

YOGI VEMANA UNIVERSITY



**M.Sc. BOTANY SYLLABUS
SEMESTER & CBCS PATTERN
(w.e.f. 2018-19)**

**DEPARTMENT OF BOTANY
YOGI VEMANA UNIVERSITY
KADAPA - 516005
ANDHRA PRADESH
INDIA**

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INDEX

S.No	Contents	Page No.
1	Syllabus Structure	3
2	Syllabus (Theory & Practicals)	4-38
3	I st Semester	4-11
4	II nd Semester	12-19
5	Elective-I: Plants and Society	20-21
6	III rd Semester	22-29
7	Elective-II: Herbal Medicine	30-31
8	IV th Semester	32-39
9	Model Question Paper (Internal Examinations) -25 Marks	40
10	Model Question Paper (Semester End Examinations) -75 Marks	41
11	List of Question Paper Setters/ Examiners/Adjudicators/Experts	42-48

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“The task of the modern education is not to cut down the jungles, but to irrigate the deserts”.

C. S. Lewis

SEMESTER-I

Paper	Title of the paper	Instructional Hrs./Week	Internal Assessment Marks	Semester End Marks	Total Marks	Credits
15011	Biology and Diversity of Virus, Bacteria, Fungi and Plant Pathology	4	25	75	100	4
15012	Genetics and Plant Breeding	4	25	75	100	4
15013	Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms	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 Developmental Biology	4	25	75	100	4
25012	Plant Reproduction	4	25	75	100	4
25013	Plant Ecology and Environment	4	25	75	100	4
25014	Cell Biology and Cytogenetics	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	Ethnobotany and Pharmacognosy	4	25	75	100	4
35012	Plant Physiology	4	25	75	100	4
35013	Tools and Techniques in Plant Science and Biostatistics	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	Herbal Medicine	4			100	4

SEMESTER-IV

45011	Plant Tissue Culture	4	25	75	100	4
45012	Genetic Engineering of Plants	4	25	75	100	4
45013	Plant Metabolism	4	25	75	100	4
45014	Biodiversity Conservation and Management	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, virus genetic material, ultrastructure of virions, isolation and purification of viruses; chemical nature, replication and transmission of viruses (by grafting, seeds, contact, water, air, soil, agricultural tools, insects). Economic importance of virus. viral diseases in plants. Viroids and Prions.

Unit-II: Bacteria and Phytoplasma

General account; classification, ultrastructure, cell wall of bacteria, nutrition, **reproduction**: fission and **genetic recombination** (transformation, transduction and conjugation), economic importance (useful and harmful aspects) , symbiotic and asymbiotic nitrogen fixation by bacteria. 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. **economic importance of fungi** (in industry, as medicine and food, biocontrol agents). **Lichens**: structure and reproduction, mycorrhizae. Mushroom cultivation methods.

Unit –IV: Plant pathology

Classification of plant diseases and symptomology. Mechanism (s) of pathogenesis and resistance and disease control measures (physical, chemical and biological control). **Case studies of economically important causative agents with special reference to crop plants**. Plant-virus interaction with emphasis on-TMV & BYMV, Plant-bacterial interaction with emphasis on blight of paddy & citrus canker; Plant-fungus interaction with emphasis on-downy mildew of bajra, club root of crucifers, red rot of sugarcane, leaf spot and tikka diseases of groundnut. Beneficial interactions of mycorrhizae.

Suggested Practicals:

1. Preparation of stains and fixatives and micrographs of virus
2. Gram staining of Bacteria
3. Demonstration of motility in Bacteria.
4. Determination of microbial counts by using Hemacytometer.
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
9. Mushroom cultivation

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 (4th 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 (3rd 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 (2nd edition), Cambridge University Press
16. R. Hall (2005). Plant Virology. Printice Hall

15012 - Genetics and Plant Breeding

Unit- I: Classical Genetics

Trait, Genotype, Phenotype, **Mendelian Principles:** Dominance, segregation, independent assortment. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity. **Sex determination:** Chromosomal Sex-Determining Systems, Genic Sex-Determining Systems, Environmental Sex Determination. **Sex-Linked Characteristics:** Sex linkage, sex limited and sex influenced characters.

Unit- II: Linkage, Recombination, Gene mapping methods and extra chromosomal inheritance

Linkage: Morgans work in Drosophila and Cross over; **Genetic Maps:** Constructing Genetic Maps, Concept of a Genetic Map. Gene Mapping with Two-Point Testcrosses, Gene Mapping with Three-Point Testcrosses, Calculating the Recombination Frequencies, Linkage maps, tetrad analysis. **Recombination:** Types, Molecular mechanism of recombination. Homologous, site specific and non-homologous recombination. Factors affecting recombination. **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Unit- III: Mutation and alterations of chromosomes

Mutation: Types: Based on Base-pairs alterations-Base substitution, Insertions and Deletions, Frameshift Mutations. Germinal vs somatic mutants, Spontaneous vs Induced mutations. Visible Mutants, Nutritional Mutants- loss of and gain-of-function, Lethal mutations- recessive and dominant, conditional lethal mutations. **Causes of Mutation-** Spontaneous and Induced Mutations. **Detection of Mutations:** in Bacteria, fungi and Plants. **Structural and numerical alterations in chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications. **Transposable Elements:** General Features; General Properties of Plant Transposable Elements; Study of Transposable Elements in Plants (Corn).

Unit-IV: Plant breeding

Historical perspectives and objectives of plant breeding. **Breeding methods – general methods:** Plant introduction, **selection:** pureline, mass and clonal selection and hybridization. Inbreeding depression, heterosis, male sterility, self-incompatibility. **Special breeding methods:** Polyploidy breeding and mutation breeding in crop improvement. **Breeding Applications:** Breeding of plants for improving yield, quality and resistant to abiotic stress, diseases and pests, earliness and adaptability.

Suggested Practical's:

1. Problems related to Mendel's laws, Probability, Pedigree analysis
2. Problems related to codominance, multiple alleles, lethal alleles, epistasis, complementation analysis, X linkage, sex-limited and sex influenced inheritance.
3. Problems related to two-point test cross, three point mapping
4. Sex determination in Drosophila humans, and plants

5. Study of floral biology, Pollination mechanisms and breeding of crops- typical examples of self and cross pollinated plants.
6. Techniques of Emasculation and hybridization.

