

**University of Mysore**  
**M.Sc. Botany Choice - Based Credit System (CBCS) Modified Syllabus- March 2015**  
**CORE SUBJECT: BOTANY – [Post Graduate]**

**DEGREE: B.Sc. Honors/ M.Sc. Botany**

**SEMESTER- I:**

**Credits: 22**

No	Paper Code	Title of the course paper	Hrs/wk L:T: P	Credits
1.	<b>HARD CORE 1.1</b>	Microbiology and Plant Pathology Theory & Practical	2:2:2	4
2	<b>HARD CORE 1.2</b>	Algae, Bryophytes, Pteridophytes and Gymnosperms-Theory & Practical	2:2:2	4
3	<b>HARD CORE 1.3</b>	Taxonomy of Angiosperms and Economic Botany – Theory & Practical # Field Study/ Tour	2:2:2	4+ 2=6
4	<b>SOFT CORE 1.1</b>	*To be Selected by the student	2:2:2	4
5	<b>SOFT CORE 1.2</b>	*To be Selected by the student	2:2:2	4
			<b>Total</b>	<b>14 + 08 = 22</b>

# Field Study/Tour: The student shall undertake a field trip of minimum of three days and shall submit the herbarium and report for evaluation for 02 credits (HC).

**SEMESTER- II:**

**Credits: 24**

No	Paper Code	Title of the course paper	Hrs/wk L:T:	Credits
1.	<b>HARD CORE 2.1</b>	Reproductive Biology of Angiosperms and Plant Morphogenesis-Theory & Practical	2:2:2	4
2	<b>HARD CORE 2.2</b>	Cell Biology and Genetics-- Theory & Practical	2:2:2	4
3	<b>HARD CORE 2.3</b>	Plant Breeding and Evolutionary Biology- Theory & Practical	2:2:2	4
4	<b>SOFT CORE 2.1</b>	*To be Selected by the student	2:2:2	4
5	<b>SOFT CORE 2.1</b>	*To be Selected by the student	2:2:2	4
6	<b>Open Elective 2.1</b>	Plant diversity and Human Welfare	2:2:2	4
			<b>Total</b>	<b>12 + 08 + 04 = 24</b>

**M.Sc. Botany: II Year/ M.Sc. Degree****SEMESTER-III****Credits: 18**

No	Paper Code	Title of the course paper	Hrs/wk L:T:	Credits
1.	<b>HARD CORE 3.1</b>	Plant Physiology and Biochemistry Theory & Practical	2:2:2	4
2	<b>HARD CORE 3.2</b>	Molecular Biology- Theory & Practical	2:2:2	4
3	<b>SOFT CORE 3.1</b>	*To be Selected by the student	2:0:2	3
4	<b>SOFT CORE 3.2</b>	*To be Selected by the student	2:0:2	3
5	<b>Open Elective 3.1</b>	Plant Propagation Techniques	2:2:2	4
			<b>Total</b>	<b>08 + 06 + 04 = 18</b>

**SEMESTER- IV****Credits: 20**

No	Paper Code	Title of the course paper	Hrs/wk L:T:	Credits
1.	<b>HARD CORE 4.1</b>	Ecology, Conservation Biology and Phytogeography- Theory & Practical	2:2:2	4
2	<b>HARD CORE 4.2</b>	***Project Work		8
3	<b>SOFT CORE 4.1</b>	*To be Selected by the student	2:2:2	4
4	<b>Open Elective 4.1</b>	Medicinal Botany	2:2:2	4
			<b>Total</b>	<b>12 + 08 + 04 = 20</b>

\*\*\*Project Work: The student shall undertake a Project Work in the Department or in any other University or Institute under the guidance of a Research Supervisor and shall submit a Project Report duly signed by Student and approved by the Research Supervisor which is evaluated as per University norms.

**Semester- Wise Credit Pattern:****I Semester= 22 [HC- 12+2=14 + 08 (SC)]****II Semester= 24 [HC- 12 + 08 (SC) + 04****(OE)] III Semester= 18 (HC- 08 + 06 (SC) +****04 (OE)] IV Semester= 20 (HC-12 +04 (SC)****+ 04 (OE)]**

**In total= 46 HC + 26 (SC) + 12 (OE)= The Department is offering 84 Credits of B.Sc. Honors/  
M.Sc. Botany (CBCS) Course including three Open Elective Course to the outside Department  
Students/**

**Important Note:**

**Student is required to earn the credit for qualifying B.Sc. Honors/ M.Sc. Botany from  
Department of Botany as follows:**

**Hard Core offered by the Department= 46 (Against maximum of**

**56) Soft Core offered by the Department = 26 (Against minimum**

**of 16)**

**Minimum Open Elective to be earned by the Student (Outside the Department) = 04**

**A total of 76 Credit is required for qualifying B.Sc. Honors/ M.Sc. Botany Course.**

**\*SOFT CORE COURSES - [Semester - wise]**

**Minimum requirement for Soft Core Paper: Candidate should have completed bachelor degree with Botany as Elective / Core subject**

<b>Sl. No</b>	<b>Semester</b>	<b>Title of the Soft Course Papers</b>	<b>Hrs/wk L:T: P</b>	<b>Credits</b>
1.	<b>I Semester</b>	Mycology	2:2:2	4
		Phycology	2:2:2	4
		Plant Pathology	2:2:2	4
2	<b>II Semester</b>	Plant Anatomy and Histochemistry	2:2:2	4
		Economic Botany	2:2:2	4
		Ethnobotany and IPR	2:2:2	4
3	<b>III Semester</b>	Plant Molecular Genetics	2:0:2	3
		Evolutionary Biology	2:0:2	3
		Plant Biotechnology	2:0:2	3
		Plant Propagation and Plant Breeding	2:0:2	3
4	<b>IV Semester</b>	Molecular Plant Pathology	2:2:2	4
		Biodiversity and Conservation Biology	2:2:2	4
		Seed Technology	2:2:2	4
		Plant Genetic Engineering	2:2:2	4

**\*\*OPEN ELECTIVE COURSE - [Semester - wise]**

<b>Sl. No</b>	<b>Semester</b>	<b>Title of the Open Elective Paper</b>	<b>Hrs/wk L:T: P</b>	<b>Credits</b>
1	<b>II Semester</b>	Plant Diversity and Human Welfare	2:2:2	4
2	<b>III Semester</b>	Plant Propagation Techniques	2:2:2	4
3	<b>IV Semester</b>	Medicinal Botany	2:2:2	4

## I SEMESTER- HARD CORE 1.1

### Microbiology and Plant Pathology

#### Theory

**Unit 1: Virology-** Origin and evolution of viruses; Classification of viruses-ICTV and Baltimore System. Genome diversity in viruses. Methods of cultivation, purification and detection of viruses. Mechanism of replication of DNA and RNA viruses.

Viroids - Structure and multiplication; Prions - Structure and multiplication. Prion diseases-

**Unit 2: Bacteriology-**Bergey's Manual of Determinative and Systematic Bacteriology; Bergey's Manual Trust; C R Woese Three domain classification of Bacteria. Archeobacteria and Eubacteria - Diversity and Evolution; Nutritional types of bacteria (Autotrophs, Heterotrophs and Symbionts); Growth of bacteria. Recombination in bacteria (Transformation, Transduction and Conjugation). Economic importance of bacteria. General characters of Actinomycetes and their economic importance. Structure and multiplication of Mycoplasma.

**Unit 3: Mycology-** Fungal diversity, Present status of fungi, habit or modes of life. Outline classification of fungi (Ainsworth-1973). Thallus structure, spore producing organs. Nutrition in fungi- Saprotrophs, Biotrophs, Necrotrophs; Symbiotrophs. Methods of reproduction in fungi - Asexual, Sexual methods. Evolution of sex in fungi, Heterothallism and Parasexuality in fungi. Life cycle pattern and phylogeny of Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Economic importance of Fungi.

**Unit 4: Plant Pathology-** Concepts and scope of plant pathology; Plant diseases and crop losses; Classification of plant diseases; Parasitism and Disease Development, Effect on Physiology of host, Host range of pathogens. Defense Mechanisms in Plants. Plant Disease Epidemics and Plant Disease forecasting. Methods of Plant disease management. Study of Plant Diseases- Sandal Spike, Citrus canker, Bacterial Blight of Paddy, Late Blight of Potato, Downy Mildew of Bajra, , Tikka disease of ground nut, Grain smut of Sorghum. Phloem Necrosis of Coffee, Root Knot Disease of Mulberry.

#### Practicals:

- 1) Tools, equipments and other requirements for studying microorganisms; lab design; lab guidelines.
- 2) Growing on test to detect the viral infection in *Nicotiana tobaccum*.
- 3) Observation of TMV under transmission electron microscope.
- 4) Measuring the dimensions of microorganisms using micrometry.
- 5) Determining total count of microbes using Haemocytometer.
- 6) Gram staining of bacteria and Special staining techniques.
- 7) Preparation of NA, sterilization, pouring, inoculation and culturing of bacteria.
- 8) Preparation of PDA, sterilization, pouring, inoculation and culturing of fungi.
- 9) Staining of fungi including VAM fungi.
- 10) Identification of different groups of fungi occurring on different substrates.
- 11) Study of the following diseases: Sandal Spike, Citrus canker, Bacterial Blight of paddy, Late Blight of Potato. Downy Mildew of Bajra, Tikka disease of ground nut, Grain smut of Sorghum, Phloem Necrosis of Coffee, Root Knot disease of Mulberry
- 12) Study of seed borne fungi by SBM and seed germination and vigour index by paper towel method.

## References:

- 1) Madigan, M.T. 2012. Brock Biology of Microorganisms, 13<sup>th</sup> Edn. Benjamin Cummings.
- 2) Willey, J., Sherwood, L. and Woolverton, C.J. 2013. Prescott's Microbiology 9<sup>th</sup> Edn., Mc Graw-Hill Education.
- 3) Wagner, E.K., and Hewlett, M.J. 2009. Basic Virology. Blackwell Science Ltd. II Edition, USA.
- 4) Kodo, C.I. and Agarwal, H.O. 1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, NY.
- 5) Conrat, F.H., Kimball, P.C. and Jay, L. 1988. Virology. Prentice Hall, Englewood Cliffs, New Jersey.
- 6) Jawaid, A. Khan and Jeanne Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Food Products Press, NY
- 7) Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 2013. Introductory Mycology 4<sup>th</sup> Edn. Wiley.
- 8) Singh, R. S. 2009. Plant Disease. 9<sup>th</sup> Edn. Oxford and IBH Pub. Co. New Delhi.
- 9) Agrios, G. N. 2005. Plant Pathology 5<sup>th</sup> Edn. Academic Press San Diego.
- 10) Rangaswamy, G. and Mahadevan, A. 2002. Diseases of crop plants in India, Prentice Hall of India Pvt. Ltd. New Delhi.
- 11) Mehrotra, R. S. 2003. Plant Pathology. 2<sup>nd</sup> Edn. Tata Mc Graw-Hill Pub. Co. Ltd., New Delhi.
- 12) Cann, A.J. 2012. Principles of Molecular Virology 5<sup>th</sup> Edn. Elsevier Ltd.
- 13) Flint, S.J. Enquist, L.W., Rancicello, V. R. and Skalka, A.M. 2009. Principles of Virology pathogenesis and control 3<sup>rd</sup> Edn. ASP Press.
- 14) Hall, R. 2014. Plant virology, 5<sup>th</sup> Edn. Elsevier USA.
- 15) Aneja, K.R. 2003. Experiments in Microbiology plant Pathology and Biotechnology, 4<sup>th</sup> Edn. New age international Publishers.
- 16) Holt, J.G., Krige, N.R., Sneath, P.H.A. Stuley, J.T. and Williams, S.T. 2010. Bergey's manual of determinative bacteriology, 9<sup>th</sup> Edn. Williams and Wilkins. USA.

## **I SEMESTER - HARD CORE 1.2**

### **Algae, Bryophytes, Pteridophytes and Gymnosperms**

#### **Theory**

**Unit 1: Diversity and distribution of algae:** Unicellular, colonial, filamentous, heterotrichous, parenchymatous, pseudoparenchymatous, siphonous forms in algal classes, General characteristics and phylogeny: **Pigmentation in algal groups:** Role of photosynthetic and accessory pigments, **Life cycles in algae:** Haplontic, diplontic, isomorphic, heteromorphic; Economic importance of algae.

