit-IV: Biophysical methods and Radiolabelling techniques

Molecular analysis using UV/Visible, NMR and ESR spectroscopy, Molecular structure determination using X-ray diffraction and NMR, molecular analysis using light scattering, different type sof mass spectrometry, Matrix Assisted Laser Desorption Ionization Mass Spectrometry (MALDI–TOF) and surface plasma resonance methods. Radiolabelling Techniques**:** detection and measurement of different types of radioisotopes normally used in plant sciences, incorporation of radioisotopes in tissues and cells, molecular imaging of radioactive material and safety guidelines.

Unit-IV: Stastical Methods

Measures of central tendency and dispersal; probability distributions (binomial, poisson and normal); sampling distribution; difference between parametric and non-parametric statstics; confidence interval, erros; levels of significance; regression and correlation; analysis of variance; X^2 test; basic introduction to muetrovariate statistics

Suggested Practical's:

1. Micrometry- calibration of microscope using stage and ocular micro meters
2. Preparation of plant material for microtome sections and double staining
3. Separation of proteins by PAGE
4. Separation of nucleic acids by Agarose gel electrophoresis
5. Demonstration of Southren blotting method
6. Absorption spectra of amino acids, Proteins and nucleic acids
7. Isolation and spectrophotometric characterization of plant pigments
8. Verification of Beer's law
9. Biostatistics problems

Suggested Readings:

1. Upadhyay, Upadhyay, Nath, 2002.Biophysical Chemistry-Principals and Techniques (3rd edition). Himalaya Publishing House.
2. Williams and Wilson, K. 1991. *A Biologist's guide to principles and techniques of practical biochemistry*, 2nd ed. Edward Arnold.
3. Freifeilder, D. *Biophysical chemistry*. W.H. Freeman
4. Vanholdem, K.E. W.C. Johnson, P.S. 1998. *Principles of Physical Biochemistry*
5. Hoppe, W. Lehmanm, W. Maskal, Hi. and Ziegler, H.1983. *Biophysics.*Springer Verlag, Berlin.
6. Wilson & Walker *2000. Practical biochemistry: Principles & Techniques.* Cambridge Univ. Press, New York)
7. Lain, D. Campbell and Raymond A. Dwek *Biological Spectroscopy* Benjamin/Cumming Pub. Co., California, London.
8. Cantor, C.R. and Schimmel, P.R. *Biophysical Chemistry* by, W.H. Freeman & Co.,
9. Glasel, A and Deutscher, M.P. 1995. *Introduction to Biophysical Methods for Protein and Nucleic Acid Research*. Academic Press.
10. Statistical methods in Agriculture and Experimental biology. 2nd ed. 1993. R. Mead, R.N. Curnow, A.H. Hasted, Panima Publication. Bangalore
11. Introduction to Biostatistics. 1995. R.N. Forthafter and E.S. Lee. Academic Press. PP 656.
12. Statistics with application to the biological and health sciences. 1985. R.D. Remington and M.A. Schork, Prentice-Hall.

35014- Molecular Biology of Plants

Unit- I: DNA replication, repair and recombination

Chmistry and molecular structure of nucleic acids, replication origin and replication fork, DNA replication (semi-conservative, conservative and dispersive models), Modes of replication (theta, rolling circle and linera mode), enzymes involved (helicases, topioisomerases, SSB, DNA ligases, primases, DNA polymerases), mechanism of replication, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms, homologous and site specific recombination.

Unit-II: RNA synthesis and processing

Mechanism of transcription in prokaryotes and eukaryotes-initation, elongation and termination of RNA synthesis, structure and function of different types of RNA (polyssysteronic and monocistronic RNAs), RNA transport, RNA polymerases, post transcriptional modifications-capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation and RNA splicing (introns. Splicing mechanisms, and alternate splicing), RNA editing.

Unit-III: Protein Synthesis and processing

Genetic code (codon degeneracy, Wobble hypothesis, Universality of genetic code)), structure and composition of prokaryotic and eukaryotic ribosomes, structures of mRNA and tRNA, events in protein synthesis (amino acid activation, initiation, elongation and termination), amino acylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase and translational proof-reading, translational inhibitors, post translational modification of proteins (protein sorting and targeting, molecular chaperons), protein folding and protein degradation.