Suggested Readings:

1. D. Peter Snustad, Michael J. Simmons. 2002. Principles of Genetics. John Wiley & Son, USA.
2. Peter J. Russell 2009. iGenetics A Molecular Approach. Pearson Ltd. USA.
3. Daniel L. Hartl, Elizabeth W. Jones. 1997. Genetics: Principles and Analysis. Jones and Bartlett Publishers Inc. USA.
4. Singh B.D. 2015. Plant Breeding principles and Methods. Kalyani Publishers. India
5. Tamarin, R. H. 2004. Principles of Genetics. McGraw-Hill Higher Education. USA
6. Phundan Singh, 2010. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
7. Hartwell, et al. 2004 : Genetics:From Genes to Genomes. McGraw-Hill Higher Education. USA
8. Pierce, B. A. (2012). Genetics: A conceptual approach. WH Freeman. USA.
9. George Acquaah. 2012. Plant Genetics and Breeding. Wiley-Blackwell. USA.
10. Karvita B. Ahluwalia. Genetics.1985. Wiley Eastern Limited. India.
11. P K Gupta.2010. Genetics. Rastogi Publications. India.
12. P.S.Verma and V.K.Agarwal. 2010. Genetics. S. Chand Publishing. India.
13. V.K.Khanna. 2017.Fundamentals of Genetics Laboratory Manual. Kalyani Publishers. India.
14. Gardner and Simmons Snustad, 2005. Principles of Genetics, John Wiley and Sons, Singapore.

15013 - Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms

Unit- I: Algae

General characters, Algae in diversified habitat (terrestrial, aquatic-freshwater and marine, Unusual habitat of algae). **Thallus organization:** unicellular motile, unicellular non-motile, colonial, filamentous, heterotrichous, siphonous, parenchymatous, pseudo parenchymatous, special thallus. Cell structure. **Reproduction** (vegetative, asexual and sexual). **Criteria for classification of algae:** algal pigments, reserve food, algal flagella. Fritsch classification. General account of Cyanophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta. **Economic importance of algae:** algae as food, fodder, fertilizers, medicines, and uses in industry, algal blooms.

Unit- II: Bryophytes

General characters, Morphology, Structure, **Reproduction:** vegetative and sexual methods and life history. Classification of Bryophytes; General account and classification of Marchantiales, Anthocerotales, Sphagnales and Polytrichales; Diversity and Evolution of Sporophyte in Bryophytes, **economic and ecological importance:** peat, medicines, food, pollution indicators, conservation, rock builders. Distribution of bryophytes in India;

Unit – III: Pteridophytes

General characters, **Habitat of Pteridophytes:** terrestrial, aquatic, xerophytic. **Morphology:** sporophyte and gametophyte. Structure and Reproduction, Sporne classification. Origin of pteridophytes, stellar evolution in Pteridophytes, heterospory and origin of seed habit. Apospory and Apogamy. Evolution of sporophyte: telome theory. General account and classification of Psilopsida, Lycopsidea, Sphenopsida and Pteropsida. Fossils of Pteridophytes. **Economic importance:** food, construction material, as horticultural plants, biofertilizers, medicines. Distribution of Pteridophytes in India.

Unit – IV: Gymnosperms

General characters, **Morphology:** vegetative and reproductive organs. **Reproduction** (vegetative and sexual), and Sporne classification. Distribution of gymnosperms in India, **General account and affinities of living gymnosperms:** Cycadales, Ginkgoales, Coniferales, and Gnetales. **Silent features and affinities of fossil gymnosperms -** Pteridospermales, Cycadeoidales and Cordaitales. **Economic importance:** wood, resins, food, oils, medicines, fibre, paper, ornamental.

Suggested Practicals:

1. Examination of vegetative and reproductive morphology of various algae from Cyanophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.
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 Bryophytes, Pteridophytes and Gymnosperms.
4. Study of fossils from Pteridophytes and Gymnosperms

Suggested Readings:

1. Bhatnagar, S.P. & Alok Moitra (1997) : Gymnosperms, New Age International (P) Ltd., Publisher, New Delhi.
2. Bilgrami, K.S., & L.C. Saha (1996) : A text Book of Algae, CBS Publishers & Distributors (P) Ltd., New Delhi.
3. Chapman, V.J., & Chapman, D.J., (1973) : The Algae (2nd Edition), ELBS & MacMillan
4. 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
5. Datta, S.C. (1984) : An Introduction to Gymnosperms, Kalyani Publishers, New Delhi
6. 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.
7. Parihar, N.S. (19) : An Introduction to Embryophyta Vol.II Pteridophyta, Central Book Depot., Allahabad.
8. Rashid, A. (1998) : An Introduction to Bryophyta, Vikas Publishing House (P) Ltd., New Delhi
9. Rashid, A. (1999) : An Introduction to Pteridophyta, Vikas Publishing Co., New Delhi,
10. Round, F.E. (1973) : Biology of the Algae (2nd Edition), Edward Arnold, London.
11. Sharma, O.P. (1990) : Textbook of Pteridophyta, MacMillan India Ltd., Delhi.
12. Sharma, O.P. (1990) : Text Book of Algae, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
13. Smith, G.M. (1955) : Cryptogamic Botany (Vol. I Algae, Fungi, & Lichens), McGraw-Hill Book Co., New York
14. Sporne, K.R. (1970) : The Morphology of Pteridophytes, (The Structure of Ferns and Allied Plants), Hutchinson University Library, London
15. Sporne, K.R. (1971) : The Morphology of Gymnosperms (The Structure and Evolution of Primitive seed Plants), Hutchinson University Library, London
16. Sundara Rajan, S. (1994) : Introduction to Pteridophyta, New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi
17. 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.

15014 - Taxonomy of Angiosperms

Unit- I: Plant Classification and Phylogeny

History of Plant taxonomy, **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; concept of monophyly and polyphyly; Phylogeny: Origin and evolution of angiosperms.