**Unit 2: Bryophytes:** Introduction, General characteristics, classification and phylogeny of Bryophytes; Distribution, habitat, External and Internal morphology and Reproduction; Comparative account of gametophytes and sporophytes of Bryophytes, Economic importance of Bryophytes.

**Unit 3: Pteridophytes:** Introduction, Classification and phylogeny; Morphology, Anatomy Reproductive Biology and phylogeny: Psilophytes, Lycophytes, Sphenophytes, Filicophyta; Evolution of Sorus, Evolution of Sporangium; Gametophyte development-

Homosporous and Heterosporous ferns; Heterospory and seed habit; Stellar evolution in Pteridophytes; Ecology of Pteridophytes; Economic importance.

**Unit 4:Gymnosperms:** Introduction, Distribution, classification and phylogeny of Gymnosperms, Range in Morphology, Anatomy, Reproduction and interrelationships of- Cycadales, Ginkgoales, Coniferales, Gnetales, Economic importance of Gymnosperms.

### **Practicals:**

#### **Practicals:**

1. **Algae:** Study of Cyanophyceae: *Anabaena*, *Oscillatoria*; Study of Chlorophyceae: *Oedogonium*, *Halimeda*; Study of Phaeophyceae: *Cystophyllum*, *Turbinaria*; Study of Rhodophyceae: *Gracilaria*, *Batrachospermum*; Economic products of algae: Biofertilizers
2. **Bryophytes:** Study of vegetative habit, Anatomy and Reproductive morphology of the Bryophytes- Hepaticopsida, Anthocerotopsida and Bryopsida. (*Marchantia*, *Dumortiera*, *Anthoceros*, *Notothylas*, *Bryum* and *Polytrichum*)
3. **Pteridophytes:** Study of vegetative habit, Anatomy and Reproductive morphology of- *Psilotum*,  
*Lycopodium*, *Isoetes*, *Ophioglossum*, *Botrychium*, *Angiopteris*, *Pteris*, *Hymenophyllum*, *Marselia*, *Salvinia*, *Azolla*.
4. **Gymnosperms:** Study of Morphology, Anatomy and Reproduction of the following examples  
Cycas,  
Pinus and Ephedra, Ginkgo, Auracaria, Podocarpus, Gnetum, Ephedra, Agathis, Cupressus, Thuja.

### **References:**

- 1) Bower, F.O 1935. Primitive land plants, Macmillan, London
- 2) Campbell, D.H. 1972 Evolution of land plants (Embryophyta, central Book Department Allahabad
- 3) Watson, E.V 1971. The structure and life of Bryophytes Hutchinson and Co. Ltd. London
- 4) Parihar, N.S. 1970 An Introduction to Embryophyta Vol. 1. Bryophyta. Central Book Department Allahabad.
- 5) Prempuri, 1981. Bryophytes, Morphology, growth and differentiation. Atmaram and sons Delhi.
- 6) Nayar, M.C., Rajesh, K.P. and Madhusoodanan, P.V. 2005. Bryophytes of Wyanad.
- 7) Murthy, AVSS. 2005. A text book of algae. IK International Pvt., Ltd., New Delhi.
- 8) Bold, H. C. and Wynne, M.J. 1978. Introduction to the algae. Structure & reproduction. Prentice Hall.
- 9) Chapman & Chapman. 1973. The Algae. Macmillan Co., NY
- 10) Fritsch, F. E. 1935. Structure & reproduction of Algae Vol. I & II. Cambridge Univ. press, London
- 11) Odum, E.P. Fundamentals of Ecology. III ed. Toppan Co., Ltd., Japan
- 12) Round, F. E. 1973. Biology of the algae. Edward Arnold Ltd., London
- 13) Smith, G.M. 1951. Manual of Phycology. Pub. Co. Waltham., Mass.



- 14) Venkataraman, G.S. et al., 1974. Algae form and function. Today & tomorrow's Pub., New Delhi.
- 15) South, G. R. & Whittick, A. 1987. Introduction to Phycology. Blackwell Scientific Publication, UK.
- 16) Hoek, V., Mann, D. G. & Jahns, H. M. 1995. An introduction to Phycology. Cambridge University Press.
- 17) Biswas, C. and Johri, B. M. 1997. The Gymnosperms. New Age Publishers, New Delhi.
- 18) Rashid A. 1986. An Introduction to Pteridophytes. Vikas, New Delhi.
- 19) Sporne K. R. 1969. Morphology of Gymnosperms. Hutchinson University Library, London
- 20) Sporne K. R. 1969. Morphology of Pteridophytes. Hutchinson University Library, London

### **I-SEMESTER - HARD CORE 1.3**

#### **Taxonomy of Angiosperms and Economic Botany**

#### **Theory**

**Unit 1: Principles and applications of Taxonomy of Angiosperms:** Scope, History and Principles of Taxonomy; Carolus Linnaeus and his contributions to Taxonomy; A brief account of the concept of family, genus and species; concept of primitive flower and evolutionary tendencies; Principles and Aims of ICBN- Naming of Plants, Description of a new species and Publications; Experimental Taxonomy- a brief account on the following disciplines in relation to Taxonomy- Anatomy, Embryology, Palynology, Cytology, Phytochemistry, Molecular Biology, Numerical Taxonomy; a brief account on IUCN and Botanical Garden; Methods of preparation, maintenance and significance of Herbarium.

**Unit 2: Major System of Classification of Flowering Plants:** Broad outlines of Bentham and Hooker's system; Engler and Prantl's system; Hutchinson's system, Takhtajan's system, Cronquist's system and a brief account on the Classification of Angiosperm Phylogenetic Group (APG)- III System.

**Unit 3: Studies of selected Families of Flowering Plants:** Salient features, morphological peculiarities, systematic position and affinities of the following families- **Dicotyledons-** Magnoliaceae, Nymphaeaceae, Papaveraceae, Urticaceae, Casuarinaceae, Nyctaginaceae, Malvaceae, Passifloraceae, Euphorbiaceae, Amaranthaceae, Droseraceae, Podostemaceae, Balanophoraceae, Loranthaceae, Meliaceae, Sapindaceae, Linaceae, Scrophulariaceae, Bignoniaceae, Acanthaceae, Rubiaceae and Asteraceae; **Monocotyledons-** Alismataceae, Araceae, Cyperaceae, Commelinaceae, Zingiberaceae, Liliaceae, Dioscoreaceae, and Orchidaceae.

**Unit 4: Economic Botany:** Cereals and Millets, Legumes, Sugar yielding plants, Spices and condiments, Fibre yielding plants, Timber yielding plants, Dyes; Rubber yielding plant, Gums and Resins, Oil yielding plants; Medicinal plants and their uses; a brief account of Ethnobotany.

#### **Practicals:**

- 1) Preparation of Herbaria.
- 2) A field trip to a floristically rich area to study plants in nature.
- 3) Identification of the flowering plants in and around Mysore using keys, floras and monographs.

- 4) Field survey for collection of important plants of the region.
- 5) Study of locally available economic products of plant origin.
- 6) Medicinal Plants and their uses.

**\*Field Study:** Every student shall undertake a field study/ Plant collection Tour of Minimum three days and submit report for evaluation during practical examination.

### **References:**

- 1) Chase, M.W. and Reveal, J.L. 2009. A phylogenetic classification of the land plants to accompany APG III. *Botanical Journal of the Linnean Society*, 161: 122-127.
- 2) Cronquist, A. 1968. The Evolution and classification of flowering plants, Thomas Nelson and Sons Ltd., London.
- 3) Gurucharan Singh. 2004. Plant Systematics: Theory and Practice, Oxoord & IBH Publishing Co. Pvt. Ltd., New Delhi.
- 4) Hill, A.F. 1952. Economic Botany, Tat McGraw Hill
- 5) Jeffrey, C, 1982. An Introduction to Plant Taxonomy, II Edn. Cambridge Uni. Press.
- 6) Johri, B.M. and Bhattacharjee, S.P. 1994. Taxonomy of Angiosperms. Narosa Publishers, New Delhi.
- 7) Kocchar, S.L. 1998. Economic Botany in the Tropics, Macmillan India, New Delhi.
- 8) Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. MacMillan, London.
- 9) Mondal, A.K. 2009. Advanced Plant Taxonomy, New Central Book Agency Pvt. Ltd., Kolkata, West Bengal.
- 10) Naik, N. 1984. Taxonomy of Angiosperms, Tata McGraw Hill, New Delhi.
- 11) Pullaiah, T. 1998. Taxonomy of Angiosperms. Regency Publications, New Delhi.
- 12) Purseglove, J.W. 1972-74. Tropical Crops: Monocotyledons and Dicotyledons, Longman, London.
- 13) Sachdeva, S.K. and Mallik, C.P. 1986. Experimental Plant Taxonomy. Kalyani Publishes, New Delhi.
- 14) Sambamurthy, A.V.S.S. 2005. Taxonomy of Angiosperms. I K International Pvt. Ltd., New Delhi.
- 15) Sharma, B.D., Singh, N.P., Raghavan, R.S. and Deshpande, U.R. 1984. Flora of India Series 2, Flora of Karnataka Analysis, Botanical Survey of India, Howrah.
- 16) Sivaranjan, V.V. 1984. Introduction to Principles of Plant Taxonomy, Kalyani Publishers, New Delhi.
- 17) Thakur, R.S. 1983. Major Medicinal Plants of India, CIMAP, Lucknow.

## **I SEMESTER - SOFT CORE**

### **Mycology**

#### Theory

**Unit 1:** An overview of Mycology. Growth forms of fungi. Fungi in biotechnology. Fungi in genetic and applied research. Classification of Fungi, Study of generalized life cycles of Myxomycetes and Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Fungi as parasites of Humans Fungi as parasites of Plants, Fungi as parasites of Insects and Nematodes. Fungi in industries and agriculture.

**Unit 2:** Estimation of Fungal diversity; Characterization of fungal communities; Quantitative Indices- richness-diversity indices-evenness-species abundance distributions. Molecular Methods for Discriminating Taxa Monitoring Species, and Assessment of Fungal Diversity: Nuclear Genome, Messenger RNA transcripts, Ribosomal/DNA Sequence Comparisons, Mitochondrial Genome.

**Unit-3:** Macro fungi and Micro fungi living on plant substrata including fruits. Terrestrial and Lignicolous macrofungi. Lichenized Fungi. Sequesterate Fungi; Micro fungi on wood and plant debris; Endophytic fungi, Saprobic Soil fungi, Fungi in stressful environment. Mutualistic, arbuscular, and endomycorrhizal fungi, Yeasts, Fungicolous fungi; Fungi in fresh water habitats. Marine and estuarine mycelial Eumycota and Oomycota. Mycetozoonans. Fungi associated with aquatic animals.

**Unit 4:** Fungi associated with Animals, Insect and other Arthropod associated fungi. Fungal parasites and Predators of Rotifers, Nematodes, and other invertebrates. Fungi associated with vertebrates. Coprophilous fungi. Anaerobic zoospore fungi associated with Animals; Fungal decomposer communities: Behavioural groupings of decomposer fungi. The fungal communities of composts. Fungal communities of herbivore dung, fungal decomposers in the root zone, Fungal interactions and practical exploitation.

