



**RANI CHANNAMMA UNIVERSITY,**

**Vidyasangama, PB-NH-4, Bhutaramanahatti,**

**BELAGAVI – 591 156**

**SCHOOL OF BASIC SCIENCES**

**Department of Studies in Botany**

**M.Sc., Botany Course**

**(CBCS)**

**STRUCTURE AND SYLLABUS**

**With effect from 2020-21**

## COURSE STRUCTURE AND SCHEME OF EXAMINATION

Sem No.	Course No	Title of the course	Credits	Teaching Hr/week	Maximum Marks		
					Exam proper	I.A.	Total
		Compulsory Courses:					
I	1.1	Microbial Diversity	4	4	80	20	100
	1.2	Biodiversity and Conservation Biology	4	4	80	20	100
	1.3	Systematic Botany of Angiosperms	4	4	80	20	100
	1.4	Evolutionary Biology & Plant Geography	4	4	80	20	100
	1.5	Practical – I Based on 1.1 & 1.2	4	4	80	20	100
	1.6	Practical – II Based on 1.3 & 1.4	4	4	80	20	100
II		Compulsory Courses:					
	2.1	Biochemistry and Bio-Physics	4	4	80	20	100
	2.2	Developmental Biology	4	4	80	20	100
	2.3	Genetics and Plant Breeding	4	4	80	20	100
		Open Elective Course:					
	2.4	Medicinal Plants	4	4	80	20	100
		Compulsory Courses:					
	2.5	Practical – III Based on 2.1	4	4	80	20	100
	2.6	Practical – IV Based on 2.2 & 2.3	4	4	80	20	100
III		Compulsory Courses:					
	3.1	Plant Physiology	4	4	80	20	100
	3.2	Cell Biology and Molecular Biology	4	4	80	20	100

	3.3	Medicinal Plants & Herbal Drug Technology	4	4	80	20	100
		<b>Open Elective Course:</b>					
	3.4	Plant Propagation Techniques	4	4	80	20	100
		<b>Specialization Courses:</b>					
	3.5	Practical V: Based on 3.1	4	4	80	20	100
	3.6	Practical VI: Based on 3.2 & 3.3	4	4	80	20	100
<b>IV</b>		<b>Compulsory Courses:</b>					
	4.1	Mycology and Plant Pathology	4	4	80	20	100
	4.2	Ecology and Environmental Biology	4	4	80	20	100
	4.3	Plant Biotechnology	4	4	80	20	100
	4.4	Research methodologies and Techniques in Botany	4	4	80	20	100
	4.5	Practical VII: Based on 4.1 and 4.2	4	4	80	20	100
	4.6	Project	4	8	80	20	100

## **M.Sc., BOTANY SYLLABUS**

### **I SEMESTER**

#### **1.1 Microbial Diversity**

Teaching Hours per Week: 4

No. of Credits: 4

#### **UNIT I**

**13 HOURS**

Plant Bacteriology: Diversity in structure and organization of Eubacteria, Spirochetes, Rickettsias, Chlamydias, Actinomycetes, Archaeobacteria, mycoplasmas and Cyanobacteria, metabolic diversity in relation to phototrophic, chemolithotrophic, symbiotic, saprophytic and parasitic mode of life. Diversity in relation to photosynthetic pigments and energy biogeochemical cycling, Present picture of phylogeny and systematics of bacteria. conversion. phylloplane and rhizosphere microbiology-role of bacteria in

#### **UNIT II**

**12 HOURS**

Methods of studying microbial biodiversity various culture methods biodiversity of culturable bacteria. Techniques used to study plant-microbe interaction. Isolation strategies recovering microbial biodiversity using environmental DNA, environmental genomics, screening environmental libraries preservation of microbial biodiversity, polyphasic taxonomy of microorganisms.

#### **UNIT III**

**13 HOURS**

Plant Virology: Origin of viruses, classification and nomenclature of Viruses with special stress on plant viruses, introduction to molecular virology, Virology on Internet - viral databases and their use for understanding viral phylogeny, Viral genomics and proteomics Transmission of viruses; Mechanism of replication of DNA and RNA viruses, modern techniques to study the viruses- Morphology, chemical composition, ultrastructure, replication. The virus cryptogram, Transmission of Plant Viruses, Virus-Vector relationship, Control of Plant Viruses. Present knowledge of Viroid's and prions. Virus pandemics in recent years -SARS Family viruses, **Covid-19 virus**- origin, Causes and Response measures.

#### **UNIT IV**

**12HOURS**

Structural diversity distribution and the ecological significance of lichens. Fungal biodiversity- taxonomic diversity, general structural features and the latest classification. Phocobionts & Mycobionts- Lichenized versus nonlichenized fungi.

#### **References:**

1. Ainsworth, G. C., Sparrow, F. K. and Sussman, A. S. (1973). The Fungi. Academic Press, New York.
2. Alexopoulou, C. J., Mims, C. W., Blackwell, M. (1996). Introductory Mycology. John Wiley & Sons, New York.
3. Atlas, M. and Bartha, R. (2000). Microbial Ecology, Longmann, New York.

4. Awasthi D. D. 2013). A hand book of lichens, Publisher: M/s Bishen Singh Mahendra Pal Singh, Dehra Dun.
5. Dubey, R. C. and Maheswari, D. K. (2010). A Text book of Microbiology, S.Chand& Company, New Delhi.
6. Fundamentals of Mycology,1983 J.H. Burnett, William Clows and Sons, London.
7. Fungal spores and their liberation and dispersal C.T. Ingold 1971 Oxford University press Oxford.
8. General Microbiology 1993 H.G. Schlegel Cambridge University press, Cambridge.
9. General Microbiology 1998 S.B. Sullia and S. shantharam oxford & IBH Publication, New Delhi.
10. Global Biodiversity Assessment 1995, V.H. Heywood, Cambridge University Press,Cambridge.
11. Larry Peterson R., Hugues B. Massicotte, Lewis H. Melville, 2004. Mycorrhizas: Anatomy and Cell Biology, CAB International, UK.
12. Measuring and monitoring fungal diversity 1999 G. Mueller, A.Y. Rossman andG.F. Bills Smithsonian Institution press, Washington DC.
13. Microbial diversity and ecosystem function1995 Allsopp, D. R.R. colwell and D.L. Hawksworth, CAB international Wallingford U.K.
14. Modern soil microbiology1997, J.D. Van Elsas, J.T. Trevors and E.M.H. Wallington Morcal Dekker, Newyork.
15. Pelezar, M. J., Chan, E. C. S and Kreig, N. R. (1993). Microbiology-concepts and Applications. McGraw Hill, Inc. New York.
16. Powar, C. B. and Daginawala, H. F. (1982). General Microbiology Vol.II. Himalaya Publishers, Bombay. Rao, A. S. (2001). Introduction to Microbiology. Prentice Hall of India, New Delhi.
17. Sally E. Smith and David J. Read (2008). Mycorrhizal Symbiosis. 3rd edn. Academic Press, New York.
18. The fungi an advanced treatise Vol I-IV Ainsworth and Sussman A.S. 1965,1966,1968,1973 Academic Press Newyork.

## **1.2 Biodiversity and Conservation Biology**

Teaching Hours per Week: 4  
No. of Credits: 4

### **Unit I**

**12 HOURS**

Biodiversity: Definition, levels of diversity - genetic, species and ecosystem diversity. Endemism - concept, types, endemism in Western Ghats, Biodiversity hotspots - general and with special reference to India; Mega-diversity regions. Importance of biodiversity, magnitude and distribution of Biodiversity. Biodiversity documentation assessment - Inventory and monitoring, Biodiversity indices, Biodiversity database.

### **Unit II**

**13 HOURS**

Threats to biodiversity, IUCN threatened plant categories, methods of conservation: In-situ

methods – Protected area network, National parks, Biosphere reserves, sacred grooves.  
Ex-situ methods: Botanical gardens, Germplasm collection seed bank, pollen bank. Human wildlife conflict, conservation case studies.