Unit- II: Identification and Nomenclature

Plant collection and specimen preparation, **methodology**-collection, processing and preservation of plant specimens; important world and Indian herbaria; Botanical Survey of India (BSI), Plant identification-taxonomic keys; **taxonomic literature**-floras, journals and computer database. **Plant Nomenclature**: Botanical Names and Phylocode; 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: Selected Families of Angiosperms and Trends in Taxonomy

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

Suggested Readings:

1. O.P. Sharma, 2016. Plant Taxonomy
2. Gamble & Fischer 1915-1935. Flora of Presidency of Madras. 3 vols. BSMS, Dehradun.
3. Heywood, V.H., RK Brummitt, A. Culham, O. Seberg 2007. Flowering Plant Families of the World. Firefly books Ltd. New York.
4. 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.
5. Lawrence, G.H.M 1951. Taxonomy of Vascular plants. McMillan, New York.
6. Naik, V.N. 1992. Taxonomy of Angiosperms. 2nd Edn. Tata Mc.Graw Hill.
7. Pullaiah, T. 2005. Taxonomy of Angiosperms. Regency publications, New Delhi.
8. Pullaiah, T. et al 1997. Flora of Andhra Pradesh. 4 vols. Scientific Publishers, Jodhpur.
9. Radford. A.E.et.al., 1974. Vascular plant systematics. Harper & Row. New York.
10. Ravi Prasad Rao, B. 2007. Plant Name Directory. ABCD, Planographers. Hyderabad.
11. Simpson, Michael G. 2006. Plant Systematics. Elseiver& Academic Press.
12. Singh, Gurucharan. 2005. Plant Systematics. Oxford & IBH. New Delhi.
13. Sivarajan, V.V.1991. Introduction to principles of Plant Taxonomy. Oxford & IBH.

25011 - Plant Developmental Biology

Unit- I: 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. **Vascular tissue system** - types of vascular bundles. Primary growth of root and stem, secondary growth in dicot stem, root and monocot stem. **Anomalous secondary growth** - abnormal position and activity of cambium, intraxylary and interxylary phloem, Wood anatomy, wood development in relation to environmental factors

Unit- II: Hormonal regulation of plant development

Overview of plant hormones. **Auxins**: discovery, structure, biosynthesis, developmental role and mode of action. **Gibberellins**: discovery, structure, biosynthesis, developmental role and physiological effects (effects on growth and development). **Cytokinins**: structure, types and biological roles of cytokinins. **Absciscic acid**: occurrence, chemical structure and physiological effects. Ethylene, brassinosteroids, polyamines, jasmonic acid and salicylic acid.

Unit- III: Environmental regulation of plant development

Structure, function and mechanism of action of phytochrome, cryptochrome and phototropins; scotomorphogenesis and photomorphogenesis. **Ecological anatomy**: Adaptations in Hydrophytes, mesophytes and xerophytes, anatomy in relation to taxonomy: Hairs, stomata, epidermal cells, **microchemistry**: crystals, cystoliths, laticiferous tissue. Bicollateral vascular bundles, wood.

Unit-IV: Programmed Cell Death and Senescence

Concept of PCD, categories of cells undergo PCD during vegetative and reproductive stages, mechanism of PCD, developmental and stress induced PCD. Overview of plant senescence, patterns of senescence, **physiological changes during senescence**: photosynthesis, respiration, nitrogen fixation, protein and nucleic acids, environmental, biochemical, and molecular aspects of senescence. Environmental influence 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, root and leaf
3. Study of secondary growth in angiosperms
4. Study of anomalous structures in angiosperms
5. Study of dermal tissue system and vascular tissue system
6. 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. Buchanan BB, Grissem W, Jones RL (2000): Biochemistry and molecular biology of plants, I.K. International Pvt. Ltd, New Delhi.
2. Cutter, E.G. (1978) : Plant Anatomy Part: I: Cells & Tissues (2nd Edn.) Plant Anatomy Part II: Experiments & Interpretations Edward Arnold, London-1
3. Eames, A.J., & Mc Daniels, L.H. (1979) : An Introduction to Plant anatomy, Tata-McGraw-Hill Publishing Co., (P) Ltd., Bombay
4. Esau. K. (1980) : Plant Anatomy, (2nd Edition), Wiley Eastern Ltd., New Delhi.
5. Fahn, A. (1997) : Plant Anatomy, Pergamon Press, Oxford
6. Foster, A.S. (1960) : Practical Plant anatomy, Van Nostrand & East –West Press, New Delhi.
7. Pandey, B.P. (1989): Plant anatomy, S. Chand & Co., New Delhi
8. Singh, V., Pandey, P.C. & Jain, D.K. (1987): Anatomy of Seed Plants, Rastogi Publications, Meerut, India
9. Stewart, W. N. and Rathwell, G. W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
10. Taiz L., Zeiger E (2003). Plant Physiology, Panima Publishing Corporation, Bangalore.
11. B.P.Pandey. Plant Anatomy 2015. S. Chand and Company Ltd, New Delhi.

25012 - Plant Reproduction

Unit- I: Flower development

Reproductive strategies in higher plants and their significance, sexual and non-sexual modes (vegetative propagation), shoot apex and phase change, flower evocation, floral meristems and floral organ development, biochemical mechanisms involved in flowering (plant hormones and carbohydrates), regulation of flowering by light (photoperiodism) and temperature (vernalization), role of circadian rhythms, endogenous clock, Genetic and molecular analysis of flower development, homeotic mutants in plants (*Arabidopsis* and *Anthurium*), sex determination in plants.

Unit –II: Male and female gametophytes

Anther differentiation, structure of anthers, tapetal development, microsporogenesis, pollen development, Structure of pollen wall and features, molecular perspective of male gametophyte development, elements of palynology: aperture, NPC system, chemical composition of pollen and pollen allergy, male germ unit, male sterility. Ovule development, megasporogenesis, female gametophyte development, organization of embryo sac, structure of embryo sac cells.

Unit-III: Pollination and Fertilization

Anther dehiscence, pollination, pollen germination, pollen-stigma interactions, path of pollen tube, double fertilization. **Self incompatibility**; biological significance and methods to overcome incompatibility - irradiation, bud pollination, stump pollination, hot water treatment, somatic hybridization. Structure, development, types and function of endosperm, endosperm haustoria.

Unit-IV: Seed and Fruit Development

Embryogenesis, physiological and genetic control of embryogenesis, embryogeny in dicots and monocots, **polyembryony** - causes, types and applications. **Apomixis** - causes, types and applications. Seed development, events associated with seed maturation, factors regulating seed dormancy, seed germination, mechanisms of mobilization of food reserves during seed germination; stages of fruit development and their regulation, fruit ripening.

Suggested Practicals

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*, *Solanum melongena* 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 method
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.