Unit – IV: Control of gene expression at transcription and translation level

Regulation of gene expression in prokaryotes, organization of prokaryotic genes- Lac operon, Trp operon, negative and positive gene regulation, Regulation of gene expression in eukaryotes: housekeeping genes, constitutive genes and regulatory genes, role of transcription factors, role of chromatin, DNA Methylation, miRNA/small RNAs in gene expression and gene silencing

Suggested Practicals:

1. Estimation of DNA by diphenylamine method.
2. Estimation of RNA by orcinol method.
3. Isolation of genomic DNA from plant tissues by CTAB method.
4. Determination of purity of DNA and quantification of DNA by UV absorption method.
5. Separation of genomic DNA on Agrose gel electrophoresis
6. Isolation of total RNA from Plant Tissues using $LiCl_2$ method
7. Determination of purity of RNA and quantification of RNA by UV absorption method.
8. Separation of genomic RNA on formaldehyde Agrose gel electrophoresis
9. Determination of Tm point of DNA isolated from plant tissue
10. Isolation of proteins from plant tissues by Lowry's method.
11. Separation of proteins by SDS-PAGE.

Suggested Readings:

1. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D.Watson , Moleucular Biology of the Cell. (Garland Publishing , New York and London)
2. D.Freifelder, Molecular Biology. A Comprehensive Introduction to Prokaryotes and Eukaryotes, (Jones and Bartlett, USA)
3. Donald Voet and Judith Voet ,Biochemistry - (John Wiles and sons)
4. Benjamin Lewin, Genes VIII. (2003) (Benjamin Cummings; United States Ed edition)
5. James D. Watson et al, Molecular Biology of the Gene , (Benjamin Cummings; 5 edition)
6. Lehninger , Principles of Biochemistry (W. H. Freeman; 4 edition)
7. Harvey Lodish et al , Molecular Cell Biology, (W. H. Freeman; Sixth Edition edition)
8. P. Turner , Instant Notes in Molecular Biology (BIOS Scientific Publ; 3rd edition)

III SEMESTER- ELECTIVE-II: PLANT PROPAGATION

Unit-I: Introduction to Plant Propagation

History, scope and importance of plant propagation, Propagation structures and equipment for propagation and growing, nursery plants, sanitation, supplementary fertilizers, care handling of nursery plants.

Unit-II: Seed Propagation

Origin and the development of seeds, germination, seed dormancy, viability of seeds, seed health, seed testing and seed certification, techniques of seed production and handling principles, seedlings in the nursery, advantage and disadvantage of seed propagation

Unit-III: Vegetative Propagation

Techniques of propagation by cuttings, grafting, budding, layering and propagation by specialized vegetative structures (bulbs, tuber, corms, rhizomes, runners, off sets, suckers), Advantage, limitations and applications of vegetative propagation, clones and genetic variation in asexually propagated plants.

Unit-IV: Micropropagation and propagation of locally important plants

Principles of tissue culture and micropropagation, techniques for micropropagation, and applications in forestry and horticulture and limitations of micropropagation

Propagation methods of some selected plants – Citrus, Mango, Banana, Mulberry, turmeric Rose, chrysanthemum, jasmine, Croton, Eucalyptus, onion and tomato

Suggested Readings:

1. Abbottt, A.J. and Atkin, R.K. (eds.) 1987 Improving vegetatively propagated crops. Academic press, New York.
2. Bose, T.K., Sadhu, M.K., & Das, P., 1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
3. Hartmann, H.T., Kester E.D., Davis, F.T., and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.
4. Krishnamurthy. H.M. 1981. Plant Growth substances including application in Agriculture.
5. L.M. Pierik 1987. In vitro culture of Higher plants Murtinus Nijhoff pub. Dordrecht.
6. M.K. Razdan 1994. An Introduction to Plant tissue culture, Oxford and IBH Pub. Co., PVT. Ltd., Bombay and Calcutta.
7. Mac Donald, B. 1987. Practical woody plant propagation for nursery growers. Portland, OR: Timber press.
8. Sadhu, M.K. 1989. Plant propagation Wiley eastern Ltd. New Delhi.