### **Unit III**

**13 HOURS**

Environmental movements: Global and regional. Environmental laws: Forest Conservation Act, Biodiversity bill (2002); Community Biodiversity Register (PBR); Convention on International Trade in Endangered Species (CITES), Ramsar Convention, Intellectual Property Rights (IPR).

### **Unit IV**

**12 HOURS**

Biodiversity Management: Sustainable development, Environmental Impact Assessment (EIA) Ecological restoration, Aforestation, Green belt, Social forestry, Agro forestry. Remote sensing and biodiversity management.

### **Reference:**

1. Ahmedullah, M. and M.P. Nayar, 1986. Endemic plants of the Indian region. Vol 1. Botanical Survey of India.
2. Krishnamurthy K V 20014. An advanced text book of Biodiversity, Principles and Practice. Oxford and IBH Publishing Co. Pvt. Ltd.
3. Negi S S 1933. Biodiversity and its conservation in India. Indus Publishing Company, New Delhi
4. Primack, Richard B 2006. Essentials of conservation biology, 4th edition, Sinauer Associates, Sunderland, Mass.
5. Rao R R 1994. Biodiversity in India (floristic aspects). Bishen Singh Mahendra Pal Singh, Dehradun.
6. Ravikumar K and D K Veda 2000. Illustrated field guide to 100 redlisted medicinal plants of conservation concern in Southern India.

## **1.3 Systematic Botany of Angiosperms**

Teaching Hours per Week: 4

No. of Credits: 4

### **Unit I**

**13 HOURS**

Brief history and development of plant classification, Importance and need for classification, hierarchical classification. phases of plant classification. Overview on pre- and post-Darwinian systems of classification. Artificial systems of classification - Herbalists, Theophrastus, Linnaeus Natural system of classification - Bentham and Hooker, Phylogenetic systems of classification - Cronquist, Takhtajan, APG system of classification, APweb.

### **Unit II**

**12 HOURS**

Botanical Nomenclature: Need for scientific names, history of botanical nomenclature. Principles of ICBN, typification, rule of priority, ranks of taxa and nomenclature of taxa,

effective and valid publication, Author citation, retention, choice and rejection of names and epithets, conservation of names, names of hybrids, names of cultivated plants.

### **Unit III**

**12 HOURS**

Tools of taxonomy: Tools of taxonomy: Floras, monographs, revisions, websites, Artificial dichotomous keys.

Herbarium methodology, significance of herbaria, floras

Botanical Survey of India Botanical Survey of India - organization and contributions of BSI

Taxonomic evidence: Chemotaxonomy, Cytotaxonomy, Embryology as taxonomic evidence.

Brief account of numerical taxonomy.

### **Unit IV**

**13 HOURS**

Major clades in APG-IV: characteristic features (APG-IV), Study of the following families with economic important, systematics and phylogeny: Magnoliaceae, Menispermaceae, Capparidaceae, Caryophyllaceae, Meliaceae, Oxalidaceae, Balsaminaceae, Meliaceae, Droseraceae, Combretaceae, Melastomataceae, Cactaceae, Sapotaceae, Oleaceae, Gentianaceae, Lentibulariaceae, Podostemaceae, Piperaceae, Myristicaceae, Lauraceae, Loranthaceae, Moraceae, Orchidaceae, Zingiberaceae, Commelinaceae, Araceae, Cyperaceae, Poaceae.

### **Reference Books:**

1. APG III, 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Botanical Journal of the Linnean Society 161: 105 –121.
2. Bennet, S.S.R. 1979. An Introduction to Plant nomenclature. International Book Distributors. 9/3. Rajpur Road, DehraDun 248001. India.
3. Bhattacharya B. and B.M. Johre. 1998. Flowering plants Taxonomy and phylogeny. Narosa Publishing House, New Delhi. Gurucharan Singh, 1999.
4. Current Concepts in Plant Taxonomy. Academic Press, London. Heywood V.H., 1976. Botanical Systematics, Academic Press London.
5. Flora of peninsular India. <http://flora-peninsula-indica.ces.iisc.ac.in/>.
6. Flora of World online. <http://www.worldfloraonline.org/>
7. Heywood, V.H. and Moore, D.M. 1984.
8. Lawrence, H.M., 1966. Taxonomy of vascular plants. The Mac Millan Company, New York. Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.
9. Plant systematics - Theory and practice. Oxford and IBH Publishing Co., Pvt Ltd., New Delhi.
10. Plant Taxonomy and Biosystematics (2<sup>nd</sup> Edition. Edward Arnold Ltd., London. Singh G., 1999. Plant Systematics, Oxford and IBH, New Delhi
11. Singh, G. 2009. Plant systematics: an integrated approach. Science Pub Inc.
12. Sivarajan V.V., 1985. Introduction to Principles of Plant Taxonomy, Oxford and IBH Publication, New Delhi. Stace, C.A. 1989.
13. Stevens, P. F. (2001 onwards). Angiosperm Phylogeny Website. Version 9, June 2008 [and more or less continuously updated since]. <http://www.mobot.org/MOBOT/research/APweb/>.

## **1.4 Evolutionary Biology and Plant Geography**

Teaching Hours per Week: 4

No. of Credits: 4

### **UNIT I**

**12 HOURS**

Origin of Life – A biogenesis, Hypothesis of panspermia. Theory of Chemical of evolution, origin of life at molecular level process- structure of Cosmos primitive earth, prebiotic synthesis, origin and evolution of RNA world, Ribonucleoprotein, adaptive radiation in progenote, Evolution of Eukaryotes – Endosymbiotic hypothesis, theories of evolution- Lamarckism Neolamarckism, Darwinism, Neo-Darwinism, Germplasm theory, Mutation theory and Synthetic theory.

### **UNIT II**

**13 HOURS**

Population genetic and Evolution – Madeline population, gene pool, gene frequency, genetic drift, founder effect, genetic polymorphism, Hardy Weinberg's Law, Genetics equilibrium and mechanism of speciation. Patterns of evolution in plants- Evolution of vegetative, reproductive structure in Algae, Fungi, Bryophytes, Pteridophytes and spermatophytes (Evolution of sporophytes in Bryophytes). Steelar evolution in Pteridophytes, Heterospory and seed habit. Fossil forms- Lepidodendron, Lepidocarpon, Stigmara.

### **UNIT III**

**13 HOURS**

Plant Geography: Principles of Plant Geography- Origin of islands and Continents. Plant tectonics and Continental drifts. Center of origin of cultivated plants-Vavilocenters and Zhukoskycenters with plants in each region.

Cladistics: Introduction – advantages and problems. Cladistics (Phylogeny) – concepts, parsimony, cladograms and trees; characters: apomorphic and plesiomorphic characters, homologous vs analogous; character states, binary and multistate characters.

### **UNIT IV**

**12 HOURS**

Plant distribution and Plant migration- Floristic regions of the world. Phytogeographical regions of India, Hansen's classifications, distribution of plants based on altitude and latitude, contisin, tricontisin and endemic distribution. Age and area hypothesis- Wills theory. Plant migration and barriers for plant migration.

### **References**

1. Darwin, C. 1859. On the Origin of Species. London: John Murray (always seek out the first edition, facsimile version, and avoid later editions)
2. Michael George Simpson, 2006. Plant systematics. Elsevier Academic Press. Nei, M. & S. Kumar, 2000. Molecular Evolution and Phylogenetics. Oxford University Press Inc.
3. Peter Skelton and Andrew Smith, 2002. Cladistics: A Practical Primer on CD-ROM with accompanying booklet by Neale Monks. Cambridge University Press.
4. Strickberger, Monroe W. 2000. Evolution. 3rd Ed., Jones & Bartlett Publishers, Inc. 40 Tall Pine Drive Sudbury, MA 01776, United States of America.
5. Futuyma, Douglas J. 2005. Evolution. Sinauer Associates, Inc., 23 Plumtree Road, Sunderland, MA 01375, United States of America.
6. Dodson E. O. and Dodson P. 1976. Evolution: Process and Product. 2nd Ed., D. Van Nostrand Company, 450 West 33rd Street, New York, N.Y. 10001



**PRACTICALS 4 hours per week**  
**Practicals - I: (1.1 - Microbial Diversity)**

- 1) Laboratory guidelines, design, tools, equipments and other requirements for studying microorganisms.
- 2) Preparation of media sterilization, inoculation.
- 3) Observation and identification of mycoplasma and Spiroplasma their related genera
- 4) Bacterial smear positive and negative staining.
- 5) Gram staining acid fast staining cell wall staining
- 6) Bacteria in milk, curd and root nodules.
- 7) Estimation of soil microbes.
- 8) Streak plate method and air borne microbes.
- 9) Vegetative organization in fungi.
- 10) Asexual and sexual reproduction in fungi.
- 11) Different fruiting bodies in fungi.