Suggested Readings

1. Mahswari, P. An Introduction to Embryology of Angiosperms, 2014. Surjeet Publications, New Delhi.
2. Shivanna, K.R. and Johri, B.M. The Angiosperm Pollen structure and Function, Wiley Eastern Ltd. Publications, 1989.
3. Bhojwani, S. and Bhatnagar, S.P. Embryology of Angiosperms (4 th Revised and enlarged Edition), 2000.
4. Raghavan, V. Molecular Embryology of Flowering Plants Cambridge: Univ. Press, 1997.
5. Pullaiah, T., K. Lakshminarayana and B. Hanumantha Rao 2001. Textbook of Embryology of Angiosperms. Regency Publications, New Delhi
6. Pullaiah T., K.Lakshminarayana and B. Hanumantha Rao 2009. Plant Reproduction. Scientific Publishers, Jodhpur.
7. Raghavan, A. 1986. Embryogenesis in Angiosperms A developmental and Experimental study. CUP, New York
8. Buchanan BB, Grissem W, Jones RL (2000): Biochemistry and molecular biology of plants, I.K. International Pvt. Ltd, New Delhi.

25013 - Plant Ecology and Environment

Unit- I: Ecology and Environment

Definition, Scope and History of Ecology; climatic and topographic factor; 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 and Classification

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. Ecological adaptations.

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; Population dynamics. Species interactions: plant-plant (inter-specific competition) and plant-animal (pollination ecology and plant defense against herbivores); concept of ecological niche.

Unit- IV: Environmental Challenges

Natural resources, Classification of natural resources. Energy resources: Renewable energy resources-solar energy, wind energy, hydeal energy, thermal energy, bio energy. Non-renewable energy resources-fossil fuels; coal, natural gas, petroleum. Environmental pollution; sources, effects and control measures of air pollution, water pollution, soil pollution and noise pollution. Global warming-greenhouse gases, impacts on global environment and biodiversity; Ozone layer depletion; El Nino Southern Oscillation, La Nino; Earth Summit – 1992 (RIO DE JANERIO) and 2002 (JOHANNESBURG) and its outcome. Bioremediation. 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. Fundamentals 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, Philadelphia.
14. Odum. E.P. & Gary W. Barrett. 2005. Ecology. Tomson Brooks/Cole, Singapore.

25014 - Cell Biology and Cytogenetics

Unit- I: Cell Membrane and Cell wall structure and function

The Cell: Discovery, Cell theory and exceptions to the cell theory. An Overview of Eukaryotic and Prokaryotic Cells and their compartmentalization. **Plant Cell wall** - structure-primary and secondary cell walls, function and biogenesis. **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

Cytoskeleton - Structure and functions of microtubules, microfilaments and intermediate filaments. Role of microtubules and microfilaments in the motor movements; implications in flagellar and other movement. **Endoplasmic Reticulum:** Structure and functions. **Lysosomes:** Structure and functions. **Peroxisomes:** Structure and functions. **Mitochondria**-structure, genome, organization, functions and biogenesis. **Chloroplast** -structure, genome organization and functions. **Golgi Bodies:** Structure and functions. **Lysosomes:** Structure and functions. **Vacuole:** structure, function and significance of vacuoles in plants.

Unit-III: Nucleus and Chromosomes

Nucleus - structure of nuclear envelope, nuclear pore complex, nucleolus and functions of nucleus. **Chromatin structure:** Histones, DNA, nucleosome morphology and higher level organization; Functional states of chromatin and alterations in chromatin organization
Chromosome: Metaphase chromosomes: centromere and kinetochore, telomere and its maintenance; Holocentric chromosomes; Heterochromatin and euchromatin. **Giant chromosomes:** Polytene and lampbrush chromosomes.

Unit-IV: Cell cycle, Cell division and Meiosis

Cell Cycle: Overview of cell cycle, **Mitosis:** Mechanism of cell division mitotic apparatus, chromosome alignment and separation, cytokinesis. **Regulation and control of cell cycle;** role of cyclins and cyclin dependent kinases in cell cycle regulation. **Meiosis:** Meiotic process – stages, chromosome pairing, chiasma formation and gene conversion, synaptonemal complex. Comparison of mitosis and meiosis. Significance of meiosis.

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 *Chironomus* 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. Alberts B, Johnson A, Lewis J, Raff Martin, Roberts K and Walter P. (2007) Molecular Biology of the Cell. Garland Publ., New York.
3. Sharma AK & A Sharma. 1980. Chromosome techniques: Theory & Practice. Batterworth.
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)
7. Lewin B (2008). Genes IX, Jones and Barlett Publishers
8. Hardin, Jeff; Bertoni, Gregory Paul; Kleinsmith, Lewis J. (2009) Becker's World of the Cell, Benjamin Cummings.
9. P.S.Verma and V.K.Agarwal.2016. Cell Biology (Cytology, Biomolecules And Molecular Biology). S. Chand Publishing
10. P.K.Gupta. 2005. Cell and Molecular Biology. Rastogi Publications

SEMESTER - II: ELECTIVE - I (Non-core): Plants and Society

Unit-I: Introduction to Plant Life

Introduction - Why to study plants. **Plant Kingdom** – Brief introduction of Non-flowering plants - thalophyta, bryophyta and pteridophyta and flowering plants - spermatophyta. **Plant Tissues:** Brief introduction of Meristems, Dermal Tissues, Ground Tissues and Vascular Tissues. **Plant Organs:** Brief introduction of Root, Stem and Leaf. **Plant life cycle** – Brief introduction of Flowers: Floral Organs, Male Gametophyte Development, Female Gametophyte Development. **Pollination and Fertilization:** Animal Pollination, Wind Pollination and fertilization.

Unit-II: Systemic classification and uses of plants to society

Plant Systematics – history of classification, identification, nomenclature and classification of plants. **Plants as source of food** – Cereals (Rice), Millets (Sorghum), Pulses (Bengal gram), Vegetables (Tomato), Fruits (Banana and Mango). **Commercial products** - stimulating beverages (coffee, tea), spices (cinnamon, cloves, nutmeg, ginger, vanilla), **Materials** - fibre, paper and wood. **Human health** – history of plants in medicine, medicinal plants (Aswagandha, Belladonna, Holy basil, nux-vomica, sarpagandha), psychoactive plants (opium, marijuana), poisonous and allergy plants, oil plants, gums and resins.

Unit-III: Plant Cell and Physiology

The Plant Cell: Brief introduction of Cell wall; Membrane and Cell organelles. **Plant Genetics:** Introduction, Monohybrid cross and Dihybrid cross, Mendelian principles. **Principles of Plant Physiology – transport systems in plants** - transpiration, water absorption from soil, translocation. **Metabolism** – Photosynthesis - brief introduction, overview, Light reactions and types of carbon fixation pathways. Respiration - Glycolysis, Krebs cycle.