#### **Practicals:**

- 1) Preparation of fungal media /agar slants for isolation of different groups of fungi.
- 2) Isolation of slime moulds.
- 3) Isolation of aquatic fungi.
- 4) Isolation of soil fungi by serial dilution technique.
- 5) Staining of fungi by Cotton blue Tryphan Blue.
- 6) Study of Myxomycetes.
- 7) Study of Chytridiomycetes
- 8) Study of Plasmodiophoromycetes
- 9) Study of Oomycetes
- 10) Study of Zygomycetes
- 11) Study of Ascomycetes
- 12) Study of Basidiomycetes

- 13) Study of Deuteromycetes
- 14) Study of Lichens

### **References:**

- 1) Alexopoulos, C. J., Mims, C. W., and Blakwell, M. 2007. Introductory Mycology 4<sup>th</sup> edn., Wiley India Edition, New Delhi.
- 2) Deacon, J. W. 1997. Modern Mycology 3<sup>rd</sup> Edition, Blackwell Science publishers, London.
- 3) Mehrotra, R.S. and Aneja, K.R. 1990. An Introduction to Mycology, New Age International (P) Limited, New Delhi.
- 4) Mueller, G M; Bills, GF and Foster, M.S. 2004. Biodiversity of Fungi, Elsevier Academic Press, New York.
- 5) Rai, M. and Bridge, P.D. 2009. Applied Mycology, CABI International, UK.
- 6) Carlile, M.J. Watkinson,S.C. and Gooday, G.W. 2001.The Fungi, 2<sup>nd</sup>edn. Academic Press, USA.
- 7) Webster, J. and Weber, R.W.S. 2007. Introduction to Fungi. 3<sup>rd</sup> edn. Cambridge University Press, Cambridge.

## **I-SEMESTER - SOFT CORE**

### **Plant Pathology**

#### **Theory**

- Unit-1:** Concept of plant disease, Economic aspects of plant diseases, Types of plant diseases, Infectious diseases, Non-infectious diseases, Causative Agents of Plant Diseases: Fungi, Bacteria, Mollicutes, Viruses and Viroids, Protozoa and Nematodes, Angiospermic parasites. Development of Plant Pathology, Plant Pathology in Practice- Plant Clinic and Plant Doctor Concept. Parasitism and pathogenicity, Host range of pathogens, Disease triangle, Disease cycle / Infection cycle. Infections and colonization, Weapons of plant pathogens, Effect of pathogen on Physiology of host plant (Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation).
- Unit-2:** Genes and Diseases, Types of plant resistance to pathogens (Horizontal and Vertical Resistance). 'R' Genes and 'avr' genes, Genetics of virulence in pathogens and resistance in host plants. Breeding for disease resistance. Defense Mechanisms of Plants (Pre-existing structural and chemical defenses, Induced structural and biochemical defenses). Plant Disease Epidemiology: Elements of an epidemic and development of epidemics, Plant Disease forecasting.
- Unit-3: Management of Plant Diseases:** Exclusion, Eradication, Cross protection, Direct protection, Integrated disease management, Chemical methods of Plant Disease Control. Biotechnological approaches to plant disease management. Gene Silencing and disease control, Mechanism of gene silencing and control of viral diseases. Engineered resistance to viral, bacterial, fungal and insect diseases of crop plants.

**Unit-4: Study of diseases of crop plants:** Potato Spindle Tuber Disease, Tobacco Mosaic Disease, Sandal Spike Disease, Bacterial blight of Paddy, Citrus Canker, Late Blight of Potato, Downy Mildew of Maize, Blight of Paddy, Angular leaf spot of Cotton, Tikka disease of ground nut, Rust of coffee, Grain and Head smut of Sorghum. Leaf blight of Paddy, Blast of Paddy, Powdery mildew of cucurbits, Wilt of Tomato, Phloem Necrosis of Coffee, Root Knot of Disease of Mulberry and Vegetables. Mineral deficiency diseases of crop plants. Seed-borne diseases.

### **Practical's:**

- 1) Isolation of bacterial, fungal, and nematode plant pathogens of crop plants.
- 2) Study of mineral deficiency diseases of Tomato and French bean.
- 3) Estimation of foliar infection by Stover's method.
- 4) Study of spore germination.
- 5) Estimation of total phenols in diseased and healthy plant tissues.
- 6) Mycoflora analysis by Standard Blotter Method SBM/agar plating method.
- 7) – 11) Study of Tobacco mosaic, Bacterial blight; Downy mildew of Maize; Powdery mildew of cucurbits; Grain smut of sorghum; Leaf rust of Coffee; Root Knot of Mulberry. Bunchy top of banana, Grassy shoot of sugar cane, Little leaf of Brinjal; Potato Spindle Tuber Disease (PSTVd)
- 12) Study of effect of pathogens on seed germination and vigour index.
- 13) Study of effect of fungicide on seed-borne pathogens.
- 14) Study of Fungal bio-control agents.

### **References:**

- 1) Agrios, G. N. 2005. Plant Pathology 5<sup>th</sup> edn. Academic Press, San Diego.
- 2) Dickinson, M. 2003. Molecular Plant Pathology, Garland Publishing Inc, CT.
- 3) Ingram, D.S. and Robertson, N.F. 1999. Plant Diseases, Collins Publishers, London.
- 4) Johnston, A and Both, C. 1983. Plant Pathologists Pocket-book. 2<sup>nd</sup> Edn. Commonwealth Mycological Institute, Oxford and IBH Pub. Co. Calcutta.
- 5) Lane, C.R., Beales P.A. and Hughes, K.J.D. 2012. Fungal Plant Pathogens, CABI Publishing, Wallingford.
- 6) Mehrotra, R. S., 2003. Plant Pathology, 2<sup>nd</sup> edn. Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.
- 7) Rangaswamy, G. and Mahadevan, A. 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
- 8) Schumann, G. L. and D'Arcy, C. J. 2012. Hungry Planet: Stories of Plant Diseases, APS Press, USA.
- 9) Singh, R. S., 2009. Plant Diseases. 9<sup>th</sup> edn. Oxford and IBH Pub.Co. New Delhi.
- 10) Vidhyasekaran, P. 2004. Encyclopedia of Plant Pathology. Viva Books Pvt. Ltd. New Delhi.

## **I SEMESTER - SOFT CORE**

### **Phycology**

#### **Theory**

**Unit 1: History and development of Phycology** in India and contributions; **Thallus organization in algae:** Cyanophyceae; Chlorophyceae; Charophyceae, Euglenophyceae; Xanthophyceae;

Bacillariophyceae; Phaeophyceae; Rhodophyceae: Affinities, general characteristics and phylogeny; **Pigmentation in algae:** Structure of chlorophyll a, b, c1, c2, xanthophylls, carotenoids, accessory pigments; Colorless algae: *Astasia*, *Phacus*, *Hyalophacus*

**Unit 2: Life cycles in algae:** Haplontic; diplontic, isomorphic, heteromorphic: haplobiontic, diplobiontic (phaeophyta & rhodophyta); **Mass cultivation of Algae- Spirulina:** Media, Seeding, cultivation systems: photobioreactors, microfarms, integrated method; harvesting; processing; drying methods; packaging; marketing; Spirulina production in India: nutritional profile; **Porphyra:** Nutritional value; methods of cultivation in advanced countries; pillar method; semiraft & open sea cultivation; advanced cultivation methods: Tissue culture; open tank cultivation; conchospores

**Unit 3: Bloom forming algae:** Diflagellate blooms, cyanophycean blooms and diatom blooms; Toxins released by the algae; bioaccumulation and biomagnification; affect of toxins on aquatic life and humans; Scenario in coastal waters of India: Monitoring and safety measures; **Algae as:** pollution indicators; algae and heavy metal toxicity; biofouling; eutropication ; algae as biofuel, importance in Food industry; cosmetics; diatomaceous earth, sea weeds as sources of medicines; dietary fibres.

**Unit 4: Algal communities of extreme environments:** Thermal hot springs; cold springs; snow, ice

**Fresh water ecology:** Ecological classification of fresh water organisms; Lentic communities: pond, lake, bog, swamp; lotic communities: streams, rapids, pools, adaptations of stream forms; **Marine Ecology:** Marine Biota; zonation; quantitative study of phytoplanktons; marine communities.

### **Practicals:**

- 1) Study of Diatoms: fresh water forms
- 2) Study of planktonic forms of lakes of Mysore city
- 3) Mounting of Botrydium from soils; rhizocysts
- 4) Chlorophyceae: Chlorella, Ulva; Chaetophora, Chlorella
- 5) Phaeophyceae: Sphacelaria, Cystophyllum
- 6) Rhodophyceae: Gracilaria, Gelidium, Polysiphonia
- 7) Cyanophyceae: Microcystis, Nostoc, Spirulina
- 8) Economic products of algae: spirulina tablets; agar agar; beta carotene (*Dunaliella salina*)
- 9) Study of diversity of marine algae
- 10) Visit to institutes

### **References:**

1. Bold, H. C. and Wynne, M.J. 1978. Introduction to the algae. Structure & reproduction. Prentice Hall.
- 2.. Chapman & Chapman. 1973. The Algae. Macmillan Co., NY
3. Fritsch, F. E. 1935. Structure & reproduction of Algae Vol. I & II. Cambridge Univ. press, London
- 4.Odum, E.P. Fundamentals of Ecology. III ed. Toppan Co., Ltd., Japan
5. Round, F. E. 1973. Biology of the algae. Edward Arnold Ltd., London

6. Smith, G.M. 1951. *Manual of Phycology*. Pub. Co. Waltham., Mass.

7. Venkataraman, G.S. et al., 1974. *Algae form and function*. Today & tomorrow's Pub., New Delhi.

## **II- SEMESTER- HARDCORE - 2.1**

### **Reproductive Biology of Angiosperms and Plant Morphogenesis**

#### **Theory**

**Unit 1:** Reproductive Biology of Angiosperms: Historical over view, Contributions of P. Maheshwari; BM Johri; BGL Swamy to the development of embryology in India; Microsporogenesis- Male gametophyte development; anther wall layers and functions; Tapetum- types, Concept of male germ unit; Pollen morphological features; Unusual features: pollen development in Cyperaceae, pollen embryosac; Scope of palynology.

**Unit 2:** Megasporogenesis- Female gametophyte development; Ovular structure & types; Development of monosporic, bisporic, tetrasporic & special types of embryo sacs; Ultrastructure & nutrition of female gametophyte; Fertilization- A general account; double fertilization; single fertilization; heterofertilization & polyspermy; Pollen recognition & rejection reactions- Types; structures; methods to overcome incompatibility reactions; Endosperm- Types; haustorial variations; ruminant & composite endosperm; Embryo- Structure; development of monocot, dicot & grass embryo; significance of embryonal suspensor; Experimental Embryology- Scope & applications.

**Unit 3:** Plant Morphogenesis: Historical developments; Models of morphogenesis- Comparison of plant v/s animal morphogenetic pathways: Embryo, *Coenorhabditis elegans*; Concepts- Cell fate/ fate maps, gradients, stem cells in plants and their significance in development, polarity, symmetry, totipotency of cell types, pluripotency, plasticity, differentiation, redifferentiation, dedifferentiation and regeneration in *Acetabularia*

**Unit 4:** Plant growth and development; types, Shoot apical meristems, root meristems; control of cell division in meristems; Quiescent center & Meristeme de attente; *Arabidopsis*- vascular patterning and leaf development, abnormal growth; Cellular basis of growth- Maintenance of cell shape; cytoskeletal elements; Photomorphogenesis- Definition, history, Hartmann's technique; Photoreceptors & photo morphogenesis, Localization and properties; effect of blue light-mediated photomorphogenesis with suitable examples.

#### **Practicals:**

##### **Reproductive Biology of Angiosperms:**

- 1) Microsporangium: Slides: Wall layers; tapetal types; two-celled & three-celled pollen; pollen tetrads
- 2) Pollen germination: *Balsam*, *Delonix*, *Hibiscus* and *Peltaphorum*
- 3) Megasporangium: Slides Female gametophyte development in *Penstemon*, *Xyris pauciflora*; 2, 4, 8-nucleate stages; mature embryo sac
- 4) Endosperm mounting : *Cucumis sativus*, *Grevellia robusta* & *Croton sparsiflorus*
- 5) Embryo: Slides: Monocot, dicot & grass embryo
- 6) Embryo mounting : *Crotalaria*

##### **Practicals: Plant Morphogenesis:**



- 1) Study of stem cells in plants: SAM, RM
- 2) Regeneration abilities of shoot apical meristems of dicots on media with combinations of growth regulators
- 3) Study of totipotency in cell types: stomata, epidermal cells, stem and leaf explants on a tissue culture media
- 4) Polarity in stem cuttings: *Pothos* spp.
- 5) Study of regeneration in succulents *Kalanchoe*, *Byrophyllum*
- 6) Study of leaf galls of plants: *Pongamia pinnata* & *Achyranthes aspera*: Morphological observations and histology.