**Practicals - I: (1.2 - Biodiversity and Conservation Biology)**

1. Study of endemic plants (a minimum of 10) - their taxonomy - distribution, threats, status and economic use, if any.
2. Study of the locally available medicinal and Economic important plants (a minimum of 10 for each) - Distribution, origin, taxonomy, status, parts used and uses.
3. Remote sensing application - vegetation mapping.
4. Rapid EIA (Environmental impact Assessment)
5. Calculation of Biodiversity indices -Shannon and Simpson index.
6. Calculation of Frequency, density and abundance of species in population.
7. Field visit to Forest ecosystem/ Wetland ecosystem/ a sacred groove.

**Practicals - II: (1.3 - Systematic Botany of Angiosperms)**

1. Identification of plants to the family, genus and species level using keys (Cook's flora, Gamble's flora or Flora Karnataka by Saldanha Flora of peninsular India and world flora online can be used.)
2. Preparation and submission of 10 herbarium sheets (Use very commonly available species for herbarium preparation, strictly avoid collecting rare plants)
3. Field trips to nearby floristically rich areas.

**Practicals- II (1.4 -EVOLUTIONARY BIOLOGY AND PLANT GEOGRAPHY)**

1. Study of homologous, analogous and vestigial organs with suitable examples.
2. Study of molecular evolution with suitable examples.
3. Patterns of Evolution in plants-vegetative and reproductive structures in Algae and Fungi.
4. Evolution of Sporophytes in Bryophytes.
5. Stellar evolution in Pteridophytes.
6. Study of Heterospory
7. Study of fossil forms –Lepidodendron, Lepidocarpon, Stigmaria and Lygenopteris.
8. Study of center of origin of cultivated plants.
9. Plant Phytogeography.
10. Plant migration and distribution with examples.
11. Study of adaptive radiation, micro and macro evolution with examples
12. Calculating gene frequencies in population by Hardy-Weinberg law.
13. Study of Vavilov centers and Zhukovsky centers with plant in each region.

**Note: New practical may be added with the permission of BoS in Botany.**

## **II SEMESTER**

### **2.1 Biochemistry and Biophysics**

Teaching Hours per Week: 4

No. of Credits: 4

#### **Biochemistry**

##### **UNIT I**

**13 HOURS**

Physical and chemical properties of water, nucleotides, nucleic acids structure of nucleotides and poly nucleotides. Chemical and physical properties of nucleic acids. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Amino acids- peptide bonds, classification and characteristics of amino acids. Proteins-primary structure, secondary structure-alpha-helix and beta sheets, solubility of protein, protein sequencing methods, protein conformation-Fibrous and globular proteins, protein folding, Ramachandran Plot, Hydropathic index, solid phase synthesis of polypeptides, protein denaturation.

##### **UNIT II**

**12 HOURS**

Carbohydrates-A brief account of monosaccharide's and disaccharides, structure of starch cellulose, pectin and chitin. lipids-lipid classification and chemical structure and physical properties of saturated and unsaturated fatty acids.

Enzymes- nature and classification of enzymes, enzyme specificity, reaction rates and activation energy, enzyme kinetics-Micheaelis-Menten equation, Line weavers Burk plot. Kinetics of Bisubstrate reactions. Enzyme inhibition.

#### **Biophysics**

##### **UNIT III**

**12 HOURS**

Atoms, bonds and molecules. Basic principles of diffusion, osmosis and viscosity, and their application in biology. Electromagnetic radiation-electromagnetic spectrum and light scattering absorption and emission of electromagnetic radiations by biomolecules. Fluorescence and phosphorescence. Theory of fluorescence-instrumentation, polarization and anisotropy of fluorescence. Fluorescence spectroscopy,UV spectroscopy, CD spectroscopy for proteins structure determination.

##### **UNIT IV**

**13 HOURS**

Nuclear Magnetic Resonance: The phenomenon of energy absorption and relaxation, chemical shifts. Instrumental; techniques –Proton NMR, C-13 NMR, P-31 NMR, two dimensional NMR-FINMR, solid state NMR, Magnetic resonance imaging. Mass spectrometry- basic theory and instrumentation, general modes of fragmentation Gas Chromatography and Mass Spectroscopy (GCMS), FTIR spectroscopy and LASERS its applications in biology and medicine.

#### **References:**

1. Principles of Biochemistry (2000) lehningermacmilon , worth publisher.

2. Fundamentals of Biochemistry (1999) D. Voet, J.G. Voet and C. W. Pratt, John Wiley and sons.
3. Biochemistry (1998) K. C. Van Holde, W.C. Johnson and P. Shing Prentice Hall International.
4. Essential of biophysics (2000) P. Narayan New Agri International publishers.
5. Modern Experimental Biochemistry (2000) R. Boyer, Benjamin, Cumming.
6. Fundamentals of Molecular Spectroscopy (1994) C.V. Banwell and E.M. Mccash, Tata McGraw –Hill publishing co. Ltd.

## **2.2 Developmental Biology of Plants**

Teaching Hours per Week: 4  
No. of Credits: 4

### **UNIT I**

**12 HOURS**

Differentiation and cell polarity in acellular (*Dictyostelium*) unicellular (*Acetabularia*, fucus egg, equisetum spore) systems, shoot apical meristems (SAM) origin structure and function organogenesis formation of auxiliary buds. Cytohistological zonation and biochemical activity in the shoot apex and ultra-structure of meristems, SAM mutant, Phyllotaxis positioning, transition to reproductive phase, vernalization – changes in the biochemical activity.

### **UNIT II**

**13 HOURS**

Mechanism of leaf primordium initiation and stomata formation, Developmental pattern at the flowering apex, ABC model, specification floral organs, molecular aspects of MADS box genes during flower development. Cellular differences in between floral organs. senescence a general account, root hair Formation, structure and function of root apical meristem (RAM) quiescent centre, origin of lateral roots, genetics of root development.

### **UNIT III**

**13 HOURS**

Androgenesis-Microsporogenesis and Micro gametogenesis- wall layers and functions; Tapetum- types, Histochemical, ultra-structural, genetical and fictional aspects concept and significance of male germ unit.

Gynogenesis- Ovular structure and types; Development of monosporic, bisporic, tetrasporic and special types of embryo sacs Histochemical, ultra-structural, genetical and fictional aspects concept and significance of female germ unit.

Pollination and fertilization-structural and functional aspects of pollen, stigma and styles in the current aspects of fertilization. Male sterility concept, causes and mechanism and present status.

## UNIT IV

12 HOURS

Embryogenesis- Cellular and biochemical aspects, composition and function of endosperm in relation to embryo development. Regulation of gene activity during zygotic embryogenesis, embryo suspensor-composition and function. Seed development and germination-Physiology and biochemistry expression of genes during seed germination. Seed dormancy and role of hormones Photo morphogenesis-photoreceptors, structure and function.