Unit-IV: Plants and Environment

The principles of ecology: The ecosystem, food chain and food web, ecological pyramids. Ecological succession. **Plant Biodiversity** - levels of biodiversity and threats to biodiversity. **Conservation of biodiversity:** *In situ* and *ex situ* conservation of biodiversity. **Human effects on plants and nature:** deforestation, climate change, pollution, loss of habitat and species.

Suggested Reading:

1. Estelle Levetin and Karen McMahon (2012). Plants and Society 6th Edition. The McGraw-Hill Publication, New York.
2. Hill.,A.W. (1952) : Economic Botany, McGraw Hill Book Co., New York.
3. Ashok Bendre & Ashok Kumar (1998-99) : Economic Botany, Rastogi Publications, Meerut, India
4. Pandey, B.P. (2000) : Economic Botany, S. Chand & Co., New Delhi
5. Krishnamurthy, K.V. (2004). An advanced text book of biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
6. Ambasht, R.S. (1974) : Text book of Plant Ecology (3rd Edn.), Students & Friends Co., Varanasi - Odum E.P. (1975) : Ecology, Holt, Rinert & Winston

7. Kormandy, E.J. (1978): Concepts of Ecology (2nd Edition), Prentice Hall of India (P) Ltd., New Delhi.
8. Sharma, P.D. (2000): Ecology & Environment, Rastogi Publications, Meerut, India.

35011 - Ethnobotany and Pharmacognosy

Unit- I: Ethnobotany

Ethnobotany, its history, scope, importance and various sub disciplines; Methods and literature in ethnobotany; Recent ethnobotanical works in India; Main world centres and workers of ethnobotany; Different aspects related to tribes of Andhra Pradesh. Wild medicinal plants and their therapeutic values with reference to tribes of Eastern Ghats.

Unit- II: Phytomedicine and Systems of Medicine

Complementary/Alternative medicine; Different systems of indigenous medicine; Ayurveda - Origin and understanding of Ayurveda; Siddha - Origin and understanding of Sidha; Unani - History and principles of practices and perspectives of Unani; Homeopathy - History and principles of practices and perspectives of Homeopathy. Phytopharmaceuticals: inventory, taxonomic validation and evaluation of sources.

Unit- III: Analytical Pharmacognosy

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

Unit- IV: Pharmacological analysis and Utilization

Drugs of alkaloids, coumarins, tannins, terpenoids and glycosides; Natural pesticides, antibiotics, and poisonous plants. Antimicrobial assay: antibacterial and antifungal screening. Potential drug yielding plants and their marketing. Intellectual Property Rights (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 Pharmacognosy. 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

Laws of diffusion and permeability, water potential in soil and root; water uptake (root pressure, apoplast and symplasmic pathways, transmembrane pathway); transport through xylem (Cohesion-tension theory, surface tension theory), transpiration, stomatal types, stomatal movement, SPAC, antitranspirants; solute and ion transport, active and passive transport, Nernst Equation, transport across membrane (membrane pumps, carriers, ion channels, aquaporins); phloem mechanism of loading and unloading of photoassimilates.

Unit-II: Mineral nutrition, nitrogen and sulfate assimilation

Mineral nutrition; essential elements, deficiency symptoms and plant disorders, treating nutritional disorders. Nitrogen: Overview of nitrogen fixation, symbiotic and asymbiotic nitrogen fixation, legume-rhizobium symbiosis, nodule formation, mechanism of nitrogen fixation, ammonia uptake and transport, nitrate uptake and reduction, nitrate and nitrite reductions. Sulfur: sulfur chemistry and function, sulfate uptake, transport and assimilation pathways.

Unit-III: Signal transduction

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, morphological, physiological and biochemical responses of plants to abiotic stresses, mechanism of abiotic stress tolerance, water deficit, osmotic stress, osmotic adjustment, stress proteins and genes (HSPs, LEAs, osmotins, dehydrins); salinity (ion toxicity and exclusion), heavy metal stress, chilling and high temperature stress (HSPs), oxidative stress and ROS scavenging system.

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:

1. Buchannan et al 2001. Biochemistry and Molecular Biology of Plants.
2. C. M. Wiltmer & M. Fricker. 1996. Stomata. 2nd Ed. Chapman Hall. U. K.

3. Delvin, R. M. 1969. Plant Physiology. Affiliated East West, New York.L.
4. Taiz & E. Zeiger. 1998. Plant Physiology. Second Edition. Sinauer Associates Inc, Publishers, Massachusetts, USA.
5. Salisbury F. B. & C. W. Ross 1992 Plant Physiology. 4 th Edn. Wadsworth Publishing Co., Belmont, California.
6. Thomas C. Moore.1992. Biochemistry and Physiology of Hormones.Narosa.
7. Hopkins, W. 1998. Introduction to Plant Physiology. ELBS & Longman, Essex., England.

35013 - Tools and Techniques in Plant Science and Biostatistics

Unit-I: Microscopic, histochemical and radioisotope techniques

Microscopy: Principles and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy. **Microtomy and staining:** Microtomy and double staining of plant sections. **Radioisotope Techniques:** Types of isotopes, radioactive decay. **Detection and measurement of radioactivity-** GM counter, scintillation counter, autoradiography. Isotopes used in biology, safety methods in handling radioisotopes.

Unit-II: Electrophoresis and Centrifugation methods

Polyacrylamide gel Electrophoresis: Native-PAGE, SDS-PAGE. **2D-Electrophoresis:** Isoelectric focusing, 2D Electrophoresis. **Agarose Gel Electrophoresis:** Preparation, separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications. **Centrifugation types:** differential centrifugation, density-gradient, analytical, and ultracentrifugation and their applications

Unit-IV: Spectroscopy and Chromatography Techniques

Spectroscopy: Laws of light absorption: Beer and Lamberts, **Instrumentation and applications:** UV- visible spectrophotometer, NMR and ESR spectroscopy, Mass Spectroscopy. **Chromatography: Principle, instrumentation, practical procedure and applications of:** Paper chromatography, thin-layer chromatography, gas-liquid chromatography, High-performance liquid chromatography (HPLC).