### **References:**

- 1) Johri, B. M. 1984. The embryology of Angiosperms. Springer Verlag
- 2) Johri, B. M. 1982. The experimental embryology of vascular plants. Springer Verlag NY
- 3) Swamy, B.G.L. & Krishnamurthy, K. V. 1982. From flower to fruit: The embryology of angiosperms. Tata McGraw Hill Co.
- 4) Eames 1961. Morphology of Angiosperms. McGraw Hill book Co., Inc., NY
- 5) Maheshwari, P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill book Co., Inc., NY
- 6) Maheshwari, P. 1963. Recent advances in the embryology of angiosperms. Edited by the International Society of Plant Morphologists, New Delhi
- 7) Bhojwani, S. S. & Bhatnagar, S. P. 1978. The embryology of Angiosperms. Vikas Publishing House, New Delhi.
- 8) Turing, A. M. 1952. The chemical basis of morphogenesis. Phil. Trans. R. Soc. Lond. B. 237: 37- 72.
- 9) Sinnot, E. W. 1960. Plant Morphogenesis. Mc Graw- Hill Book Co. Inc. New York, USA.
- 10) Steeves, T.A. & Sussex, I. M. 1989. Patterns in Plant development. 2<sup>nd</sup> edition, Cambridge University Press. Chasan, R. 1994. Tracing tracheary element development. The Plant Cell 6:917-919.
- 11) Lyndon, R. F. 1990. Plant Development : The Cellular basis. Unwin Hyman, London.
- 12) Aloni, R. 1987. Differentiation of vascular tissues. Annu. Rev. Plant Physiol. 38:179- 219.
- 13) Raman, A. 2007. Insect induced plant galls of India; unresolved questions. Curr. Sci. 92 (6): 748-757.
- 14) Smith, H. 1975. Phytochrome and Photomorphogenesis- an introduction to the photocontrol of plant development. Mc Graw- Hill Book Co. (UK), Ltd.
- 15) Mohr, H. 1972. Lectures in photomorphogenesis. Springler- Vohrleg, Berlin, Germany.

## II- SEMESTER - HARD CORE 2.2

### CELL BIOLOGY AND GENETICS

#### Theory

**Unit 1: Biomolecules** – Structure, Composition of biomolecules and their stabilizing Interactions ( Carbohydrates, Lipids, Proteins and Nucleic acids ). Unit membrane structure and Functions. Mechanism of protein sorting and intracellular transport including apoplast to symplast transport. Electrical properties of membranes.

**Unit 2: Functions of intracellular Organelles:** Cell wall, Membranes, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Spherosomes, Peroxisomes, Ribosomes, Endoplasmic Reticulum, Plastids, Chloroplast, Vacuoles and Cytoskeleton. Cell Cycle and mechanism of cell cycle regulations. A brief account of cell signaling, Receptors, Second messengers. General mechanism of Signal Transduction Pathway, Programmed cell death in life cycles of plants.

**UNIT 3: Chromosomal theory of inheritance-** concept and evidences, types of chromosomes, special chromosomes, chromosome molecular structure, structural and numerical alterations and their implications, **Mendelian principles** –Dominance, segregation, independent assortment, **Extensions of Mendelian principles-** codominance, incomplete dominance, gene interactions, multiple alleles ,lethal alleles, pleiotropy, penetrance and expressivity, polygenic inheritance, linkage and crossing over, sex linked inheritance, sex limited and influenced traits, genome imprinting, extra nuclear inheritance, **Concept of the gene-** classical-alleles, multiple alleles, pseudoalleles, complementation test, experiments on rII locus and lozenge locus, modern-, jumping genes, overlapping and genes within genes, split genes, nested genes, fusion genes

**UNIT 4: Gene mapping methods-** linkage maps, tetrad analysis, Recombination in bacteria mapping genes in bacteria by interrupted mating technique, fine structure mapping, transduction and transformation mapping, mapping genes in bacteriophages, **sex determination and dosage compensation-** Chromosomal and genetic basis of sex determination, mechanism of sex determination in melandrium, *C. elegans*, drosophila and humans, dosage compensation mechanisms in humans, Drosophila and *C. elegans*,

#### Practicals

1. Determination of reducing sugars by Nelson-Somogyim's method.
2. Estimation of total soluble sugars by volumetric method.
3. Quantitative determination of free Amino acid content in germinating seeds.
4. Estimation of Ascorbic acid in plant tissues.
5. Estimation of Phospholipids by TLC.
6. Slides/Charts/photos NP (Cytology Genetics and Embryology).
7. study of mitosis in normal and induced root tips cells of onion
8. study of meiosis in onion flower buds , translocation in rhoeo
9. study of special chromosomes- B chromosomes, and sex chromosomes
10. determination of chiasma frequency in onion
11. To solve genetic problems on linkage, ordered and unordered tetrads

## References:

1. A.G. Atherly, J.R. Girton, J.R. Donald. 1999. The Science of Genetics. Saunders College Publishers. Fortworth
2. A.J.F. Griffith, W.M. Gelbart, J.H. Muller and R.C. Lewintin. 1999. Modern Genetic analysis. W.H. Freeman and co. N.Y.
3. D. Hartl. 1991. Basic Genetics. II edn. Jones and Barlett Publishers Inc. Boston.
4. D.J. Fairbanks and W.R. Anderson. 1999. Genetics the continuity of life. Brooks's/Cole publishing company. California.
5. R.J. Brooker. 1999. Genetics –analysis and principles. Addison Wesley Longman Inc. California.
6. Snustad, D.P., Simmons, M.J. and Jenkins, J.R. 1997. Principles of Genetics. Hohn Wiley & son's inc. N.Y.
7. T.A. Brown. 1989. Genetics a molecular approach. Van Nostrand Reinhold (intn) Co., Ltd. London.
8. Tamarin, 1985. Principles of Genetics. V. edn. WC Brown publ. Co. Winchester, A.M. 1969. Genetics. III edn. Oxford and IBH, New Delhj.
9. Strickberger, Monroe W. 2000. Evolution. 3<sup>rd</sup> Ed., Jones & Bartlett Publishers, Inc. 40 Tall
10. PineDrive Sudbury, MA 01776, United States of America
11. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Rafi, Keith Roberts, and Peter Walter. 2008. Molecular biology of the cell, 5th ed., Garland science, Taylor & Francis Group, LLC, 270 Madison Avenue, NewYork NY f 0016, US
12. Alberts, B., Bray, D., Lewis, J , Raff, M., Roberts, K and Watson, J.D. 1999 . Molecular biology of the cell. Garland Publishing, Inc.,New York
13. Kleinsmith, L.J. and Kish, V.M. 1995 .Principles of Cell and Molecular Biology 2<sup>nd</sup> Edition Harper Collins College Publishers, New York, USA.
14. Lodish, H. Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell,J. 2000. Molecular Cell Biology 4<sup>th</sup> Edition. W.H. Freeman and Co. New York, USA
15. B.B. Buchanan, W.Gruissem and R.L. Jones . USA (2000) .Biochemistry and Molecular Biology of Plants. Ed. ASPP Press.

## II Semester Hard Core: 2.3

### Plant Breeding and Evolutionary Biology

- Unit 1 Introduction :** Objective and role of plant breeding, The evolution of plant breeding, scope of plant breeding, sciences related to plant breeding, The vavilov concept, Recent trends in plant breeding. **Breeding Methods:** Plant introduction and Acclimatization, Domestication and agriculture, pure line, clonal, mass and progeny selections, recurrent selection, Pedigree, bulk and back cross methods, Heterosis breeding synthetic and composite varieties. **Breeding Techniques :** Mutation breeding, Polyploidy, Hybridization, Tissue culture techniques in crop improvement , protoplast fusion, electrophoration, electro fusion, biolistics, somatic hybridization, Transgenic plants ( Gmo's), The role of Gene technology in plant breeding.
- Unit 2 Breeding for Specific Purposes :** Breeding for disease resistance, insect resistance, drought and salinity, quality trait, multiple cropping systems, Ideotype breeding, breeding for Adaptation. **Crop breeding and seed production :** Breeding field crops, seed production techniques, release of new varieties, intellectual property rights, computer application in plant breeding, Crop breeding Institutes/ centers. Genetic Resources and Germplasm conservation. **Scientific Plant breeding** Green revolution, The elite crop ( Golden rice), **Modern Plant breeders :** M.S. Swaminathan, Norman E. Borlaug, N.I. Vavilov.
- Unit 3 Nature of evolution :** The origin, Theories of Evolution of life, Earth and Universe, condition of the early earth, Emergence of the first living cell, origin of Prokaryotic and Eukaryotic cells, life in the Paleozoic, Mesozoic and coenozoic era. **Development of Evolutionary thoughts ,** Ecological context, Before Darwin, Darwinsim, Darwins evolutionary theory, Neo – Darwinism, modern synthesis. **Fossil evidence of Ancient life,** fossilization, Interpreting Geological tombs and fossil record . Evidences from comparative, morphology, Patterns of Development, Comparative Physiology and Biochemistry, Biogeography, Paleontology, Taxonomy, Anatomy and Embryology, plant and animal breeding, Evidence from changing earth and sea. Extinctions. Evolutionary ecology.
- Unit 4 Natural Selection :** Types of natural selection, selective forces, selection models, sexual selection, selection and non adaptive characters, Adaptive radiation, Artificial selection, **Variation :** Gene flow, Genetic drift, Gene Mutation – mendelian concept, Chromosomal mutation, Architectural changes in chromosomes, The Hardy – Weinberg law, Polyploidy in plant evolution, **Speciation and origin of higher categories :** Types of speciation, Models of speciation, pattern of speciation, Isolating Mechanism and species formation, signification of speciation. Evolution at the Molecular level; Evolution and biodiversit conservation.

## **Practicals**

- (1) Study of floral biology of crops - typical examples of self and cross Pollinated plants.
- (2) Selfing and Hybridization techniques - Bagging, Emasculation
- (3) Pollen viability: germination test and TTC test
- (4) Studying of Centre's of origin of cultivated crops - N.I. Vavilov concept.
- (5) Mode of pollination study in different crops
- (6) Identification of crop breeding Institutes/ centers, logos
- (7) Studying and identification of contributors of plant breeding - M.S. Swaminathan, N.I. Vavilov, Norman . E. Borlaug .
- (8) Contributions of scientists to Evolutionary biology
- (9) Models and Photographs related to evolution.
- (10) Group activity.

## **References:**

- 1) A.G. Atherly, J.R. Girton, J.R. Donald. 1999. The Science of Genetics. Saunders College Publishers. Fortworth
- 3) A.J.F. Griffith, W.M. Gelbart, J.H. Muller and R.C. Lewintin. 1999. Modern Genetic analysis. W.H. Freeman and co. N.Y.
- 4) D. Hartl. 1991. Basic Genetics. II edn. Jones and Barlett Publishers Inc. Boston.
- 5) D.J. Fairbanks and W.R. Anderson. 1999. Genetics the continuity of life. Brooks's/Cole publishing company. California.
- 6) R.J. Brooker. 1999. Genetics –analysis and principles. Addison Wesley Longman Inc. California.
- 7) Snustad, D.P., Simmons, M.J. and Jenkins, J.R. 1997. Principles of Genetics. Hohn Wiley & son's inc. N.Y.
- 8) T.A. Brown. 1989. Genetics a molecular approach. Van Nostrand Reinhold (intn) Co., Ltd. London.
- 9) Tamarin, 1985. Principles of Genetics. V. edn. WC Brown publ. Co.
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- 11) Strickberger, Monroe W. 2000. Evolution. 3<sup>rd</sup> Ed., Jones & Bartlett Publishers, Inc. 40 Tall PineDrive  
Sudbury, MA 01776, United States of America
- 12) Futuyma, Douglas J. 2005. Evolution. Sinauer Associates, Inc., 23 Plumtree Road, Sunderland, MA  
01375, United States of America
- 13) Dodson E. O. and Dodson P. 1976. Evolution: Process and Product. 2<sup>nd</sup> Ed., D. Van Nostrand Company,  
450 West 33<sup>rd</sup> Street, New York, N.Y. 10001
- 14) Chopra, V.L. 2000. Plant Breeding- theory and practices. Oxford and IBH Publishing Co. Pvt. Ltd.
- 15) Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of Plant Breeding. Narosa Publishing  
House, New Delhi.