### References

1. Bell P.R. 2000 Green Plants, their origin and Diversity, Cambridge University Press,
2. Bhojwani, S. S.and Bhatnagar, S. P. 1978. The embryology of Angiosperms. Vikas Publishing House, New Delhi.
3. Eames, 1961. Morphology of Angiosperms. McGraw Hill book Co., Inc., New York.
4. Johri, B. M. 1982. The experimental embryology of vascular plants. Springer Verlag, New York.
5. Johri, B. M. 1984. The embryology of Angiosperms. Springer Verlag.
6. Maheshwari, P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill book Co., Inc., New York.
7. Maheshwari, P. 1963. Recent advances in the embryology of angiosperms. ed. New Delhi
8. Raghavan V. 1986 Embryogenesis in Angiosperms, Cambridge University Press Cambridge.
9. Robert F. Lyndon 1988 The Shoot Apical Meristem, Cambridge University, Press, UK.
10. Swamy, B.G.L. & Krishnamurthy, K. V. 1982. From flower to fruit: The embryology of angiosperms. Tata McGraw Hill Co. New Delhi.
11. Wearing P.F. and Philips, I.D.S.1981 Growth and Differentiation in Plants. Pergamon

## Paper-2.3: Genetics and Plant Breeding

Teaching Hours per Week: 4

No. of Credits: 4

### Unit I

13 HOURS

Transmission Genetics: An over view of Mendelian Genetics, extension of Mendelian's principles-Quantitative inheritance, multiple alleles, lethal allele. Extra nuclear inheritance: Inheritance of mitochondrial and chloroplast genes, male sterility in plant.

Sex determination: Role of chromosomes and hormones in sex determination, molecular basis of sex determination and dosage compensation in man and Drosophila, Genetic disorders in man and their managements, Genetic testing and counselling, sex determination in plants.

**Unit II****12 HOURS**

Population Genetics: Population and gene pools, Allele frequencies and genotype frequencies, Hardy-Weinberg's Law, Factors effecting allelic frequencies in population- Mutation, Migration, Non-random mating, selection, genetic drift, genetic equilibrium.

Linkage and crossing over, Cytological and molecular basis of crossing over, Recombination: -homologous and non-homologous, Linkage maps mapping by 2 point and 3-point test cross.

**Unit III****12 HOURS**

DNA as genetic material, Gene concept, Mechanism of DNA replication in prokaryotes and eukaryotes, Enzymes in DNA replication. Types and role RNA, Genetic Code-Contribution of Nirenberg and Khorana. Structural and numerical abnormalities.

**Unit IV****13 HOURS**

Plant Breeding: Mode of reproduction, methods of hybridization in self- and cross-pollinated plants, Plant Introduction, Domestication and acclimatization, patterns of evolution in crop plants. Heterosis-genetic basis of heterosis. Breeding plants for resistance to abiotic and biotic stresses. Marker Assisted Selection (MAS) in plant breeding.

**References:**

1. Concept of Genetics 4th Ed: William S Klung and M R Cummings
2. Elementary Principles of Plant Breeding, Chaudhary H K.
3. Genetics 4th Ed: Susan Elrod and William Stan field.
4. Genetics: Denial J Fairbanks.
5. Genetics: MW Stritckberger.
6. Genetics-Analysis and Principles: Robert J Brooker.
7. Heterosis, Frankel R and Bet Dagan.
8. Molecular Genetics: G S Stent.
9. Plant Breeding, Singh B D.
10. Plant Breeding-Theory and Practices, Chopra V L.
11. Principles and Practices of Plant Breeding, Sharma J K.
12. Principles of Genetics: D Peter Snustad et al.
13. Singh, B.D. (2005). Plant breeding: principles and methods. 7th edn.
14. Strickberger, M.W: Genetics (4th edn). Mcmillan Publishing company, New York.
15. The Human Genome: R Scott Hawley and Catherine and Mori.
16. Understanding GENETICS-A molecular approach. Norman V Rothwell.

### **2.5 Practical Based on 2.1**

1. Extraction of chloroplast pigments and demonstration of their absorption spectra.
2. Extraction of seed protein depending upon the solubility.
3. Estimation of protein by Lowry's method
4. Extraction of Chlorophyll pigment by paper chromatography
5. UV and Visible spectra of biomolecules.
6. Fractionation of proteins by gel filtration.
7. Estimation of phospholipids.

### **2.6 -Practical- IV Based on 2.2**

1. Microtome sectioning and histochemical stains (PAS, Protein and RNA).
2. Histochemical nature of matured shoots and root apices using thin sections (PAS, Protein, RNA and DNA) L.S. of Maize, Banyan roots.
3. Histochemical nature of floral meristems (PAS, Protein DNA, RNA)
4. Developmental and histochemical nature of anther/Ovule/Embryo (PAS, Protein, RNA) using available plant material.
5. In vitro pollen germination to find out the percentage of viability and also the effect of volatile substances on germination and tube growth use different methods of culture (hanging, sitting suspension, surface).
6. Acetolysis test to demonstrate the nature of pollen wall.
7. Study to composition of wet and dry stigmatic papillae (Esterase, peroxidase, RNA, Proteins, PAS)
8. Multiple staining for localizing pollen tubes in the pistil.
9. DNA fluorochromes to study the nuclei of pollen grains and pollen tube.
10. Study of different types of endosperm, isolation of different embryonic stages.

### **2.6 -Practical –IV Based on 2.3**

1. Preparation of stains, Fixatives, preservatives and pre-treatments to plant material.
2. Study of mitosis.
3. Preparation of karyotypes using Feulgen technique
4. Determination of mono, dihybrid and test cross ratio.
5. Mutation induction by EMS
6. Polyploidy induction by Colchicines
7. Genetics problems on linkage and crossing over, gene mapping and population genetics.
8. Techniques of Emasculation and hybridization.

## OPEN ELECTIVE: MEDICINAL BOTANY

Teaching Hours per Week: 4

No. of Credits: 4

### Unit 1

12 HOURS

History, scope and importance of medicinal plants. A brief account of Indigenous medicinal sciences- Ayurveda, Siddha and Unani. Brief account of herbal formulations and preparations.

### Unit II

13 HOURS

Plant identification- Elementary knowledge of Binomial nomenclature- Outline of Bentham and Hooker classification, Herbarium techniques and deposition of specimen in herbaria, Ethnic communities of India. Ethnobotany and folk medicine, Applications of ethnobotany.

### Unit III

13 HOURS

Study of some important medicinal plants with reference to their systematic position, diagnostic features, methods of propagation and medicinal uses of *Solanum trilobatum*, *Cardiospermum halicacabum*, *Vitex negundo*, *Adathodavasica*, *Azadirachta indica*, *Gloriosa superba*, *Eclipta alba*, *Aristolochia indica*, *Phyllanthus amarus*, *Boerhaaviadiffusa*, *Curcuma longa*, *Ocimum sanctum*, *Centella asiatica*, *Aloe vera*, *Coleus forskohlii* and *Costus speciosus*.

### Unit IV

12 HOURS

Methods of preparation of herbal extracts and phytochemical analysis. Antibacterial and antifungal activity assay of herbal extracts, Medicinal plants and plant products used in the treatment of Jaundice, cardiac problems, infertility, cancer and diabetes. Conservation of medicinal plants- In situ and Ex situ. IPR and Patenting.

### Practicals:

1. Identification and medicinal value of locally available medicinal plants.
2. Morphology of the useful parts of important medicinal plants.
3. Methods of propagation of important medicinal plants.
4. Demonstration of solvent/s extract/s preparation using Soxhlet apparatus.
5. Demonstration of antibacterial/ antifungal activity using medicinal plant extracts.

### References:

1. Trivedi, P. C. (2006). Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, (2008). Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
3. Yoganarasimhan, S. N. Medicinal Plants of India- Vol 1- Karnataka, Interline Publishing Pvt.
4. Gokhale, S. S., Kokate, C. K. and Purohit, A. P. (1994). Pharmacognosy. NiraliPrakashan. Pune.
5. Tyagi and Dinesh Kumar (2005). Pharma Forestry. Field Guide to Medicinal Plants. Atlantic Publishers and Distributors, New Delhi.
6. Singh and Jain (1985). Taxonomy of Angiosperms. Rastogi Publications, Meerut.
7. Sinha R. K. and Shweta Sinha (2001). Ethnobiology. Surabhe Publications – Jaipur.