Unit-IV: Biostatistics

Introduction, role of statistics in botanical research, collection of data, tabulation. Statistical tools: **Variables:** qualitative variables and quantitative variables, measurement of variables. Frequency distribution, **Measures of Central Tendency:** Arithmetic mean, Median, Mode, Average, Percentage. **Measures of Dispersion:** Mean Deviation, Variance and Standard deviation, Coefficient variation. **Probability;** measures of probability, laws of probability. **Probability Distributions:** Binomial, Poisson, Normal and 't' distribution. Regression and Correlation, The Chi-Square test, Analysis of Variance (ANOVA). Non-Parametric statistics: Advantages and disadvantages of Non-Parametric 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. Absorption spectra of amino acids, Proteins and nucleic acids
6. Isolation and spectrophotometric characterization of plant pigments
7. Verification of Beer's law
8. Statistical problems

Suggested Readings:

1. Upadhyay, Upadhyay, Nath, 2002. Biophysical Chemistry-Principals and Techniques (3rd edition). Himalaya Publishing House.
2. P.K. Bajpai (2012). Biological Instrumentation & methodology (Tools and Techniques of Biology) S Chand & Company Pvt Ltd.
3. Wilson & Walker 2000. Practical biochemistry: Principles & Techniques. Cambridge Univ. Press, New York
4. Williams and Wilson, K. 1991. A Biologist's guide to principles and techniques of practical biochemistry, 2nd ed. Edward Arnold.
5. Lain, D. Campbell and Raymond A. Dwek Biological Spectroscopy Benjamin/Cumming Pub. Co., California, London.
6. Cantor, C.R. and Schimmel, P.R. Biophysical Chemistry by, W.H. Freeman & Co.,
7. Glasel, A and Deutscher, M.P. 1995. Introduction to Biophysical Methods for Protein and Nucleic Acid Research. Academic Press.
8. R.N. Curnow, A.H. Hasted. 1993. Statistical methods in Agriculture and Experimental biology. 2nd ed.. R. Mead, Panima Publication. Bangalore
9. R.N. Forthafter and E.S. Lee. 1995. Introduction to Biostatistics. Academic Press. PP
10. P.S.S.Sundar Rao and J. Richard, 2014. Introduction to Biostatistics and Research Methods. PHI Learning Pvt. Ltd. New Delhi.

35014 - Molecular Biology of Plants

Unit- I: Genetic material structure, DNA replication and repair

Genetic material: Experimental evidences for genetic material- Fred Griffith, Avery, Hershey Chase experiments. Chemical and molecular structure of DNA and RNA. **DNA Replication:** Models for DNA replication- semi-conservative, conservative and dispersive models; Modes of replication- theta, rolling circle and linear mode, Replication origin and replication fork, enzymes involved in DNA replication-helicases, topoisomerases, SSB, DNA ligases, primases, DNA polymerases, mechanism of replication in prokaryotic and Eukaryotic organisms. **DNA damage and repair:** DNA damage and repair mechanisms.

Unit-II: RNA synthesis and processing

Components for Transcription: Template DNA, RNA polymerases-prokaryotic and eukaryotic, Promoters, Transcription factors. **Mechanism of transcription in prokaryotes and eukaryotes-**, Initiation, elongation and termination of RNA synthesis. **Post transcriptional modifications of RNA:** capping, Polyadenylation. **RNA splicing-** introns. Splicing mechanisms and alternate splicing. **RNA Editing:** Mechanism of RNA editing, **RNA Transport:** Mechanism of transport of RNA to Cytoplasm.

Unit-III: Protein Synthesis and processing

Genetic code -codon degeneracy, Wobble hypothesis, Universality of genetic code, **Ribosomes:** structure and composition of prokaryotic and eukaryotic ribosomes, **Structures-** mRNA and tRNA, **Translation process in prokaryotic and Eukaryotic organisms:** events in protein synthesis-amino acid activation, initiation, elongation and termination. **Inhibitors of protein synthesis:** Antibiotics. **Post translational modification of proteins-**protein sorting and targeting, molecular chaperons, protein folding and protein degradation.

Unit – IV: Regulation of Gene Expression

Stages of gene regulation: DNA level, transcriptional, post transcriptional, translational and post translational. **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 LiCl₂ 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 T_m point of DNA isolated from plant tissue

10. Isolation of proteins from plant tissues
11. Estimation of proteins by Lowry's method.
12. Separation of proteins by SDS-PAGE.

Suggested Readings:

1. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson , Molecular 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)
9. David P. Clark, Lonnie Dee Russell (1997). Molecular Biology: Made Simple and Fun. Cache River Press,
10. Robert Weaver (2007). Molecular Biology.McGraw-Hill Companies,Incorporated
11. Geoffrey M. Cooper, Robert E. Hausman (2007). The Cell: A Molecular Approach. ASM Press
12. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Keith Roberts (2014). Essential Cell Biology. Garland Science.
13. John Wilson, Tim Hunt (2002). Molecular Biology of the Cell: A Problems Approach. Garland Science.
14. Rene Fester Kratz (2009). Molecular and Cell Biology For Dummies. Wiley.
15. Hardin, Jeff; Bertoni, Gregory Paul; Kleinsmith, Lewis J. (2009) Becker's World of the Cell, Benjamin Cummings.
16. Benjamin Lewin, Jocelyn Krebs, Stephen T. Kilpatrick, Elliott S (2011). Goldstein. Lewin's GENES X. Jonnes and Bartlet Publishers
17. Peter J. Russell (2009). iGenetics A Molecular Approach. Pearson Ltd. USA.
18. R.W. Twyman (1998). Advanced Molecular Biology: A concised reference. Bios Scientific Publishers.
19. Lizabeth A. Allison (2011). Fundamental Molecular Biology, Wiley.

SEMESTER - III: ELECTIVE - II: (Non-core) Herbal Medicine

UNIT – I: Ethnobotany

Introduction, history, scope and importance, Inter disciplinary approaches in Ethnobotany. Study of Medicinal, Edible and Miscellaneous plants used by the Tribes. **Breif account on Indian medicine:** Ayurveda, Homeopathy, Unani and Siddha. Study of locally available medicinal plants and their thereupetic values (*Adathoda*, *Gymnema*, *Andrographis*, *Rauwolfia*, *Ocimum*).

UNIT – II: Pharmacognosy

Introduction, history and scope of Pharmacognosy. Drugs of alkaloids, glycosides, phenolics, antibiotics, psychoactive and poisonous plants. **Study of important medicinal plants:** Amla, Aswagandha, Aloe, Brahmi, Kesar. **Classification of drugs** - Alphabetical, Morphological (Organized and unorganized), Taxonomical, Chemical, Pharmacological, Chemotaxonomical and **drug evaluation** - morphological, microscopic, physical, chemical and biological evaluation. Genetic engineering of medicinal plants.