## **II- SEMESTER - SOFT CORE**

### **Plant Anatomy and Histochemistry**

#### **Theory**

**Unit 1:** Primary vegetative body of the plant: Anatomical features of leaf, stem and root (Both Dicot and Monocot), leaf of fern and gymnosperm. Structure of modified leaves- Kranz anatomy and C<sub>4</sub> photosynthesis. Ultrastructure and chemistry of the cell wall, formation of the cell wall and its uses.

**Unit 2:** Ultra structure and differentiation of xylem and phloem tissues. Apical meristems: shoot apex of Pteridophytes, gymnosperms and angiosperms, theories, Root apical meristem.

**Unit 3:** Secondary growth: Vascular cambium, secondary xylem of gymnosperms and dicots and secondary phloem of gymnosperms and dicots. Periderm and Bark- Anomalous secondary growth in monocots and climbers. (leaf antogeny : Dicot: simple, compound, monocot. Floral anatomy: flower parts, floral meristem, vascular system).

**Unit 4:** Plant Histochemistry: Tests for Minerals, Carbohydrates, Lignins, Polyphenols, Proteins, Lipids and Nucleic acids. Study of instruments: (a) Camera lucida (b) Micrometry (c) Microtome. Principles of histochemical stains: Killing, fixing & staining of plant tissues. Double staining: TBA method.

#### **Practicals:**

- 1) Staining of xylem and phloem elements.
- 2) Anatomy of roots in: Ficus, Musa, Dieffenbachia, Orchid.
- 3) Anomalous secondary growth in the following examples: Stems of Aristolochia, Nyctanthes, Pyrostegia, Peperomia, Tinospora, Achyranthes.
- 4) Ecological anatomy.
- 5) Vasculature in floral organs.
- 6) Double staining technique.
- 7) Embedding: TBA method, embedding for electron microscope, Sectioning, Microtomes, Whole mounts maceration.
- 8) Histochemical- PAS Test, Sudan black lipids, Feulgen reaction – N acids

#### **Reference:**

- 1) Abraham F. 1982. Plant Anatomy. 3<sup>rd</sup> edn. Pergamon Press. Oxford.
- 2) Cariquist S, 1967. Comparative Plant Anatomy- Holt Reinert and Winston, NY.
- 3) Cutter D G, 1971. Plant Anatomy- Part 1, Cell and Tissues Edward Arnold London.
- 4) Cutter D G, 1971. Plant Anatomy- Part 1, Cell and Tissues Edward Arnold London. Part-II.
- 5) Eames and McDaniel 1947, II edn., “ Plant Anatomy” McGraw Hill, N.Y.
- 6) Esau K 1965, Plant Anatomy, Joh Wiley and Sons, N.Y.
- 7) James D Mauseth, 1998. Plant anatomy The Benjamin/ Cummins Publishing Co.Inc.
- 8) Katherine Esau, 1979, Anatomy of seed plants- first Wiley eastern reprint. New Delhi.
- 9) Krishnamurthy K. V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers and Publishers) Pvt. Ltd. Madras.

## **II- SEMESTER - SOFT CORE**

### **Ethnobotany and IPR**

#### **Theory**

- Unit 1:** Ethnobotany: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Ethnic groups and Ethnobotany: Major and minor ethnic groups or Tribals of India, and their life styles. Forest Vs. ethnic groups; Plants in Tribal life with reference to Magico-religious rituals and social customs. Sacred groves.
- Unit 2:** Methodology of Ethnobotanical studies: a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places f) Protocols.
- Unit 3:** Role of ethnobotany in modern Medicine with special examples; Medico-ethnobotanical sources in India with special reference to Karnataka; Tribals Vs. Agriculture: Shifting, Podu and Jhum cultivation. Role of ethnic groups on surrounding environment. Crop Genetic sources. Endangered taxa and forest management (participatory forest management).
- Unit 4:** Ethnobotany and legal aspects. Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Ethnobotany as a source (recent) of already known drugs: a) *Withania* as an antioxidant and relaxant b) *Sarpagandha* in brain ailments c) *Becopa* and *Centella* in epilepsy and memory development in children d) *Phyllanthus fraternus* in diabetic and viral jaundice e) *Artemisia* as a powerful cerebral antimalarial agent and its possible use in tuberculosis. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

#### **Practicals:**

- 1) A visit to a Tribal area to collect data
- 2) Listing of Crude drugs in Pansali shops (local crude drugs shops) and their identification (little known drugs only).
- 3) A visit to nearby Sacred Groves.

#### **References:**

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- 3) Lone et al., Palaeoethnobotany
- 4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
- 6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
- 7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
- 8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996
- 9) Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. London

## II- SEMESTER - SOFT CORE

### Economic Botany

#### Theory

**Unit 1: Study and utility of the useful parts of the following:** Cereals and Millets- Rice, Wheat, Maize, Barley, Sorghum and Millets. Pulses: Red gram, Green gram, Black gram, Horse gram, Pea, Cow pea, Bengal gram. Oil Yielding plants: Sunflower, Safflower, Groundnut, Linseed, Rape seed. A brief introduction to horticultural plants. Floriculture.

**Unit 2: Study and utility of the useful parts of the following:** Sugar yielding plants- Sugar cane and Sweet potato. Spices and condiments- Ginger, Turmeric, Cardamom, Cinnamon, Clove, Saffron, All spice, Black pepper, Nutmeg, Red pepper, Coriander, Cumin, Fennel and Vanilla,

**Unit 3: Study and utility of the useful parts of the following:** Fibre- Cotton, Jute, Flax, Hemp, Sann hemp, China grass, Coconut and Kapok. Timber yielding plants- *Tectona*, *Dalbergia* and *Rosewood*. Dyes- Indigo, Henna: Masticatories and fumitories: Areca nut, Beetle leaf, Tobacco. Rubber- Para rubber and other substitutes Gums- Gum Arabic, Karyia gum

**Unit4: Medicinal Botany:** Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences. Ethnomedicinal plant Gardens. Important medicinal plants and their uses. Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

#### Practicals:

- 1) Field survey for collection of economically important plants of the region.
- 2) Study of locally available economic products of plant origin.
- 3) Study of important medicinal plants and their uses.

#### References:

- 1) Hill, A.F. 1952. Economic Botany, TataMcGraw Hill
- 2) Kocchar, S.L. 1998. Economic Botany of Tropics.
- 3) Kochar, L.S. 1981. Economic Botany in the Tropics, Macmillan
- 4) Pandey, B.P. 2000. Economic Botany. S. Chand & Company, New Delhi.
- 5) Pandey, S.N. and Chandha, A. 1999. Economic Botany. Vikas Publishing House Pvt. Ltd. New Delhi.
- 6) Peter B. Kaufman *et al.*, 1999. Natural Products from Plants
- 7) Purseglove, J.W. 1972. Tropical Crops-Monocotyledons and Dicotyledons



## **II SEMESTER - OPEN ELECTIVE**

### **Plant Diversity and Human Welfare**

#### **Theory**

**Unit 1:** Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. **Values and uses of Biodiversity:** Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

**Unit 2:Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, **Management of Plant Biodiversity:** Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

**Unit 3:Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development

**Unit 4: Role of plants in relation to Human Welfare;** a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Fruit crops of Karnataka and their commercial importance. Wood and its uses.

#### **Practicals:**

- 1) Study of plant diversity (Bacteria to flowering plants).
- 2) Study of exotic species- Identification and morphological characteristics.
- 3) Identification of forest trees through bark, wood, flowers, leaves and fruits.
- 4) Maceration, Study of wood (Tracheary elements, fibres).
- 5) Methods of preservation and canning of fruits.
- 6) Visit to the local ecosystem to study the plants.
- 7) Visit to plantation crop research institute.

#### **References:**

- 1) Krishnamurthy, K.V. (2004). An advanced text book of biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

### III- SEMESTER - HARD CORE 3.1

#### **Plant Physiology and Biochemistry**

##### Theory

**Unit 1: Biomolecules-** A brief account of carbohydrates, proteins, lipids and nucleic acids; **Principles and applications of Chromatography-** Basic principle, Partition Coefficient, Survey of chromatographic procedures, techniques of chromatography, types of chromatography and their applications; **Spectroscopy-** Basic principle, Electromagnetic spectrum, the Laws of Absorption, Absorption Spectrum, Instrumentation for UV, Vis. And Infrared spectroscopy, NMR, and applications; **Electrophoresis-** Basic principle, Migration of an ion in electric field, Factors affecting electrophoretic mobility, types of electrophoresis- micro electrophoresis, moving boundary electrophoresis and Zone electrophoresis and their applications; **Centrifugation-** Basic principle- Relative Centrifugal Force, Instrumentation- Desktop, High speed and Ultra centrifuge, Preparative Centrifugation-(i) Differential centrifugation (ii) Density Gradient Centrifugation –(a) rate zonal (b) iso-pycnic, Analytical Centrifugation and applications.

**Unit 2: Solute transport:** Transport of solutes across the membranes Transmembrane proteins, Transport of ions, solutes and macro-molecules, Mechanism of translocations in phloem; Plant hormones: Discovery, Biosynthesis, Metabolism, transport and Physiological effects of plant hormones and their applications; Phytochrome: Photochemical and Biochemical properties of phytochrome. Role played in signal transduction pathway stomatal physiology; **Phytosynthesis in higher plants** (i) Photophosphorylation (ii) Calvin cycle (iii) Photorespiration (iv) C<sub>4</sub> – Pathway (Cycle); (v) CAM in plants; Oxidative Phosphorylations; (i) Glycolysis (ii) TCA – Cycle (iii) ET – Chain.

**Unit 3: Nitrogen metabolism** (i) Molecular mechanism of N<sub>2</sub> fixation (ii) Biosynthesis of amino acids (iii) Assimilation of nitrate & ammonium; Lipid metabolism: Fats and Oils biosynthesis and oxidation of lipids; Physiology of Seed Germination and Flowering. **Proteins:** Classification, Structure- primary, secondary, tertiary and quaternary structure; properties of proteins; **Enzymes:** Nomenclature, nature and properties of enzymes, active sites, co-enzymes, kinetics of enzyme action, Catalysis, specificity and inhibition, Allosteric enzymes, Ribozyme and Abzyme.

**Unit 4: Stress Physiology:** Water deficit and its physiological consequences; Drought tolerance mechanisms, Salinity stress and plant responses. Heat stress and heat shock proteins; Metal toxicity. Biotic stress, HR and SAR mechanisms.

## **Practicals:**

- 1) Estimation of protein by Lowry's method
- 2) Determination of water potential of tissue by plasmolytic method
- 3) Determination of water potential by Gravimetric method
- 4) Quantitative estimation of chlorophyll a, chlorophyll b and total chlorophyll in plant tissue
- 5) Determination of diurnal fluctuation of acid content of CAM plants (TAN)
- 6) Determination of temperature quotient (Q<sub>10</sub>) of water uptake
- 7) Separation of chlorophyll pigments/Anthocyanin by TLC
- 8) Protein analysis by SDS PAGE method.
- 9) Estimation of Alpha-amylase activity in germinating seedling.

## **References:**

- 1) Barkla, B.J., and Pantajo, O. 1996. Physiology of ion transport across the tonoplast of higher plants. *Ann. Rev. Plant Physiol.* 47: 159-184.
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- 4) Kozaki, A., and Takeba, G. 1996. Photorespiration protects C3 plants from photooxidation. *Nature* 384: 557- 560.
- 5) Taiz, L., and Zeiger, E. 1998. *Plant Physiology.* Sinaur Associates Inc. Publishers, Sunderland Massachusetts.
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- 7) Rabinowithc, E., and Jee, G. 1969. *Photosynthesis.* Willey Press, New York.
- 8) Rudier, W., and Thummlar, K. 1994. *The Phytochrome, Chromophore I. Photomorphogenesis in Plants, II Edition, Netherlands,* 51-69.
- 9) Spanswick, R.M. 1981. Electrogenic ion pumps. *Ann. Rev. Plant Physiol.* 32: 267-289.
- 10) Mc Elroy, W.D. 1995. *Cell Physiology and Biochemistry.* Prantice Hall of India.
- 11) Walsh, C.T. 1979. *Enzymatic reaction mechanisms.* Editors: W.H. Freeman, New York.
- 12) Webb, E. 1984. *Enzyme nomenclature.* Academic Press, Orlando Fla.
- 13) Zimmermann, M.H., and Milburn, J.A. *Transport in Plants. 1. Phloem transport (Encyclopedia of Plant Physiology. New Series Vol. 1),* Springer, New York.
- 14) Devline and Witham, 1986. *Plant Physiology.* CBS Publs. and Distributors, New Delhi.
- 15) Hopkins, W.G. 1995. *Introduction to Plant Physiology,* John Wiley & Sons. Inc., NewYork, USA.
- 16) Moore, T.C. 1989. *Biochemistry and Physiology of Plant Hormones.* Springer Verlag, New York, USA.
- 17) Singhal *et al.* 1999. *Concepts in Photobiology, Photosynthesis and Phytomorphogenesis,* Narosa Pub. House, New Delhi.