8. Pal, D. C. and Jain, S. K. (1998). Tribal medicine. Naya Prakash, Bidhan Sarani, Calcutta.
9. Jain, S. K. (1995). Contribution to Indian ethnobotany. 3rd edition, Scientific publishers, Jodhpur, India.
10. Jain, S. K. (1995). A Manual of Ethnobotany , 2nd edition.
11. John R. Dean. (2010). Extraction Techniques in Analytical Sciences John Wiley & Sons, Ltd. UK.
12. Surhone, L. M., Tennoe, M. T. and Henssonow, S. F. (2011). Soxhlet Extractor. Betascript Publishing. Germany.
13. Schwalbe, R., Moore, L. S. and Goodwin, A. C. (2007). Antimicrobial susceptibility testing protocols. CRC Press, Taylor and Francis Group, Boca Raton, London, New York.



### **III SEMESTER**

#### **3.1 PLANT PHYSIOLOGY**

Teaching Hours per Week: 4

No. of Credits: 4

##### **UNIT-I.**

**12 HOURS**

Bioenergetics - First and second law of thermodynamics. Relation between free energy change and equilibrium constant. Reduction potential. Relation between reduction potential and free energy change. Water uptake, transport and transpiration, Stomatal physiology, mechanism and regulation of guard cell Hexose catabolism – Study of Glycolysis and citric acid cycle and its regulation.

##### **UNIT-II.**

**13 HOURS**

Oxidative phosphorylation and photophosphorylation. Electron transfer reaction in mitochondria. Light absorption by chloroplast pigments. Light harvesting complexes. Macromolecular organization of chloroplast membranes. Carbohydrate biosynthesis and inter conversions. Photosynthetic carbon reduction cycle and its regulation. C4 pathways and photorespiration. CAM plants. Biosynthesis of sucrose, starch and cellulose.

##### **UNIT-III.**

**13 HOURS**

Lipid metabolism – fatty acid biosynthesis and oxidation. Biosynthesis and catabolism of storage lipids. Biosynthesis and functions of membrane lipids. Membrane transport – organization of transport at plasma membrane and Tonoplast pumps, carriers and ion channels, P-type and V- type, ATPases, ABC transporters. Regulation of membrane transport in guard cells.

##### **UNIT-IV.**

**12 HOURS**

Nitrogen metabolism – uptake of nitrate and its reduction; catalytic and genetic regulation of nitrate reductase. Symbiotic nitrogen fixation, mechanism of action of nitrogenase. Plant growth regulators-synthesis, mechanism of action and functions of auxins, gibberellins, cytokinin's, ethylene, abscisic acid.

#### **REFERENCES:**

1. Essential of Biophysics, P. Naryanan. New Agri International publisher, 2000.
2. Fundamentals of Biochemistry. D. Vote, J.G. Vote, and C.W. Pratt, John Wiley and Sons 1999.
3. Physical Biochemistry, K.E Van Holde, W.C. Johnson and P. Shing Ho, Prentice Hall International IN. 1998.
4. Plant Biochemistry, P.M dey and J.B. Harborne, Harcourt Asia Ltd. Academic press, 1997.
5. Salisbury F.B. Plant Physiology. Thomson.
6. Signal and Signal transduction pathways in plants. K. Palme (Ed.) Kluwer Academic publishers 1994.

7. Smith H. Phytochrome and photomorphogenesis: An introduction to the photocontrol of plant development. McGraw Hill London.
8. Taiz L. and Zeiger E. Plant Physiology. Panima, New Delhi.
9. Zimmermann M.H. Xylem structure and ascent of sap. Springer.

### **3.2 CELL AND MOLECULAR BIOLOGY**

Teaching Hours per Week: 4  
No. of Credits: 4

#### **UNIT-I**

**13 HOURS**

Microscopy: Concepts and applications of Light, Phase contrast, Fluorescent and Electron microscopy. Autoradiography, Cell fractionation and Centrifugation technology.

Chromosome: Organization of chromatin – nucleosome model, Euchromatin and heterochromatin, constitutive and facultative heterochromatin, rearrangement, repetitive and non-repetitive DNA, C-value paradox, structure and organization of telomere, centromere and kinetochore.

Central dogma of molecular biology, Fine structure of gene, Concept of split gene, Gene families, Overlapping gene, Pseudo gene and cryptic gene. Molecular markers and their applications.

#### **Unit – II**

**12 HOURS**

Cell cycle- Regulation of CDK-cyclin activities, cellular check points, DNA damage and repair-Excision repair, Post replication repair, Mismatch repair, SOS response and mutagenesis, transcription couples repair in prokaryote and eukaryotes.

Mutation: Chemical and radiation mutagens, molecular basis of mutations and their role in evolution and cancer development. Oncogenes, Proto-oncogenes, P53 gene, Tumour suppressor genes, RB gene, E2F gene, RAS genes.

#### **Unit – III**

**12 HOURS**

Transposable elements: Retro-elements, mechanism of transpositions, Prokaryotic transposons: Insertion and composite sequences, AC-DS elements in Maize, Transposable elements in man, Applications of transposons in research and health care system. Human genome project.

Expression of Genome: Transcription - RNA polymerase-types, structure and function, mechanism of transcription-initiation, elongation and termination in prokaryotes and eukaryotes. RNA processing-capping, polyadenylation, splicing, alternate splicing, exon shuffling, structural organization of m-RNA, t-RNA and r-RNA, m-RNA transport.

## Unit – IV

13 HOURS

Translation: t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins.

Gene regulation in prokaryotes: Concept -Lac operon-positive and negative control, tryptophan operon, Gene regulation in phages and viruses, A detailed study of Gene regulation in eukaryotes.

### References:

1. A.K. Tobin, 1992, Plant organelles compartmentation of Metabolism in Photosynthetic tissue, Cambridge University, Press.
2. G. Shanmugam, 1988, Cell Biology Lab Manual, Mac. Millan, India Ltd., Madras.
3. Gamer, E.J. and Sherstal. D.P. Principles of Genetics, 6th Ed. John Wiley and Sons, New York, Garland Publishers, 1999
4. Genes IX– Benjamin Lewin, Jones and Bartlett, 2008
5. Genes X– Benjamin Lewin, Jones and Bartlett, 2011
6. George, M. Malacinski, 1986, Macmillan publishing co., New York. Molecular Genetics of Mammalian cells.
7. H.S. Bhamaah, 1990, Molecular cell Biology, Anmol Publication New Delhi.
8. H.S. Bhamrah, 1990. Molecular cell Biology, Anmol Publications, New Delhi.
9. Herkowitz, I.W. 1977, Principles of Genetics, 2nd Ed. Macmillon Publ. Co., New York.
10. James Jorwell, Honey Ladish, 1986. Molecular cell biology scientific American Books. New York. P.S. Verma and V.K. Agarwal, 1999. Cell Biology and Genetics S. Chand and company Ltd., New Delhi.
11. Lewin B. 2004. Genes 8th Ed. John willey and sons. New York.
12. Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD.
13. Prescott, D.M. 1988 Cells: Principles of Molecular structure and function. Jones and Bortlet pub. Boston.
14. Reeta Arora, 1988. Cell Biology, Anmol Publications New Delhi
15. G. Shanmugam, 1998. Cell Biology Lab Manual, Macmillan India Ltd., Madras.
16. Roerl Miesfeld, 1999, Applied Molecular Genetics, Wiley's Liss Publication.
17. S.C. Rastogi, 1995, Concepts, in Molecular Biology. Reeta Area, 1998, Cell biology, Anmol Publications, New Delhi.
18. Strickberg, M.W. 1985. Genetics 3rd Ed. Macmillan Pub. Co., New York.
19. Syenga. I. 1972, General cytogenetics, North Hapland Pub. Co.
20. Waston, I.D. Et. Al. 1965. Molecular, Biology of the gene. 4th Ed.