UNIT III: Herbal Cosmetics

Uses of herbal cosmetics like emulsifiers (fixed oils, waxes, butters), moisturizing agents, colours, perfumes, and fragrances, bleaching agents, preservatives, antioxidants, chelating agents, skin lotions, sunscreens, dyes, anti aging creams, deodarants, nail polishes, hair oils, soaps, shampoos, nail polishes and lipsticks.

UNIT IV: Medicinal plants

Formulation and standardization of various herbal cosmetic products, Henna, Turmeric, Sandalwood, Neem, Coconut, Rice, Holy basil, Red sandal wood, Camphor, Jaboba. Drugs for digestive disorders – *Withania somnifera*. Memory stimulants – *Centella asiatica*, *Bacopa monnieri*. Drugs for dissolving kidney stones – *Musa paradisiaca*. Antiinflammatory drugs – *Cardiospermum*. Anticancer drugs – *Catharanthus roseus*.

Suggested Readings:

1. Harborne, J. B. 1948. Phytochemical Methods (Ed.) Chapman and Hall, London.
2. Khare, C. P. 2000. Indian Herbal Therapies. Delhi Book Co., M-Connaught, Circus, New Delhi.
3. Kokate, C. K. Purohit, A.P. Gauchely, S.B. 1990. Pharmacognosy, Narial Prakashan, India.
4. Jain, S.K. 1995. Mannual of Ethnobotany, Scientific Publishers, Jodhpur.
5. Wallis, T. E. 1999. Text Book of Pharmacognosy, (5th Ed.) CBS Publishers & Distributions, New Delhi.
6. Singh, M. P. and Panda, Himadri 2005. Medicinal herbs with their formulations. Volume 1 & 2. Daya Publishing House, Delhi.
7. Herbal cosmetics, hand book By H. Panda
8. Kumar, N.C. (1993). An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi.
9. Rao, A.P. (1999). Herbs that heal. Diamond Pocket Books (P) Ltd., New Delhi.
10. Gokhale, S.S., C.K.Kokate and A.P. Purohit (1994) Pharmacognosy. Nirali Prakashan. Pune.
11. Tyagi, Dinesh Kumar (2005) Pharma Forestry. Field Guide to Medicinal Plants. Atlantic Publishers and Distributors, New Delhi.

12. Farooqi, A.A., and B.S. Sreeramu (2004). Cultivation of Medicinal and Aromatic Crops. University Press (India) Pvt. Ltd., Hyderabad.
13. Singh & Jain (1985) Taxonomy of Angiosperms. Rastogi Publications, Meerut.

45011 - Plant Tissue Culture

Unit- I: Basics of plant tissue culture technique

Historical aspect and landmarks in plant tissue culture, concept of cellular totipotency and cellular differentiation, basic techniques in plant tissue culture, formulation of media for plant tissue culture, cultural conditions, physiological, biochemical and molecular role of mineral, carbohydrate and growth regulators in differentiation of organs under *in vitro* conditions.

Unit-II: Pathways of *in vitro* regeneration (Vegetative explants)

In vitro regeneration methods: Micropropagation, organogenesis (direct and indirect), somatic embryogenesis; Problems of tissue culture: contamination, phenolics, recalcitrance; Genome reorganization induced *in vitro*, somaclonal and gametoclonal variations; problems in establishment of regenerated plants in nature, hardening of plants.

Unit- III: Pathways of *in vitro* regeneration (reproductive explants) and protoplast culture

Gametic embryogenesis (androgenesis and gynogenesis), doubled haploids, culturing of ovary, ovule, nucellus, embryo, embryo rescue, triploid production, 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

Meristem culture for production of virus free plants, artificial seeds, production of secondary metabolites from cell suspension culture and hairy root culture, elicitors, plant cell reactors-bio reactors culture of isolated single cell, role of tissue culture in gene transfer, cryopreservation and germplasm storage.

Suggested Practicals

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. Razdan, M.K. 2014. Introduction to Plant Tissue Culture (Second edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Bhojwani, S.S. 1990. Plant Tissue Culture Applications and Limitations: Elsevier, New York
3. Bhojwani, S.S. and M.K.Razdan 1996. Plant Tissue Culture. Theory and practice (rev. ed) Elsevier Science Publishers, New York.

4. Collins, H.A. and S. Edwards 1998. Plant Cell Culture. Bios Scientific Publishers Oxford, UK.
5. Kalyan Kumar De. 1997. Plant Tissue Culture. NCB Agency, Kolkata.
6. Pullaiah, T. 2009. Plant Tissue Culture. Scientific Publishers, Jodhpur.
7. Vasil, I.K and T.A. Thorpe 1994. Plant Cell and Tissue Culture. Kluwer.

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 phosphatases, 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). **Gene Isolation methods:** Genomic DNA and cDNA libraries and their applications. **Gene manipulation tools:** 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: Advanced Methods in Genetic Engineering

Microarrays: Principle, Various Types, Methodology and Applications. **Proteomics:** Protein microarrays and their applications. **Advances in sequencing technology:** next-generation sequencing' (NGS) technology and applications. **RNA interference (RNAi):** Mechanism of RNAi in plants, Pathways of biogenesis of miRNA, siRNA and their role in crop improvement. **Genome Editing Technologies:** CRISPR technology principle, methodology and applications in crop improvement.

Unit-III: Marker Assisted Breeding

Molecular Markers: Different kinds of molecular markers - Morphological markers, Biochemical markers, molecular markers- RFLP, RAPD, SCARs, SSRs, AFLP, ISSRs, CAPs, SNPs- Principle, Methodology and their merits and demerits. **Marker Assisted Breeding:** Potential use of Marker assisted selection (MAS) in crop improvement *i.e* Submergence tolerance in rice; Blast disease resistance in rice; drought tolerance in rice.

Unit-II: Plant transformation and Transgenic Plants

Introduction to transgenic plants. **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. **Applications of Transgenic plants:** Herbicide Resistance, Male sterility, Insect resistance (Bt transgenics), Virus resistance, Pest Resistance, Fungal resistance. Genetic engineering of plants for nutritional quality improvement (Vitamin A-Golden rice; Vitamin E), transgenic plants for extended shelf life of fruits, manipulation of flower colour, Abiotic stress tolerance, Edible vaccines. **Concerns and risks of transgenic plants:** Possible Ecological concerns and risks of transgenic crops.