### III- SEMESTER - HARD CORE 3.2

#### **Molecular Biology**

- Unit 1: Nature of genetic material:** nucleic acids as genetic material, nucleic acid primary and secondary structure and types, **Organization of chromosomes and genes in prokaryotes and eukaryotes-** operon, interrupted genes, gene families, unique and repetitive DNA, heterochromatin, euchromatin, transposons, mitochondrial and chloroplast genome organization, Transposable elements in prokaryotes and eukaryotes, genetic and evolutionary significance, **DNA replication-** patterns, Messelson and Stahl and Taylor's experiment, enzymes of replication, mechanism of DNA replication in prokaryotes and Eukaryotes, proof reading and error correction mechanisms
- Unit 2: Molecular mechanism of mutation, repair and recombination:-** **Mutation-**DNA damage by spontaneous mutations, physical and chemical mutagens and their molecular mechanisms, **Repair mechanisms-** direct reversal of damage, base and excision repair, recombinational repair, SOS repair, translesion repair synthesis, transcription coupled repair, **Recombination-** homologous recombination, models of recombination, mechanisms, protein machinery of homologous recombination, genetic consequence of homologous recombination, gene conversion, site specific recombination, mechanism and biological significance, non homologous recombination- transposition, molecular mechanisms of transposition- conservative, replicative and retrotransposition
- Unit 3: RNA synthesis, processing and translation:** transcription activators and repressors, promoters, RNA polymerases and transcription factors, mechanism of transcription in prokaryotes and eukaryotes, **RNA processing-** capping, polyadenylation, splicing, alternative splicing, RNA editing, exon shuffling and RNA transport, **Translation and processing-** ribosomes, tRNA aminoacylation, aminoacyl tRNA synthetase, genetic code, wobble hypothesis, deciphering of the code, translation mechanism, translation proof reading, translation inhibitors and post translation modifications
- Unit 4: Regulation of gene expression in Prokaryotes:** Operon concept, regulation at transcription initiation- lac and trp operon control, regulation of lytic and lysogenic cycles in lambda phage, regulation beyond transcription initiation-premature termination- trp operon, ribosomal proteins as translational repressors, riboswitches, **Regulation of gene expression in eukaryotes-**transcription activators and repressors, regulation after transcription initiation- alternative splicing, translational control in ferritin and transferrin mRNA, RNA interference, role of chromatin in regulation of gene expression and gene silencing

**Practicals:**

1. Isolation of DNA from cauliflower,
2. Isolation of DNA from Onion
3. Isolation of DNA from mulberry leaves
4. Estimation of DNA by DPA method
5. Estimation of RNA by orcinol method
6. Estimation of proteins by Biuret method
7. Estimation of protein by Bradford method
8. Determination of T<sub>m</sub> value of DNA
9. Photo graph/ charts related to molecular biology

**References:**

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Rafi, Keith Roberts, and Peter Walter. 2008. Molecular biology of the cell, 5th ed., Garland science, Taylor & Francis Group, LLC, 270 Madison Avenue, New York NY 10016, US
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K and Watson, J.D. 1999 . Molecular biology of the cell. Garland Publishing, Inc., New York
3. Kleinsmith, L.J. and Kish, V.M. 1995 .Principles of Cell and Molecular Biology 2<sup>nd</sup> Edition Harper Collins College Publishers, New York, USA.
4. Lodish, H. Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology 4<sup>th</sup> Edition. W.H. Freeman and Co. New York, USA
5. Malacinski, G.M. and Freidfelder, D. 1998. Essentials of Molecular Biology 3<sup>rd</sup> Edition. Jones and Bartlett Publishers, Inc., London.
6. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology; Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. Harris, Nand Oparka, K.J. 1994. Plant Cell Biology A Practical Approach. IRL Press, Oxford University Press, U.K.
8. F.M. Ausubel, R. Brent, R.E. Kingston, D.D. Moore, J.G. Seidman, J.A. Smith, K. Struhl, (Current Edition) (2005). Current Protocols in Molecular Biology.
9. B.B. Buchanan, W. Gruissem and R.L. Jones . USA (2000) .Biochemistry and Molecular Biology of Plants. Ed. ASPP Press.
10. T.A. Brown, 2000. Essential of Molecular Biology, Vol-I & 2 Oxford University Press. James D. Watson, Tania, A. Baker, Stephen, P. Bell, Alexander , Gannm, Michael Levine. 2004.
11. Molecular Biology of the gene. 5<sup>th</sup> Edition, Pearson Education. Philip M Gilmartin and Chris Bowle. 2002. Molecular Biology of Plants. Vol 1 & 2 Oxford University Press.

### **III- SEMESTER- SOFT CORE**

#### **Plant Molecular Genetics**

##### **Theory**

**Unit 1:** Plants as genetic tools in Biology: *Arabidopsis*, *Rice*, *Maize*, *saccharomyces*. Genome organization. *Arabidopsis thaliana*- an experimental model for understanding plant development and functions. Plant genes and regulation: Nucleus and chromatin organization, DNA packaging, organization and types of DNA sequences; functional and non- functional sequences, organization of plant nuclear genes, plastid genes and mitochondrial genes.

**Unit 2:** Genes responding to hormones, phytochrome, responses to abiotic stresses. Genes induced by water stress and Freezing stress. Genes involved in photosynthesis and nitrogen fixation and their regulation; Molecular Development: Induction of Flowering, flower development. Genetic and molecular analysis of flower development. Genes involved in Fertilization, seed development, Embryo development.

**Unit 3:** Genetics of *Agrobacterium*; Biology and genetics of *Agrobacterium tumefaciens*. The Ti-Plasmid. *Vir* genes and expression. The mechanism of T-DNA transfer and integration. Basic features of vectors for plant transformation.

**Unit 4:** Proteomics, Genomics and Bioinformatics: Structural and functional genomics, Comparative Genomics- biochemical, evolutionary, physiological and phylogenomics. Tools to study functional genomics: Proteomics- functional and comparative proteomics. Protein distribution, characterization and identification, differential display proteomics, detection of functional linkages, pharmacogenomics. Bioinformatics- tools of bioinformatics, data bases and data base management, Bioinformatics in taxonomy, biodiversity, agriculture. Bioinformatics in drug design and drug discovery.

##### **Practicals:**

- 1) *Arabidopsis thaliana*- study of plant system and its biology
- 2) *Arabidopsis* RNA extraction (total and polysomal) for Northern Blotting.
- 3) Expression of foreign genes in plant cells through *Agrobacterium tumefaciens* (Chart)
- 4) Production of tobacco transgenic plants and assay for the introduced transgenic (Chart)
- 5) Co-cultivation of tobacco *Agrobacterium tumefaciens*
- 6) Learning gene bank formats- EMBL format, FASTA format, Swiss- PROT, Ex PASy

##### **References:**

- 1) Buchmann, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. ASPP Press, USA
- 2) Ausubel, F.M., Brent, R., Kingston, R.E., Moore, D.D., Seidman, J.G., Smith, J.A., and Struhl, K. 2005. Current protocols in molecular biology. Current Edition.
- 3) Brown, T.A. 2000. Essentials of Molecular Biology. Vol. I & II, Oxford University Press.

- 4) Potrykus, I., and Spangenberg, G. 1995. Gene transfer to plants. Springer, Berlin, Heidelberg.
- 5) Watson, J.D., and Baker, T.A., Bell, S.P. Gannm, A. and Levine, M. 2004. Molecular Biology of Genes. 5<sup>th</sup> Edition, Pearson Education.
- 6) Gilmartin, P.M., and Bowler, C. 2002. Molecular Biology of Plants. Vol. I & II, Oxford University Press.
- 7) Karchar, S.J. 1995. Molecular Biology- A Project Approach, Academic Press, New York.
- 8) Sambrock, J., Fritch, E.F., and Maniatis, T. 1989. Molecular cloning- a laboratory manual.
- 9) Slater, A., Scott, N., and Flower, M. 2000. Plant Biotechnology- the Genetic Manipulation of Plants, Oxford University Press.
- 10) Lea, P.J., and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology. John Willey and Sons Press, New York.
- 11) Draper, J. 1988. Plant Genetic Transformation and Gene Expression. Blackwell Scientific Publications, Oxford.
- 12) Old, R.W., and Primrose, S.B. 2004. Principles of Gene Manipulation. An introduction to Genetic Engineering. 5<sup>th</sup> Edition, Blackwell Science Publications.

### **III- SEMESTER - SOFT CORE**

#### **Evolutionary Biology**

##### **Theory**

**Unit 1: Nature of Evolution:** Theories of origin of Universe, origin of Earth and origin of life. A **History of Life on Earth:** Before Life Began, The Emergence of Life, **Precambrian Life-** Prokaryotes, Eukaryotes, Proterozoic life; **Paleozoic Life-**The Cambrian Explosion; **Paleozoic Life-** Ordovician to Devonian, Marine life, Terrestrial life; **Paleozoic Life-** Carboniferous and Permian, Terrestrial life, Aquatic life; **Mesozoic Life-** Marine life, Terrestrial plants and arthropods, Vertebrates; **The Cenozoic Era-** Aquatic life, Terrestrial life, The adaptive radiation of mammals, Pleistocene events.

**Unit 2: Development of Evolutionary Thoughts:** Before Darwin, Charles Darwin, Darwin's Evolutionary Theory, Evolutionary Theories after Darwin, Modern Synthesis. **Evidences for the theory of organic evolution:** Palaeontology, Biogeography, Taxonomy, Comparative Anatomy and Embryology, Comparative Physiology and Biochemistry, Plant and Animal Breeding.

**Unit 3: Variations:** Gene mutation- Mendelian concept; Chromosomal mutations- Architectural changes in the chromosomes. **Speciation and origin of higher categories:** Natural Selection- Selective forces, Types of Natural Selection, Selection models, Sexual Selection, Selection and nonadaptive characters. **Isolating Mechanism and Species formation:** Mendelian Genetics, Isolation and Subspeciation; Premating and Postmating Mechanisms; Chromosomal Rearrangement as Isolating mechanisms. **Polyploidy:** Autotetraploidy in plant evolution, Allotetraploidy in experiment and in nature, Polyploidy in the Animal kingdom.

**Unit 4: Evolutionary mathematics:** Hardy-Weinberg law, Selection Pressure and Rate of Evolution, Mutation Pressure and Genetic Equilibrium, Genetic Drift. **Molecular basis of evolution and Neo-Darwinian evolution.**

##### **Practicals:**

- 1) Study of Geologic Time scales.
- 2) Models and Photographs related to organic evolution
- 3) Models and photographs related to natural selection, isolation and speciation
- 4) Evidences of Polyploidy and Evolution
- 5) Evolutionary mathematics problems

##### **References:**

- 1) Strickberger, Monroe W. 2000. Evolution. 3<sup>rd</sup> Ed., Jones & Bartlett Publishers, Inc. 40 Tall Pine Drive Sudbury, MA 01776, United States of America
- 2) Futuyma, Douglas J. 2005. Evolution. Sinauer Associates, Inc., 23 Plumtree Road, Sunderland, MA 01375, United States of America
- 3) Dodson E. O. and Dodson P. 1976. Evolution: Process and Product. 2<sup>nd</sup> Ed., D. Van Nostrand Company, 450 West 33<sup>rd</sup> Street, New York, N.Y. 10001



## III-SEMESTER - SOFT CORE

### **Plant Biotechnology**

#### **Theory**

**Unit 1: Introduction:** History, Concepts, Scope and applications of plant tissue culture, Totipotency, factors affecting totipotency, Micropropagation and its applications, techniques and applications of Meristem culture, Embryo culture, Endosperm culture and Somatic embryogenesis including synthetic seeds production.