### 3.3 MEDICINAL PLANTS AND HERBAL DRUG TECHNOLOGY

Teaching Hours per Week: 4

No. of Credits: 4

#### UNIT-I.

**12 HOURS**

History, scope and importance of medicinal plants. A brief account of Indigenous medicinal sciences- Ayurveda, Siddha and Unani. Brief account of herbal formulations and preparations. Ethnic communities of India. Ethnobotany and folk medicine, Applications of ethnobotany. Organization and institutes: national medicinal plant board (NMPB) foundation for revitalization of local health tradition (FRLHT) national botanical research institute (NBRI) central institute for medicinal [ and aromatic plants (CIMAP) AYUSH

#### UNIT-II

**13 HOURS**

Importance & scope of post-harvest management of crop, fruits and vegetables in Indian.Economy, Importance of post-harvest loss management in crops, flowers and fruits.Pre- and Post-harvest factors affecting shelf life of crops, flowers and fruits. Packing techniques- grading, containers, cushioning, vacuum packing, canning, bottling, freezing, dehydration, drying, UV and Ionizing radiations. Principles of preservation by heat, low temperature, chemicals and fermentation. preservatives and colors permitted and prohibited in India. Storage techniques- Zero Energy Cold Storage Chambers and On Farm Storage facilities.Microbial contaminants and post-harvest pathology in crops, flowers and fruits.

#### UNIT-III.

**12 HOURS**

Database of medicinal plants, Methods of preparation of herbal extracts and phytochemical analysis. Antibacterial and antifungal activity assay of herbal extracts, Medicinal plants and plant products used in the treatment of Jaundice, cardiac problems, infertility, cancer and diabetes. Conservation of medicinal plants- In situ and Ex situ. IPR and Patenting, threatened medicinal plants.

#### UNIT-IV

**13 HOURS**

Method of isolation and estimation of the following drugs; Forskolina from *Coleus forskoalii* L-Dopa from *Mucunapuriensis* Alicin- *alliun sativa* Piperine from *piper nigrum* Catechines from *camellia sinensis* (green tea). Study of some important medicinal plants with reference to their systematic position, diagnostic features, methods of propagation and medicinal uses of *Solanum trilobatum*, *Cardiospermum halicacabum*, *Vitex negundo*, *Adathodavasica*, *Azadirachta indica*, *Gloriosa superba*, *Eclipta alba*, *Aristolochia indica*, *Phyllanthus amarus*, *Boerhaaviadiffusa*, *Curcuma longa*, *Ocimum sanctum*, *Centella asiatica*, *Aloe vera*, *Coleus forskohlii* and *Costusspeciosus*.

## References:

1. Cultivation of selected Medicinal Plants published by National medicinal plants board, Department of AYUSH, Ministry of Health and Family Welfare Government of India, Chandralok Building, 36, Janpath, New Delhi 110001.
2. Dynamics of Medicinal and Aromatic Plants by Singh, H.P., Sunita T. Pandey and Babita Singh. Indus valley Publication
3. Demand and supply of Medicinal Plants in India by D.K. Ved and G.S. Goraya by Gajendra Singh Gahlot for M/s Bishen Singh Mahendra Pal Singh, Dehra Dun, India and Foundation for Revitalisation of Local Health Traditions Bangalore, India.
4. Handbook of Horticulture Edited by K.L. Chadha and published by Directorate information and publication of Agriculture, Indian Council of Agricultural Research Krishi Anusandhan Bhavan, Pusa, New Delhi 1100 12.
5. Aromatic and Medicinal Plants by M.P. Shiva, AlokLehri and Alka Shiva. International Book Distributors, 9/3, Raipur Road, 1st floor, P.Box No. 4, Dehradun248 001.
6. Medicinal Plants Field and Laboratory Manual for identification with its phytochemical and in vitro studies data by S. Farooq. International Book Distributors, 9/3, Raipur Road, 1st floor, P.Box No. 4, Dehradun248 001.
7. Indian Medicinal Plants – Kirtikar and Basu, B.O.
8. The Medicinal and Poisonous Plants of India – J.F.Calus
9. Medicinal Plants of Arid Zone – UNESCO Publication
10. Some Useful Aromatic Plants – R.L. Bachawar
11. Indigenous Medicinal Plants – P. Kaushik
12. Drug Plants of India – V.S. Agrawal and B.Ghosh.
13. OshadhiDarshani (Information on cultivation of medicinal plants, growers and traders compiled by Dr. K.P. Srivasuki. Publied by Andhrapradesh medicinal and Aromatic plants board, Hyderabad.
14. A Handbook of Medicinal Herbs by D.J. Despande. Published by Agrobios (India) AgroHouseAgro-technique of selected medicinal plants. CD published by National medicinal plants board, Department of AYUSH, Ministry of Health and Family Welfare Government of India, Chandralok Building, 36, Janpath, New Delhi 110001.
15. Phytosanitation, HACCP, GM fruits and vegetableFood Biotechnology, by Roges, A. 1989. Elsevier Applied Sci. Pub., London, U.K.
16. Functional Foods by Goldberg, I. 1994. Chapman and Hall, New York.
17. Postharvest physiology and storage of tropical and subtropical Fruits,2005, CABIPublishing.
18. Postharvest by Wills, Mcglasson, 2007, CABI.
19. Jain, S. K. (1995). Contribution to Indian ethnobotany. 3rd edition, Scientific publishers, Jodhpur, India. 10. Jain, S. K. (1995).
20. A Manual of Ethnobotany, 2nd edition. 11. John R. Dean. (2010). Extraction Techniques in Analytical Sciences John Wiley & Sons, Ltd. UK.

### **Practical-V Practical's based on 3.1**

1. Effect of time and enzyme concentration on the rate of enzyme action.
2. Effect of substrate concentration and pH on enzyme action.
3. Extraction of total lipids from plant tissue purification by column chromatography analysis by TLC
4. Determination of lipase activity in germinating seeds.
5. Determination of chlorophyll a/b ratio in C3 and C4 plants.
6. Crassulacean acid metabolism.
7. Estimation of proline from stressed plants.
8. Gibberellin induction of amylase activity in cereal grains.
9. Bioassay of Cytokinin concentration using test system of greening of cotyledons.
10. Effect of light, K, Ca and some inhibitions and against stomatal opening.
11. Determination of Photosynthesis rates in C3 and C4 plants using IRGA.

### **Practical-VI Practical's based on 3.2**

1. Identification of different stages of mitosis and study of morphology of metaphase chromosomes from Onion root meristems. (Allium/Maize)
2. Determination of chromosome number at mitotic metaphase and diakinesis/metaphase I of meiosis Maize/Allium/Rhoeo/Aloe/ Tradescantia and translocation heterozygote in Rhoeo.
3. Karyotype analysis in Allium and Aloe
4. Study of Polytene chromosome in Chironomus larvae/Fruit fly.
5. Estimation of DNA by Diphenyl method
6. Estimation of RNA by Orcinol method
8. Demonstration of microscopes (phase contrast, fluorescence, SEM, TEM) Charts and photographs and Videos.

### **Practical-VI based on 3.3**

1. Identification and medicinal value of locally available medicinal plants.
3. Methods of propagation of important medicinal plants.
4. Demonstration of solvent/s extract/s preparation using Soxhlet apparatus.
5. Demonstration of antibacterial/ antifungal activity using medicinal plant extracts.
6. Estimation of total amino acids in germinating and non- germinating seeds
7. Estimation of ascorbic acid in ripe and unripe fruits.
8. Agarose gel electrophoresis for separation of DNA Charts/models and photographs

### **3.4 OPEN ELECTIVE PLANT PROPAGATION TECHNIQUES (THEORY)**

Teaching Hours per Week: 4

No. of Credits: 4

#### **Unit-I**

**12 HOURS**

History, scope and importance of plant propagation, propagation structures, green house equipment's and media, seed propagation, structure of seeds, techniques of seed production types of seeds –recalcitrant, orthodox, post-harvest handling of seeds.

#### **Unit-II**

**13 HOURS**

Vegetative propagation: techniques of propagation by cutting, stem cuttings- hard wood, semi hard wood, soft wood and herbaceous, leaf cuttings, leaf bud cuttings, root cuttings. Biology and techniques of grafting: Whip and tongue, wedge and cleft, bark, side grafting approach.