45011- Evolution and Plant Breeding

Unit-I: Evolutionary History and Thoughts

Lamarck, Darwin Concepts of variation, adaptation, struggle, fitness and natural selection, Mendalism, spontaneity of mutations, the evolutionary synthesis. The evolutionary time scale, Eras, periods and epoch, major events in the evolutionary time scale, origins of unicellular and multi cellular organisms; major groups of plants

Unit-II: Origin of cells, unicellular and molecular evolution

Origin of basic molecules, abiotic synthesis of organic monomers and polymers, concept of Haldane, experiments of Miller (1953), the first cell; evolution of prokaryotes, origin of eukaryotic cells, evolution of unicellular eukaryotes and anaerobic and aerobic metabolisms. Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis, origin of new genes and proteins; gene duplication and divergence

Unit-III: The Mechanisms

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, adaptive radiation, isolating mechanism, speciation; allopatricity and sympatricity; convergent evolution; sexual selection; co-evolution.

Unit-IV: Plant Breeding

Principles, methods-selection, hybridization, inbreeding depression, heterosis, male sterility, sporophytic and gametophytic self-incompatibility, haploidy, triploidy and polyploidy, Breeding plants for improving yield and quality and resistant to diseases and pests. Role of polyploidy and distant hybridization in plant improvement. Induced mutations in crop improvement. Role of marker assisted selection in plant breeding.

Suggested Practicals:

1. Contributions of Evolutionary biologists.
2. Models and Photographs related to evolution.
3. Explanation of Hardyweinbergh law with some genetic problems.
4 Study of floral biology, Pollination mechanisms and breeding of crops- typical examples of self and cross pollinated plants.
5. Techniques of Emasculation and hybridization.

Suggested Readings:

1.Chaudhary, R.C. 1997. Introduction to Plant Breeding. Oxford & I B H New Delhi.
2.Elrod, S. and Stansfield, W.2002. Genetics, Schaum's Outlines. Tata Mc Graw Hill, New Delhi.
3.Griffiths, A. J. F., Miller, J.H., Suzuki, D. T., Lewontin, R. C., and Galbert, W. M. 2000. An Introduction to Genetic Analysis. W. H. Freeman Publishers, New York.
4.Hard, D.L. and Jones, F.W. 1998. Genetics: Principles and Analysis (4^{th} Ed.) Jones & Barlett Publ. Massachusetts, USA.
5.Khush, G.S. 1973. Cytogenetics of Aneuploids, Academic Press, New York.
6.Poehlman, J. M and Borthakur, D. 1972 Breeding Asian Field Crops. Oxford and IBH Publishing Co., New Delhi.
7. Rastogi,.V. B. 1997.Organic Evolution. Pitambar Publishing, India
8.Russel, P.J. 1998. Genetics (5^{th} Ed.) The Benjamin / Cummings Publishing Co., Inc., USA.
9.Singh, B. D.,2000 Plant Breeding Principles and Methods. Kalyani publishers, Ludhiana.
10.Stebbins, G. L., 1973. Process of Organic Evolution. Prentice – Hall Pvt. Ltd., New Delhi.
11. Chahal, G.S. and Gosal, S.S. *Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches*, Narosa Publishing House, New Delhi.
12. Darbeshwar Roy, 2000. *Plant Breeding: Analysis and Exploitation of variation*, Narosa Publishing House, New Delhi.
13. Singh, P. 2001. *Essentials of Plant Breeding*, Kalyani Publishers, Hyderabad.