**Unit 2: Haploid production:** Androgenesis and Microspore culture, Significance of Haploids, Diploidization and bulbosum technique. Isolation, culture methods and regeneration of protoplasts, somatic hybridization, fusogens, fusion techniques and its applications, Somaclonal variations.

**Unit 3: Techniques of Suspension Culture:** Types and their applications, Production of secondary metabolites through suspension culture, Microinjection, Bioreactors, Hairy root culture, Elicitors and biotransformation. Principles and methodology of genetic engineering, applications of genetic engineering, Transgenic plants and their applications. Plant Germplasm storage by cryopreservation and its advantages.

**Unit-4: Biofertilizers:** Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Blue Green Algae and VAM. Single Cell proteins ( SCP): Health benefits and advantages of single cell proteins- *Spirulina*. Biofuels: Ethanol and Biofuel production from plants. Mushroom cultivation and its advantages. Bioremediation: Phytoremediation; Biodegradation, Xenobiotics. Biotechnology of medicinal and aromatic plants for human welfare.

#### **Practicals:**

- 1) Biotechnology lab design organization, sterilization techniques, nutrition medium.
- 2) DNA isolation and restriction digestion and separation and analysis by submarine electrophoresis.
- 3) Micropropagation of Plants through leaf culture, shoot tip culture and anther culture and preparation of synthetic seeds.
- 4) Identification of Invitro secondary metabolites-alkaloids, steroids and flavonoids.
- 5) Biological control of insects through -*Bacillus thuringiensis*
- 6) Industrial production of ethanol from sugar and its estimation alcohol meter.
- 7) Preparation of biofertilizers such as *Rhizobium* and seed testing.
- 8) Single cell protein production-Shake flask culture- *Spirulina and Chlamydomonas*.
- 9) Biogas production from waste from anaerobic digester.
- 10) Mushroom cultivation *Pleurotus and Agaricus*.

**References:**

- 1) Slater, N. Scott and M. Fowler. Plant Biotechnology 2003: The genetic manipulation of plants. Oxford University Press, Oxford.
- 2) Plant Biotechnology. 2000. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds). Springer Verlag, Heidelberg.
- 3) Text Book of Biotechnology. 2004. H.K. Das (ed). Wiley India Pvt. Ltd., New Delhi.
- 4) Plant Biotechnology -The Genetic Manipulation of Plants, Adrian Slater, Nigel Scott and Mark Flower, Oxford University Press, (2000).
- 5) Plant Genetic Transformation and Gene Expression by (eds) J.Draper *et.al.* Blackwell Scientific Publications, Oxford (1988).

### III Semester- Soft Core

#### Plant Propagation and Plant Breeding

- Unit -1 **Introduction** - History, Scope and importance of Plant propagation  
Propagation structures with reference to green house equipment and media. **Seed Propagation** – The development of Seeds, techniques of seed production and handling principles and media. Vegetative Propagation :**Techniques of propagation by 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, slide grafting approach. **Techniques of budding** : T – budding patch budding, chip budding, ring budding. Layering and its natural modifications: Simple layering, tip layering, Mound or stool layering, air layering, Compound or Serpentine layering and trench layering. Propagation by specialized stems and roots. **Micro propagation** – techniques and applications in forestry and horticulture 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.
- Unit -2 **Introduction:** Historical events related to plant breeding, objectives of plant breeding, salient achievements of plant breeding, Agencies engaged in Plant breeding. **Plant Genetic resources, Origin, Conservation and Utilization** : Centers of origin of crop plants, Exploration and collection of plant Genetic Resources, Evaluation of Germplasm collection, Documentation, Conservation of plant Genetic Resources, Utilization of Genetic Resources. **Application of selection of self – pollinated crops** : The theory of pure line selection – Genetic basis, Sources of Genetic variation in pure lines, the land variety ( races). **Medellian Consequences of Planned hybridization in self – pollinated crops** : Early experiments on hybridization in plants, planned hybridization. **Quantitative Inheritance** : Basis of Genetic Analysis, Analytical procedure, Interpretation of Estimated parameters. Applications of Biometrical Genetics in plant breeding.
- Unit - 3 **Types of Plant breeding Methods:** Pedigree Method, Bulk population breeding method, the single seed descent method, Back cross Method, **Fertility regulating Mechanisms** : Manual or Mechanical control, Genetical control, Incompatibility, Male sterility, Genetic engineering for Male sterility, chemical control, **Genetic Basis of Heterosis** : Introduction, effects of Heterosis, Interbreeding depression, Conventional theories of Heterosis, Biometrical approach to Heterosis, breeding for Heterosis. **Synthetic and composite varieties** : Genetic basis, procedure for developing **synthetic and composite varieties** : Genetic basis, procedure for developing synthetic varieties, Assessment of General combining ability. **Breeding for resistance to disease and insect pests** : The host, the pathogen, types of Genetic Resistance, Genetic basis of Host – pathogen Interaction, breeding methodology, development of multi varieties, breeding for Horizontal resistance, combining ‘VR’ and ‘HR’

Unit - 4 **Mutation breeding:** Induction of mutation, Mutagen treatment and selection of Mutants, Induction of Mutations through tissue culture, significance of Induced Mutations in Plant breeding, salient achievements of Mutation breeding. **Polyploidy in plant breeding :** Types of polyploids, Induction of Polyploidy, Phenotypic effects of Polyploidy, significance of polyploids, polyploidy breeding **Tissue culture in crop Improvement :** Micropropagation, somaclonal variation, protoplast culture and somatic hybridization, Invitro production of haploids, **Molecular approaches to crop Improvement :** Probes, Gel electrophoration, Electrofusion, biolistics, Gene Cloning, Transgenic plants (Gmo's), Molecular markers, Construction of Genetic maps, Application of DNA makers in plant breeding, the role of Gene technology in plant breeding. Engineering crops for useful Agronomic Traits. Biometry in relation to molecular Genetics in plant breeding, plant breeders, Rights, release and multiplication of varieties, Crop breeding Institutes/centers, Molecular biology in relation to intellectual property rights.

### **Practicals**

- (1) Types of vegetative propagation : Cutting, Grafting, budding, layering
- (2) Propagation by modified stems and modified roots
- (3) Preparation of media, explants, culture, initiation of shoot multiplication ((demonstration).
- (4) Pot and green house implants ( demonstration)
- (5) Studying of floral biology
- (6) Hybridization techniques - Bagging, Emasculation
- (7) Pollen viability test : Seed germination test, TTC test
- (8) Mode of pollination study in different crops
- (9) Visit to crop breeding institutes / centers - report submission.
  
- (10) Estimation of protein quality, Amino acid Analysis and determination of oil and Fatty acids.
- (11) Observation of colour and conditions of mature anthers in different crops.
- (12) Identification and studying of important plant breeders.

### **References:**

1. Abbott, A.J. and Atkin, R.K. 9eds.) 1987 Improving vegetatively propagated crops. Academic press, New York.
2. Bose, T.K., Sadhu, M.K., & Das, P., 1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
3. Hartmann and Kester, 1983. Plant propagation
4. Hartmann, H.T., Kester E.D., Davis, F.T., and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.
5. Krishnamurthy. H.M. 1981. Plant Growth substances including application in Agriculture.
6. L.M. Pierik 1987. In vitro culture of Higher plants Murtinus Nijhoff pub. Dordrecht.
7. M.K. Razdan 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. N. Delhi.

## III SEMESTER- OPEN ELECTIVE

### **Plant Propagation Techniques**

#### **Theory**

**Unit 1:** Introduction – History, scope and importance of plant propagation, Propagation structures with reference to green house equipment and media, Seed propagation – The development of seeds, techniques of seed production and handling principles and media.

**Unit- 2:** Vegetative propagation: Techniques of propagation by cuttings: 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 3:** Techniques of budding: T – budding patch budding, chip budding, ring budding; Layering and its natural modifications: simple layering, tip layering, mound or stool layering, air layering, compound or serpentine layering and trench layering; Propagation by specialized stems and roots.

**Unit- 4:** Micropropagation – techniques and applications in forestry and horticulture; Advantage, limitations and applications of vegetative propagation, clones, genetic variation in asexually propagated plants, different methods. Propagation methods of some selected plants – Citrus, gape, mango, mulberry, hibiscus, rose, Croton, Eucalyptus.

#### **Practicals**

1. Vegetative propagation: Types of Cuttings
2. Vegetative propagation: Types of Grafting
3. Vegetative propagation: Types of Budding
4. Vegetative propagation: Types of Layering
5. Propagation by modified stems and
6. Propagation by modified Roots
7. Preparation of media, preparation of explants, culture, initiation of shoot multiplication (demonstration)
8. Pot & green house implants (demonstration)

#### **References:**

- 1) Abbott, A.J. and Atkin, R.K. (9eds.) 1987 Improving vegetatively propagated crops. Academic press, New York.
- 2) Bose, T.K., Sadhu, M.K., & Das, P., 1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
- 3) Hartmann and Kester, 1983. Plant propagation
- 4) Hartmann, H.T., Kester E.D., Davis, F.T., and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.
- 5) Krishnamurthy. H.M. 1981. Plant Growth substances including application in Agriculture.
- 6) L.M. Pierik 1987. In vitro culture of Higher plants Murtinus Nijhoff pub. Dordrecht.
- 7) M.K. Razdan 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. N. Delhi.

## **IV- SEMESTER- HARD CORE 4.1**

### **Ecology, Conservation Biology and Phytogeography**

#### **Theory**

- Unit 1: Introduction and scope of Ecology-** Plants and the environment- plant adaptation, ecotypes; Life Cycles and Life History- Life span, Plant growth, Frequency of reproduction, Life history strategies; Habitat Ecology- Fresh Water and Marine water ecology (ecosystems), Wetlands and their Characteristics; Plant Communities and Ecosystems- Species diversity, Community structure, Ecosystem function; Interactions among Plants- Competition, Commensalism and Parasitism, Mutualisms, Herbivory.
- Unit 2: Habitat ecology & Environment -** The distribution of biomes, Major Terrestrial Biomes; Forests-Tropical Forests, Temperate Forests, Taiga, Grasslands, Savanna, Temperate Grasslands/Prairies, Tundra, Desert, Chaparral, Management of terrestrial, aquatic and mangrove vegetation; The Changing Ecosystem- Characteristics of disturbances; Fire, Succession and Agriculture practices; Pollution, Protecting habitats and species; Environmental Education Programmes- WWF, UNEP, IUCN, MAB.
- Unit 3: Biodiversity & Conservation Biology-** Science in the Service of Biodiversity. Biodiversity and its value. Biodiversity issues, Concerns, Management. Biodiversity Hot spots. Biodiversity- Creation and Destruction, Threats & current status of biodiversity. Invasive alien species as threat to biodiversity. Conservation Strategies, Past, Present, and Future- Attitudes about Conservation, Conservation Movements; Endangered Species Act. 2002(GOI) National Biodiversity Conservation Strategy; Geologic and Biogeographic Forces, Selecting Reserves- Biogeography, Representation, Tools for Inventory and Evaluation; Protected area Network of India- History, size and scale & management.
- Unit 4: Phytogeography-** Physical features of the world, India & Karnataka. Climatic zones, tectonics, continental movements; Types of plant distribution – discontinuous distribution - land bridge theory, continental drift, polar oscillation, shifting of poles, glaciation: continuous distribution-cosmopolitan, circumpolar, circumboreal, circumaustral, pantropical. Distribution of plants – coastal regions, Rivers & Lakes of India & Karnataka; Distribution of plants – Islands; Distribution of crop plants Natural & artificial social environments; Floristic regions of the world, India; Floristic Ecological plant geography; Ecological crop geography; Plant dispersal, migrations & isolation - endemic plants of Western ghats; Origin, Distribution and acclimatization of coffee, cardamom, sugarcane, cashew, ragi, maize, wheat, rice & cotton; Remote sensing, study of vegetation by GIS (Geosynchronous Information system).