#### **Unit-III**

**12 HOURS**

Techniques of budding: T- budding, patch budding chip budding ring budding. Layering and its natural modifications: simple layering tip layering, mound and stool layering air layering, compound and serpentine layering and trench layering. Propagation by specialized stem and roots

#### **Unit-IV**

**13 HOURS**

Micro propagation techniques: cell and tissue culture techniques, media, growth regulators, micro and macro nutrients, sterilization techniques, MS media, root, bud. Advantage, limitations and applications of vegetative propagation, clones, genetic variation in asexually propagated plants, different methods. Propagation methods of some selected plants – citrus, grape, mango, mulberry, hibiscus, rose, croton, eucalyptus, banana, orchids, papaya, watermelon, potato, tomato, chilly, coconut, pepper, anthurium. Nursery techniques: composting, green house, planting mixture, vermicompost.

#### **References:**

1. Abbott, A.J. and atkin R.K. 9eds (1987) improving vegetatively propagated crops, academic press, London.
2. Bose, T.K., Sadhu M.K. & Das, P. (1986) propagation of tropical and subtropical horticultural crops, Nowya Prakash, culcutta.
3. Hartmann and Kester (1983) plant propagation.
4. Hartmann H.T., kestere.D.davis, f.T. and geneve R.L. 1997 plant principle s and practices prentile hall of india private limited ,newdelhi.
5. Krishnamurthy H.M. (1981) plant growth substances including application in agriculture.
6. Pierik L.M. (1987) invitro culture of higher plantsmurtinusNijhoff pub. Dordrecht.

7. Razdan, M.K. (1994) an introduction to plant tissue culture, oxford and IBH pub.co. PVT Ltd. Bombay and Calcutta.
8. Mac Donald, B. (1987) practical woody plant propagation for nursery growers Portland OR timber press.
9. Sadhu, M.K. (1989) plant propagation Wiley eastern Ltd. New Delhi.

### **Practicals for open elective**

1. Vegetative propagation: types of cuttings
2. Vegetative propagation: tapes of grafting
3. Vegetative propagation: types of budding
4. Vegetative propagation: types of layering
5. Propagation by modified stems and
6. Propagation by modifies roots.
7. Micro propagation: preparation of media, preparation of explants, culture, initiation of shoot. Multiplication (demonstration)
8. Pot and green house implants (demonstration)



## **IV SEMESTER**

### **4.1 MYCOLOGY & PLANT PATHOLOGY**

Teaching Hours per Week: 4

No. of Credits: 4

#### **MYCOLOGY**

##### **Unit-I**

**12 HOURS**

Mycology: Present status of fungi; Outline classification of fungi (Ainsworth-1973). Vegetative organization in fungi; Nutrition in fungi (saprotrophs, biotrophs, necrotrophs; symbiotrophs); Methods of reproduction in fungi - Asexual and sexual methods; Spore liberation in fungi; Evolution of sex in fungi; Heterothallism and parasexuality; Life cycle pattern and phylogeny of Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina; Fungi and their economic importance. Somatic incompatibility – Systems in Ascomycetes and Basidiomycetes in culture and in nature, parasexuality.

##### **Unit-II**

**13 HOURS**

Fungal physiology: Nutrition of carbon, nitrogen, mineral, vitamin and growth regulators, metabolism and biosynthesis of carbohydrates (Including chitin) non carbohydrate (organic acids and lipids) and nitrogen (including lysine, amino acids, nucleic acids and proteins) secondary metabolites and their role. Fungal genetics: Fungi as organism for genetic study, genetic markers, isolation and selection of mutants, tetrad analysis. Industrial application of fungal genetics and strain improvements.

#### **PLANT PATHOLOGY**

##### **UNIT-III**

**12 HOURS**

Introduction and history of plant pathology – Plant diseases caused by fungi, bacteria, virus and nematodes, The concept of disease in plants, Classifications of plant diseases. Genetic engineering and plant pathology, Significance of plant diseases, Plant diseases and world crop production, Effects of changes in agricultural methods and in human society on the development and spread of plant diseases, Diagnosis of plant disease. Parasitism and disease development –Attack of pathogens: Mechanical force exerted by pathogens in host tissues, Chemical weapons to pathogens, enzymes, Microbial toxins on plant diseases, Growth regulators in plant diseases.

##### **Unit-IV**

**13 HOURS**

Plant defense mechanism against pathogens – structural metabolic pre-existing biochemical. Environmental effects on infections: Effect of temperature, soil, pH moisture, wind, light, Host – plant nutrition. Herbicides and pesticides. Plant disease epidemiology, The elements of an endemics, Measurement of plant disease, pattern, Comparison, Development, modeling computer simulation, forecasting of plant disease endemics. Management and control of plant diseases: Control methods that exclude the pathogen from the host, Control methods that

eradicate the pathogen inoculums. Cultural methods, Biological methods. Environmental factors that cause plant disease. General Chromatistics, Diagnosis, and control, Temperature effects, Moisture effects. Air pollution, nutritional deficiencies in plants. The often Confused Etiology of stress disease.

## References:

1. "A higher level phylogenetic classification of the Fungi". *Mycological Research* 111(5): 509–547. doi:10.1016/j.mycres.2007.03.004. PMID 17572334. 3. 21st century guidebook of fungi, David Moore, Geoffrey D. Robson, Anthony P. J. Trinci: Cambridge university press. 2011.
2. Agrios, G. N. 2005. *Plant Pathology* 5th edn. Academic Press, San Diego.
3. *An introduction to fungi*: by H.C. Dube, Scientific publisher India, fourth edition, 2015.
4. *Biodiversity of fungi: Inventory and Monitoring methods* by M. S. Foster, G. F. Wills and J. M. Mueller, first edition, Academic Press, 2004.
5. *Mycoremediation: Fungal Bioremediation* by Harbhajan Singh, first edition, John Wiley and Sons, Hoboken, New Jersey, 2006.
6. Dickinson, M. 2003. *Molecular Plant Pathology*, Garland Publishing Inc, CT.
7. *Fungal Biology* by J. W. Deacon, forth edition, Blackwell Publishing Ltd, 2006.
8. Hibbett DS, Binder M, Bischoff JF, Blackwell M, Cannon PF, Eriksson OE, et al. (2007).
9. Ingram, D.S. and Robertson, N.F. 1999. *Plant Diseases*, Collins Publishers, London.
10. *Introduction of Fungi* by John Webster and Roland Weber, Third edition, Cambridge
11. *Introductory Mycology* by Alexopolous J., Mims C. W. and M. Blackwell, fourth edition,
12. Johnston, A and Both, C. 1983. *Plant Pathologists Pocket-book*. 2nd edn. Commonwealth Mycological Institute, Oxford and IBH Pub. Co. Calcutta. Kolkata, 2007.
13. *Topics in Mycology and Pathology* by L. N. Nair, first edition, New Central Book Agency
14. University Press, 2007. Wiley India Pvt Ltd, 2007.

## 4.2 ECOLOGY AND ENVIRONMENTAL BIOLOGY

Teaching Hours per Week: 4

No. of Credits: 4

### Unit-I

12 HOURS

History and scope of ecology and environmental biology: ecosystem – concept, structure, types, components, functions and dynamics. Energy flow in the ecosystem, trophic levels food chains food web ecological pyramid. Biogeochemical cycle; hydrological cycle, gases nutrient cycle, and sedimentary nutrient cycle. Major terrestrial ecosystem of the world- deserts, grasslands, savanna, tundra, forest.

### Unit-II

13 HOURS

Population ecology- growth and characteristics of population natality, mortality, life table, age structure, concept of carrying capacity, concept of density dependent and density independent action in population control, Biotic community- concept, structure, dominance, fluctuation and succession, ecological niche- intraspecific and inter specific interactions allelopathy predation.-prey relationship.system ecology and ecological models.

### Unit-III

12 HOURS

Major aquatic ecosystems of the world- fresh water ecosystem, marine ecosystem, Plant indicators in pollution. Global environment problem, ozone depletion, global warming and climatic change. Basics of chemical ecology, Plant mimicry, Pollination ecology, carbon sequestration, Ecosystem services, Ecology and climate change.

### Unit-IV

13 HOUR

Study of Intellectual Property Rights – patents, trademark, geographical indication, copyright; IPR and Traditional Knowledge; Bio-piracy of traditional knowledge, National and international organizations and treaty related to traditional knowledge – WIPO, TKDL, TRIPS, CBD, Nagoya protocol. linkage between resources livelihood, energy security, sustainability, ecological planning.