45012-Genetic Engineering of Plants

Unit-I: Genetic Engineering Tools

Introduction to Genetic engineering. Enzymes used in genetic engineering – Restriction endonucleases, types, properties and applications, DNA ligases, polynucleotide kinase, alkaline phosphotases, S1 nuclease, terminal transferase, topoisomerases, methylases and gyrases. Cloning Vectors – Characteristic features of desired vectors, *E.coli* based vectors (plasmids, bacteriophage derivatives, cosmids, BACs), yeast (YACs, shuttle vectors). Characteristics of expression vectors. Gene Isolation methods: Genomic DNA and cDNA libraries and their applications. Molecular cloning strategies: cDNA synthesis. Polymerase chain reaction - Principle, types and applications. Sequencing of nucleic acids – Maxam –Gilbert chemical degradation and Sanger's dideoxy chain termination methods. Blotting methods: Southern, Northern and Western blotting.

Unit-II: Plant transformation and Transgenics

Types of Plant transformation Methods. Agrobacterium-mechanism of T-DNA transfer and its integration into plant genome, basis of tumor formation, role of virulence gene, use of Ti and Ri plasmids as vectors, electroporation, microinjection, particle bombardment method and Chloroplast transformation, selection of transformants. Transgenic plants for crop improvement: Herbicide Resistance, Male sterility, Insect resistance (Bt transgenics) Virus resistance, Pest Resistance, Fungal resistance. Genetic engineering of plants for nutritional quality improvement (Golden rice), transgenic plants for extended shelf life of fruits, manipulation of flower colour, Abiotic stress tolerance, Edible vaccines. Possible Ecological concerns and risks of transgenic crops. IPR: Basics Intellectual Property Rights (IPR).

Unit-III: Molecular Markers

Principles and applications of Molecular markers. DNA polymorphism and different kinds of molecular markers - Morphological markers, Biochemical markers, molecular markers, non PCR based and PCR Based molecular markers- RFLP, RAPD, SCARs, Simple Sequence Repeats, AFLP, ISSRs, CAPs, SNPs and their merits and demerits. Potential use of Marker assisted selection (MAS) in crop improvement i.e drought tolerance in plants. Quantitative traits loci (QTL) and its applications.

Unit-IV: Genomics and Proteomics

Microarrays: Types of Microarrays-cDNA and Oligonucleotide arrays. Making of arrays- Printing of oligo nucleotides and PCR products on glass slides, nitrocellulose paper. Preparation of fluorescent-labelled cDNA or end-labelled RNA probes, Hybridization and acquisition of data, analysis and its applications. Proteomics: Separation and Identification of specific proteins by 2D- gel Electrophoresis and MALDI-TOF. Protein microarrays and their applications. RNA interference (RNAi): Mechanism of RNAi in plants, Pathways of biogenesis of miRNA, siRNA and their role in crop improvement.

Suggested Practicals:

1) Preparation of *E.coli* growth curve by turbidimetric method
2) Preparation of *E.coli* competent cells by $CaCl_2$ method
3) Setting up a ligation reaction
4) Bacterial transformation by heat shock method
5) Isolation of plasmid DNA by alkaline lysis method and separation by agarose gel electrophoresis
6) Restriction digestion of plasmid DNA
7) Polymerase Chain reaction (PCR)
8) RAPD
9) Demonstration of *Agrobacterium* mediated plant transformation method

Suggested Readings:

1) Sambrook, E.Ffrisch and T. Maniatis (2000) Molecular Cloning: A Laboratory manual; Cold

Spring Harbor Laboratory Press New York,

2) SL Berger and AP Kimmel (1998) Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, , Academic Press, Inc San Diego.
3) D V Goeddel (, 1990) Methods in Enzymology Vol. 185, Gene Expression Technology, ,

Academic Press, Inc. San Diego

4) DA Mickloss and GA Freyer (1990). DNA Science. A first Course in Recombinant Technology,

Cold Spring Harbor Laboratory Press, New York

5) SB Primrose (1998) Molecular Biotechnology (2nd Edn), Blackwell Scietific Pub. Oxford.
6) JA Davies and WS Reznikoff (1992) Milestones in Biotechnology. Classic papers on Genetic Engineering Butterworth-Heinemann, Boston,