Suggested Practicals:

1. Preparation of E.coli growth curve by turbidimetric method
2. Preparation of E.coli competent cells by CaCl₂ 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. Surinder Chopra, Shelby J. Fleischer, Agnès Ricroch (2014). *Plant Biotechnology: Experience and Future Prospects*. Springer Publications, Singapore.
2. Suresh Kumar Gahlawat, Raj Kumar Salar, Priyanka Siwach, Joginder Singh Duhan, Suresh Kumar, Pawan Kaur (2017). *Plant Biotechnology: Recent Advancements and Developments*. Springer Publications, Singapore.
3. Malik Zainul Abidin, Usha Kiran, Kamaluddin, Athar Ali (2017). *Plant Biotechnology: Principles and Applications*. Springer Publications, Singapore.
4. Adrian Slater, Nigel W. Scott and Mark R Flower (2012). *Plant Biotechnology: the genetic manipulation of Plants*. Oxford University Press, UK.
5. Sudhir K. Sopory, Ashwani Kumar (2008). *Recent Advances in Plant Biotechnology and its Applications*. I K International Publishing House, New Delhi.
6. H.S.Chawla (2017). *Introduction to Plant Biotechnology (3/e)*. CRC Press.
7. P.S. Srivastava, Alka Narula, Sheela Srivastava (2005). *Plant Biotechnology and Molecular Markers*. Kluwer Academic Publishers, New York.
8. T. A. Brown (2016). *Gene Cloning and DNA Analysis: An Introduction, 7th Edition*. Wiley-Blackwell.
9. Christopher Howe (2007). *Gene Cloning and Manipulation*. Cambridge University Press.
10. U.Satyanarayana (2008). *Biotechnology*. Books & Allied Ltd.

45013 - Plant Metabolism

Unit- I: Bioenergetics and Enzymes

Energy transformation in living systems, laws of thermodynamics, free energy, standard free energy changes; Phosphoryl group transfers, biological energy transducers; Enzymes, principles, nomenclature, classification, enzyme regulation, enzyme kinetics (Michaelis-Menten equation, and Reversible reactions), coupled reaction, biocatalysts, isozymes and ribozymes.

Unit- II: Biomolecules

Overview of amino acids, peptides and proteins, overview of protein structure (secondary, tertiary and quaternary structures, Ramachandran plot), protein denaturation and folding. Carbohydrates: monosaccharides, disaccharides, hetero and homopolysaccharides; synthesis and degradation of sucrose and starch (hexose phosphate pool, triose phosphate/pentose phosphate metabolite pools and their interactions); gluconeogenesis, Lipids: storage and structural lipids, functions of lipids, fatty acid biosynthesis and catabolism (β -oxidation).

Unit –III: Photosynthesis and Photorespiration

Photosynthesis: Overview, light absorption and energy conversion, light harvesting complexes, photoprotective mechanisms, electron transport pathways in chloroplast membranes, photophosphorylation. Carbon fixation pathways - C_3 , C_4 , CAM pathways and C_3 - C_4 intermediates. Photorespiration - biochemical basis of photorespiration, photorespiratory pathway, role of photorespiration in plants.

Unit- IV: Secondary metabolites

Overview, Primary metabolites vs. secondary metabolites. Structure, biosynthesis, biological and economic importance of Alkaloids, Terpenoids (monoterpenes, sesquiterpenes, polyterpenes, volatile oils), Phenols (phenolic acids, coumarins, flavonoids, lignins).

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 C_3 , C_4 and CAM leaves
4. Determination titrable acidity (TAN) in leaves of C_3 & 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. Lefebvre & D. Turpin. 1997. Plant Metabolism. 2nd ed., Addison-Wesely Pub. Co. New York.
5. Buchanan 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.

45014 - Biodiversity Conservation and Management

Unit- I: Biodiversity

Perception and History; Biodiversity and its components, 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; Agro diversity - vavilov centers of crop plants; Exotics and Invasive species.

Unit- II: Biodiversity values

Direct use value; food, medicinal value, industrial values, ecotourism; Indirect value: biological control, environmental modulation, ecological services; Economic importance of fiber, medicine, yielding gums and resins and essential oils, timber and non-timber forest products and aromatic plants.

Unit- III: Conservation Practice

History of Conservation, Principles of conservation; the process of extinction; threats to biodiversity; IUCN red list categories; 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

Global strategy for plant conservation (GSPC); Brief account on national and international conservation organizations- WWF, UNEP, IUCN; Biodiversity laws; Biological diversity act, 2002 ; Brief account on International agreements on biodiversity conservation-CBD, CITES, RAMSAR; 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/ millets/pulses/fruits/vegetables/oil seeds/fibre.
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. Fundamentals 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.
14. Ricklefs, R,E. &Gary L. Miller. 2000. Ecology. 4th ed. W.H. Freeman and Company. New York.
15. Sabins, 1997. Remote Sensing-principles and interpretation. 3rded.W.H.Freeman&Co., New Delhi
16. Sharma, P.D. 2009. Ecology and Environment. 10th ed. Ratogi Publications, Meerut.
17. Stiling, P. 2002. Ecology. Prentice-Hall of India, New Delhi.

YOGI VEMANA UNIVERSITY: KADAPA
M.Sc. BOTANY

(MODEL QUESTION PAPER FOR INTERNAL EXAMINATION)

Time: 1 Hour

Max. Marks: 25

Section- A

Answer ALL short answer questions

2 x 2.5 = 05 Marks

1. a) Short answer question
(or)
b) Short answer question
2. a) Short answer question
(or)
b) Short answer question

Section- B

Answer ALL Essay questions

2 x 10 = 20 Marks

3. (a) Essay question
(or)
(b) Essay question
4. (a) Essay question
(or)
(b) Essay question

YOGI VEMANA UNIVERSITY: KADAPA

M.Sc. BOTANY

(MODEL QUESTION PAPER FOR SEMESTER END (EXTERNAL) EXAMINATION)

Time: 3 Hours

Max. Marks: 75

Part- A

Write short notes on any **FIVE** of the following
Each question carries **THREE** marks

5 x 3 = 15 Marks

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)

Part- B

Answer **ALL** the following questions
Each question carries **FIFTEEN** marks

4 x 15 = 60 Marks

9. Essay question
(or)
10. Essay question
11. Essay question
(or)
12. Essay question
13. Essay question
(or)
14. Essay question
15. Essay question
(or)
16. Essay question

(Note: Syllabus consists of Four (4) Units. Paper setters are requested to ask minimum two questions from each Unit)

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