### References:,

1. Muller Dombois J. And Ellenberg, H. (1974) aims and methods of vegetation ecology Wiley, new york.
2. Odum, E.P. (1971) fundamentals of Ecology, saunders, Philadelphia.
3. Kormondy, E. J. (1996) concepts of ecology, prentice hall, India, New Delhi.
4. Foin, T.C. (1976) ecological system and environment, Mifflin, boston.
5. Nobel B.J. and Wright, R.T. (1996) environmental science, prentice hall New Jersey.
6. Lillesand T.M. and Kiefer R.W. (1987) Remote sensing and image interpretation , John Wiley and sons, new York.

7. Agarwal, S.B. and Agarwal, M. (Ed.) (2000) environmental pollution and responses, CKC press, London.
8. Koshoo, T. N. (1991) environmental concept and strategies ashish publ. House, new delhi.
9. Colinvaux P.C. (1993) ecology John Wiley and Sons, New york.

### **4.3 PLANT BIOTECHNOLOGY**

Teaching Hours per Week: 4  
No. of Credits: 4

#### **Unit I**

**12 HOURS**

Introduction: Definition Old and New Biotechnology. An interdisciplinary activity, Scopes and importance, commercial potential, Biotechnology centres in India.

Genetic Engineering: Introduction, Genetic Engineering of microorganisms, Tools in Genetic Engineering Enzymes in genetic engineering - restriction endonucleases, types and their actions, other DNA modifying enzymes, Cloning vectors- plasmids isolation and purification - Ti Plasmid, pBR322, pUC-series. Phage vectors-M13 phage vectors, Cosmids -types, phasmids or phagemids, shuttle vectors-types; YAC and BAC vectors, Lambda phage vectors, Lambda phage DNA as a vectors, Cloning vectors and expression vectors, Vectors for plant cells, Direct transformation methods.

#### **UNIT II**

**13 HOURS**

Plant Tissue Culture: Scope and importance of plant tissue culture , Basic requirements for tissue culture laboratory, composition of tissue culture medium ,explants for organogenesis, Micro propagation, embryo and endosperm culture, somatic embryogenesis, variation and cell line selection, androgenesis and microspore culture, significance of haploids, diploidization and bulbosum technique, Somatic Hybrids- Isolation and protoplast culture and somatic hybridization and its significance, Somaclonal variations. Role of tissue culture technology in crop improvements.

#### **Unit III**

**13 HOURS**

Industrial Biotechnology: Introduction, Industrial microbial products: Alcohol production (Beer), Antibiotics production (penicillin), production of Vitamins (Vitamin B12), production of Single Cell Protein, Algal protein: (Spirulina) Fungal protein: (Mushroom) and economic aspects. Genetic engineering of plants for delayed ripening and better shelf life.

Biofuels: Introduction, Production of biogas, Structure of biogas plant, Biochemistry of methane production, Biogas research in India, Uses of biogas.

Biofertilizers: Introduction, Types, Blue green algae, Sea weeds, Azolla, Vesicular arbuscular mycorrhizal fungi and Rhizobium.

## Unit IV

12 HOURS

The genetic manipulation of herbicide resistance, strategies for engineering herbicide resistance, the environmental impact of herbicide-resistant crops, The genetic manipulation of pest resistance-GM strategies for insect resistance, *Bacillus thuringiensis* approach to insect resistance, insect resistant crops and food safety. Virus free plant production, Transgenic approaches to viral and bacterial disease resistance. Engineering for stress tolerance -The nature of abiotic stress, the nature of water deficit stress, targeted approaches towards the manipulation of tolerance to specific water deficit stresses.

## REFERENCES:

1. Glazer, A.N and Nikaido. H. 1995. Microbial Biotechnology. W.H.Freeman And co. New York.
2. Gliick Barnard and Pasternak, Jack.J.1996. Molecular Biotechnology principles and application of recombinant DNA: Pavan publishers. New Delhi.
3. Kumar.H.C. 1992. Text book on Biotechnology. East west press. New York.
4. Walker.J.M and Gingold. W.B. 1989. Molecular Biology and Biotechnology. 2nd edition. Royal Society of chemistry, London.
5. Keshav Trehan.1990. Biotechnology. Wiley Eastern/td. New Delhi.
6. Gaurd.R.S. Gupta.G.D and Gukhade.S.B.2000. Practical Biotechnology: Nirali park ashan publishers. Pune. 33
7. Firn.R.K and Prave.P Biotechnology. 1988. Hanser Publisher publication. New York.
8. Dube.H.C.1991. Fungi and Biotechnology. Today's and tomorrow's Printer and Publishers. New Delhi.
9. Stanbury.P.F and Whitaker.A. 1985. Principles and Fermentation technology pergaman press. Oxford.
10. Wiseman.A.1987. Hand book of enzyme Biotechnology. Ellis Horwood ltd. New York
11. Tejovathi.G, Vimala.Y and Rekha Bhadauria, 1996. A practical manual for plant Biotechnology. CBS publishers and distributors. New Delhi.
12. Narayanan. L.M., Selva Raj, A.M., Mani.A and Arumugam.N.1998. Molecular Biology and Genetic Engineering. Saras publication. Nagercoil. India.
13. Colin Ratledge and Bjorn Kristainsen.2004. Basic Biotechnology. Cambridge University press London.
14. Snyder.L. and Champness, W. 1997. Molecular Genetics of Bacteria. American Society for microbiology. Washington DC.
15. Asenjo, J.A.1990. Separation process in Biotechnology. Marcel Dekker, New York.

## 4.4 Research methodologies and Techniques in Botany

Teaching Hours per Week: 4

No. of Credits: 4

### Research Methodology

#### UNIT I

13HOURS

Foundations of Research: Meaning, Objectives, Motivation, Utility, types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology.

Methodology: Literature review, Defining the research question, Approaches and Methodology, Documentation and presentation of data, Analysis and interpretation of data, manuscript preparation.

#### UNIT II

12

#### HOURS

Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Botanical Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

### Techniques in Botany

#### UNIT III

12HOURS

Biostatistics: Measures of Central tendencies (Mean, mode, median,) Standard deviation, Dispersion and Variability. The variance and coefficient of variation, Correlation and regression, ANOVA, Chi square test for goodness of fit and independence.

#### UNIT IV

13HOURS

Computer application in Biology: bioinformatics, plant databases and their applications.

Culture Technique: Basic laboratory principles and techniques Principles, types, plant media preparation, sterilization, inoculation, Equipment's and instruments -Laminar air flow, autoclaves, thermo bath, and incubators.

### References

1. An Introduction to Biometry- Mungikar, A. M. (1997), Saraswati Printing Press Aurangabad.
2. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
3. Methods in Experimental Biology.-Ralph, R. (1975).Blakie, London
4. Plant Tissue Culture: Theory and Practice, a Revised Edition by S.S. Bhojwani and M.K. Razdan.
5. Research Methodology For Biological Sciences (01 Edition, 2013)- Gurumani, N. (2013), MJP Publishers
6. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

7. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995).  
Scientific writing for agricultural research scientists – a training  
reference manual. West Africa Rice Development Association, Hong  
Kong.

### **Practical-VII Practical's based on 4.1, 4.2 and 4.3**

1. Rhizosphere, Rhizoplane, phylloplane studies of fungi.
2. Fungal physiology – Growth on different carbon source media and nutritional studies.
- 3.. Disease of cereal crops. a) Blast disease of Rice. b) Yellow smut of wheat. c) Loose smut of wheat. d) Downy mildew of sorghum. e) Anthracnose of sorghum
4. Disease of plantation crops. a) Downy mildew of grapes. b) Leaf rust of coffee. c) Tikka disease of ground nut. d) Late blight of potato.
5. Estimation of spore production of fungal pathogens of leaves using Haemocytometer method.
6. Water Analysis: a. Estimation of BOD and COD
7. Estimation of PO<sub>4</sub>, SO<sub>4</sub> and NO<sub>3</sub>. c.
8. Estimation of Major Cations- Na, K, Ca, Mg and Salinity
9. Field excursion to an industrial area to assess environmental impact.