MR Walker and R Rapley (1997) Route Maps in Gene Technology, Biackwell Science

Ltd, Oxford Molecular Biotechnology. Glick

7) D. Balasubramanian .Concepts of Biotechnology
8) Primrose, Sandy B. Twyman, Richard (2006) Principles of Gene Manipulation and Genomics Old and Primrose, Blackwell publishers, 6th Edition
9) H.S. Chawla (2003) Introduction to Plant Biotechnology Second Edition. Science Publishers

45013-Biodiversity Conservation and Management

Unit- I: Biodiversity

Nature of biodiversity-genetic, species and ecosystem diversity. Magnitude and distribution of biodiversity; global biodiversity hotspots-hotspots in India; India-a mega diversity center-floristic richness and Centers of Plant Diversity of India; Agrodiversity - vavilov centers of crop plants; Exotics and Invasives.

Unit- II: Biodiversity values

Values of biodiversity-plants as food, forage, fiber, medicine, yielding gums, resins and essential oils, timber and non-timber forest produce: wild ornamental plants and ecotourism.

Unit- III: Conservation of Biodiversity

Principles of conservation; the process of extinction; threats to biodiversity; IUCN threat categories and criteria; threatened plants of India; *in situ* conservation of biodiversity: natural protected areas-biosphere reserves, wildlife sanctuaries, national parks and sacred groves with reference to India; *ex situ* conservation- significant botanical gardens of the world and India, and gene banks.

Unit- IV: Management of Biodiversity

Brief account on national and international conservation organizations- WWF, UNEP, IUCN; Brief account on International agreements on biodiversity conservation-CBD, CITES, RAMSAR; Biodiversity laws; Joint Forest Management; Biodiversity Registers; Bio-security in India; Concept of sustainable development; Biodiversity and Biotechnology.

Suggested Practical's:

1. Study of local crops, each one from cereals/ pulses/ oil seeds.
2. Visit to any protected area-documentation of biodiversity and their utility.
3. Determination of species diversity Indices.
4. Mapping of endemic and threatened taxa of Andhra Pradesh.
5. Project work- student has to work any local biodiversity issue and submit a report.

Suggested Readings:

1. *Alan beebay & Anne-Maria Brennan. 2008. First Ecology. 3rd ed. Oxford University Press.*
2. Ashish Kothari.1997. *Understanding biodiversity-Life sustainability and equity.* Orient Longman
3. Christian Leveque, Jean-claude Mounolou and Vivien Reuter. 2004. *Biodiversity*. John Wiley
4. Cunningham, W.P. & M.A.Cunningham 2007. *Principles of Environmental Science-Inquiry and applications.* Tata Mc GrawHill Pub.New Delhi.
5. Dash, M.C.2009. Fundementals of Ecology. Tata Mc GrawHill Pub.New Delhi.
6. Gary A. Krupnick and W. John Kress (Eds.). 2005. *Plant Conservation: A Natural History Approach.* University of Chicago Press.
7. Given, D.R.. 1995. *Principles and practice of plant conservation*. Timber Press, Oregon.
8. **Jensen**, John R. 2007. ***Remote Sensing*** *of the Environment: An Earth Resource Perspective.* 2nd ed., Upper Saddle River, NJ: Prentice Hall
9. Krishnamurthy, K.V. 2004. *Advanced Textbook On Biodiversity: Principles And Practice*. Oxford
10. Lillesand. T.M. & R.W.Kiefer. 2000. *Remote Sensing and Image Interpretation.* John Wiley
11. Molles, M.C. 2005. *Ecology-concepts and applications*. Mc Graw Hill. Boston
12. Rao, R.R. 1994. *Biodiversity in India*. Bishen Singh & Mahendra Pal Singh, Dehra Dun.
13. Rao, Ravi Prasad B. 2005. Biodiversity. In Pullaiah, T (ed.) *Taxonomy of Angiosperms*. Regency publications, New Delhi. Pp. 287-317.
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17. Stiling, P. 2002. *Ecology*. Prentice-Hall of India, New Delhi.

45014- Plant Metabolism

Unit- I. Bioenergetics and Enzymes

Energy transformation in living systems; Laws of thermodynamics, free energy and standard free energy changes; bioenergetics, coupled reaction, phosphoryl group transfers, biological enrgy transducers, principles and mechanism of catalysis, enzymes and enzyme kinetics (Michaelis-Menten equation, and Reversible reactions), enzyme regulation, isozymes.

Unit- II: Biomolecules

Overview of amino acids, peptides and proteins, overview of protein structure (secondary, tertiary and quarternary structures, Ramachandran plot, domains, motif and folds), protein denaturation and folding, protein functions. Carbohydrates: monosaccharides and disaccharides, hetero and homopolysaccharides, Glycoconjugates (proteoglycans, glycoproteins, and glycolipids), Gluconeogenesis and pentose phosphate pathway. Lipids: Stoarge and structural lipids, functions of lipids, fatty acid biosynthesis and catabolism (β, oxidation).

Unit –III: Photosynthesis, Respiration and Photorespiration

Photosynthesis: Overview and current knowledge on the mechanism of photosynthesis, Light absorption and energy conversion, light harvesting complexes, photoprotective mechanisms electron transport pathways in chloroplast membranes, ATP synthesis in chloroplasts; Carbon fixation pathways-C_3, C_4, CAM pathways; C_3-C_4 intermediates, Synthesis and degradation of sucrose and starch (hexose phosphate pool, triose phosphate/pentose phosphate metabolite pools and their intercations).

Respiration: Overview, glycolysis, citric acid cycle, glyoxalate cycle, Plant mitochondrial electron transport and plant mitochondrial ATP synthesis, alternative oxidase system. Photorespiration-biochemical basis of photorespiration, photorespiratory pathway, role of photorespiration in plants.

Unit- IV: Secondary metabolites

Overview, Primar metabolites vs. secondary metabolites, Three major groups of secondary metabolites, biosynthesis and roles of Trepenoids, phenolic compounds (lignin, lignin, flavonoids, coumarins, stilibenes, styrolpyrones and arylpyrones) and nitrogenous compounds (Alkaloids)

Suggested Practicals:

1. Determination of total chlorophyll content and a/b ratio in leaves.
2. Separation of chloroplast pigments into two and four groups. Recording of their absorption spectra.
3. Comparative anatomy of C3, C4 and CAM leaves
4. Determination titrable acidity (TAN) in leaves of C3 & CAM plants.
5. Estimation of proteins in plant samples by Biuret or Lowry's method.
6. Estimation of reducing sugars in plant samples by Nelson's method.
7. Determination of amylase activity in germinating seeds.
8. Estimation of Amino acids by ninhydrin method...

9. Determination of Catalase activity in germinating seeds.
10. Reaction of amino acids and sugar.
11. Isolation of some natural products; caffeine, eugenol

Suggested Readings:

1. Govindjee, ed. 1982-83. *Photosynthesis.* Vol. I & II. Academic Press Inc. New York
2. S Raghavendra. 1988. *Photosynthesis*; A Comprehensive Treatise. Cambridge University Press, Cambridge, U. K.
3. Dey and Horborne. 1998 *Plant Biochemistry,* Academic Press.
4. D.T. Dennis, D.B. Layzell, D.D. Lefebyre & D. Turpin. 1997. *Plant Metabolism.* 2nd ed.. Addison-Wesely Pub. Co. New York.
5. Buchnan Gruissen & Jones. 2001. *Biochemistry and Molecular Biology of Plants.*
6. H.W. Keldt. 1997. *Plant Biochemistry and Molecular Biology*. OUP.
7. Lehninger, A.L. 2001. *Biochemistry*. Kalyani Publishers. Ludhiana.
8. Wilkins, M.B.(ed) 1987. *Advanced Plant Physiology*. ELBS & Longman. Essex., England.
9. Thomas C. Moore. 1992 II Eds. *Biochemistry and Physiology of Plant Hormones.*Narosa Publishers
10. Horton HR , Moran LA , Ochs RS et al., 2001.*Principles of Biochemistry*, III edn. Prentice Hall.
11. Matthews CK, Van Holde KE & Ahem KG 2000. *Biochemistry* III edn. Sanfransisco. Benjamin Cummings.