## **Practicals:**

- 1) Study of local vegetation by quadrat method.
- 2) Water analysis for pollution studies.(Biomonitoring)
- 3) Study of wetland flora and phytoplanktons.
- 4) Study of ecological adaptations in plant.
- 5) A visit to nearby major biomes.
- 6) *In situ* method of conservation.
- 7) *Ex situ* method of conservation .
- 8) Eminent Phytogeographers of the world (photos)
- 9) Continental drift (charts).
- 10) Physical features of world – Oceans Deserts, Islands, Mountains.
- 11) Physical features of India – Rivers, Mountains, Islands.
- 12) Floristic regions of world – India & Karnataka.
- 13) Study of endemic plants of India.
- 14) Origin, acclimatization & distribution of Coffee, Cardamom, Sugarcane, Cashew, Ragi, Maize, Wheat, Rice & Cotton.

## **References:**

- 1) Polunin N 1961, Introduction to plant geography
- 2) Good R.D. 1974, Geography of the flowering plants.
- 3) James H. Brown, Biogeography, II Edition 1998.
- 4) Cain SA 1944, Foundations of plant Geography.
- 5) Croizat 1952, Manual of Phytogeography.
- 6) Edgar Anderson 1972, Plants, man & Life.
- 7) Valentine D H 1972 taxonomy, Phytogeography & Evolution.
- 8) Phil Gibson J. and Gibson Terri R. (2006). Plant ecology. Chelsea House, 132 West 31st Street, New York NY 10001.
- 9) Primack, Richard B. 2006. *Essentials of conservation biology*, 4<sup>rd</sup> edition, Sinauer Associates, Sunderland, Mass. ISBN 0-87893-720-X [required]
- 10) Pechenik, J. A. 2004. *A short guide to writing about biology*. Fifth edition. Pearson Longmans, New York, NY, USA. [required]
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## IV- SEMESTER- SOFT CORE 4.1

### **Molecular Plant Pathology**

#### **Theory**

**Unit 1: Introduction:** Concepts and Scope of Physiological and Molecular Plant Pathology: **Molecular Diagnosis of Plant diseases:** Molecular approaches to plant disease diagnosis; Nucleic acid based probes for detection of plant pathogens including non-culturable organisms. **Pathogenicity and Disease Development:** Factors; Induced resistance, virulence and pathogenicity factors. Plant-pathogen interactions with emphasis on incompatible interactions and induced resistance.

**Unit 2: Pathogenesis:** Necrogenic plant pathogenic bacteria with emphasis on hrp and avr genes and virulence factors. Fungal plant pathogens with emphasis on virulence and pathogenicity factors. Plant viruses with emphasis on virus replication, virus transport in plants and control of plant viruses with transgenic plants. **Signal Transduction:** Recognition of the pathogen by the host, transmission of the alarm signal to the host defense providers. Necrotic defense reaction, Defense through hypersensitive response. Molecular basis of induced biochemical reaction. Local and systemic acquired resistance (SAR).

**Unit 3: Genetics of Plant Diseases and Resistance:** Genes and Diseases, Physiological specialization among plant pathogens; Variability in viruses, bacteria and Fungi; Levels of Variability in pathogens and Loss of virulence in plant Pathogens. Genetics of virulence in pathogens and of resistance in host plants. Molecular plant breeding for disease resistance.

**Unit 4: Genetics and Molecular Basis of Host-pathogen Interaction:** Evolution of Parasitism; genetics of host-pathogen interaction; gene for gene relationship; Criteria for Gene for gene type Relationship; Molecular basis of host pathogen interaction; Host-Parasite interaction. **Biotechnological Methods of Plant disease Management:** Genetic engineering and crop protection. Cross Protection. Gene Silencing and disease control- Mechanism of gene silencing and control of viral diseases. Engineered resistance to viral, bacterial, fungal and insect diseases of crop plants.

#### **Practicals:**

- 1) Testing hypersensitivity reaction on *Nicotiana and Bajra*.
- 2) Estimation of lipoxygenase in diseased and healthy plants.
- 3) Estimation of polyphenols in diseased and healthy plants.
- 4) Studying systemic acquired resistance in crop plants.
- 5) Genetic testing of disease resistance in plants.
- 6) Molecular detection of viruses, Mycoplasma, fungi and bacteria from infected plants.
- 7) In-vitro testing of pathogen virulence.

#### **References:**

- 1) Singh R S (1973). Plant Disease. Oxford and IBH Pub.Co. New Delhi.
- 2) Agrios G N (1994). Plant Pathology 2<sup>nd</sup> Edn. Academic Press NY.
- 3) Johnston A and Both C – 1983-Plant Pathologists Pocket-book. 2<sup>nd</sup> Edn.
- 4) Commonwealth Mycological Institute, Oxford and IBH Pub. Co. Calcutta.
- 5) Rangaswamy G and Mahadevan A 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
- 6) Mehrotra R S –1983-Plant Pathology Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.
- 7) Vidhyasekaran P 2004. Encyclopedia of Plant Pathology. Viva Books Pvt.Ltd. New Delhi.



## **IV- SEMESTER- HARD CORE 4.2**

### **Project Work:**

The student shall undertake a Project Work in the Department or in any other University or Institute under the guidance of a Research Supervisor and shall submit a Project Report duly signed by Student and approved by the Research Supervisor which is evaluated as per University norms.

## **IV- SEMESTER- SOFT CORE**

### **Biodiversity and Conservation Biology**

#### **Theory**

**Unit 1: Biodiversity:** Definition, scope and constraints, Convention on Biodiversity - Earth Summit, Megabiodiversity and Hot Spot. **Genetic Diversity:** Nature and origin of genetic variations, Measurement of genetic diversity, Determinants of genetic diversity. **Species Diversity; Wild Taxa:** Species inventory, Species diversity- Diversity indices and comparisons. **Agro biodiversity and Cultivated Taxa:** Origin and evolution of cultivated species diversity, Diversity in domesticated species, Feral plants, Domesticated microbes. **Ecosystem Diversity:** Measuring ecosystem diversity, Major ecosystem types of the world.

**Unit 2: Values and uses of Biodiversity:** Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes. **Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss. Invasive species.

**Unit 3: Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. **Management of Plant Biodiversity:** Organizations associated with biodiversity management-Methodology for execution- IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

**Unit 4: Biodiversity and Biotechnology:** Role in assessment of biodiversity and bioresources, Utilization of biodiversity, Conservation of biodiversity, Adverse impacts of biotechnology on biodiversity.

**Practicals:**

- 1) Study of nearby area natural vegetation to record genetic and species diversity
- 2) Study of cultivated and feral plants
- 3) *In situ* and *Ex situ* Conservation methods
- 4) A visit to Botanic Gardens, Zoologic Park, Biosphere Reserves, National Parks and Sanctuaries.

**References:**

- 1) Krishnamurthy K. V. (2007). An Advanced Textbook on Biodiversity: Principles and Practice. Oxford & IHB Publishing Co. Pvt. Ltd. New Delhi.
- 2) Christian Leveque and Jean-Claude Mounolou (2003). Biodiversity. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.
- 3) Jeffries Michael J. (2006). Biodiversity and conservation, 2nd ed. Taylor and Francis Group, New York.

## **IV- SEMESTER- SOFT CORE**

### **Seed Technology**

#### **Theory**

- Unit 1:**An introduction to Seed Science and Technology and its Goals, Development of Seed Technology Industry in India. Seed as basic input in agriculture, Seed Biology: Seed development, morphology and anatomy of dicot and monocot seeds. Seed structure and functions. Seed programmes and organizations: Seed village concept, seed production agencies, seed industry and custom seed production in India. International Seed Science and Technology Organizations.
- Unit 2:**General Principles of seed production in self and cross pollinated and vegetatively propagated crops; Hybrid seed production; Maintenance of inbred lines and breeders seeds; Synthetic and composite seeds; Improved seed and their identification. Germplasm Banks, Seed Processing: Harvesting- seed drying, seed cleaning and grading; Equipment needed; Seed Storage- types of storage structure; seed factors affecting storage life; effect of storage on relative humidity; temperature and moisture; Seed deterioration of commerce, Seed treatment.
- Unit 3:**Seed quality Testing: Devices and tools used in seed testing. ISTA and its role in seed testing. Seed Sampling: Physical purity and heterogeneity test. Seed moisture content: importance and determination and methods, Viability and Vigour Testing, Genetic purity testing : objective and criteria for genetic purity testing, Seed health Testing: field and seed standards ; designated diseases, objectionable weeds - significance of seed borne diseases, Seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes. Testing of GM seeds and trait purity. Preparation and dispatch of seed testing reports; storage of guard samples; application and use of seed standards and tolerances.
- Unit 4:**Seed Certification: Principles and Philosophy of Seed Certification, purpose and Procedures, National Seed Programme: National Seed Corporation- agencies responsible for achieving self reliance in seed production and supply of quality of seeds (State Seeds Corporation; National Seed Development Council- Central Seed Committee; Seed market surveys, seed industry in relation to global market , concept of WTO, GATT, IPR, Plant Variety Protection and its significance; UPOV and its role.

#### **Practicals:**

- 1) Determination of physical purity of seed samples.
- 2) Determination of composition of pure seed.
- 3) Determination of seed Heterogeneity.
- 4) Visual examination of dry seeds for disease symptoms. (Any five).
- 5) Determination of moisture content by hot air oven method.
- 6) Determining seed viability by T.T.C. test.
- 7) Determination of seed germination by TP/BP/Sand method.
- 8) Evaluation of seedlings vigour by BP/Sand methods.
- 9) Seed vigour evaluation by (a) conductivity test (b) Hiltner's test (c) Performance test (d) accelerated ageing test.
- 10) Examination of suspensions obtained from washings of seed.
- 11) Infection sites studied by planting seed components.
- 12) Detection of seed-borne fungi and their characters of five seed borne pathogens.

- 13) Identification of common seeds using seed photos, seed manuals, seed atlas.
- 14) Visit to seed industries/seed companies to understand seed processing.

### References:

- 1) ACAR.2009. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.
- 2) ACAR.2013. Handbook of Horticulture. Indian Council of Agricultural Research, New Delhi.
- 3) Agarawal, P. K. 2005. Principles of Seed Technology. 2<sup>nd</sup> edn. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- 4) Basra, A. S. 2006. Handbook of Seed Science and Technology, The Haworth Press, USA.
- 5) Black, M, Bewley D, and Halmer, P. 2006. The Encyclopedia of Seeds:
- 6) Copeland, L. O. and McDonald, M. B. 2001. Principles of Seed Science and Technology. 4<sup>th</sup> Ed. Chapman & Hall.
- 7) Copeland, L.A. 1995. Principles of Seed Science and Technology- Kluwer Academic Publishers, The Netherlands.
- 8) Michael, B. and Bewley, D. 2000. Seed technology and its biological basis. Wiley-Blackwell.
- 9) Neergaard, P. 2005. Seed Pathology, Palgrave, Macmillan, Denmark. Science, Technology and Uses. CABI, UK.
- 10) Vanangamudi, K., Natarajan, K., Saravanan, T., Natarajan, N., Umarani, R., Bharathi, A. and Srimathi, P. 2006. Advances in Seed Science and Technology: Vol: III: Forest Tree Seed Technology and Management, Agrobios, New Delhi.

## **IV- SEMESTER- SOFT CORE**

### **Plant Genetic Engineering**

#### **Theory**

**Unit 1:Introduction to Genetic Engineering:** Concepts and scope of genetic engineering. Milestones in Plant Recombinant DNA Technology. Importance of gene manipulation in future perspectives. **Tools in Genetic Engineering:** Enzymes in genetic engineering - Restriction endonucleases- types and action, All 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, Lamda phage DNA as a vectors. Cloning vectors and expression vectors. Vectors for Plant cells, Vectors for animal cells, Baculovirus vectors-adenoviruses Retroviruses, Transposons as vectors. Synthetic construction of vectors.

**Unit 2:Binary vectors for plant transformation:** Introduction, Desirable features of any plasmid vector, Development of plant transformation vector, Basic features of vectors for plant transformation, Optimization, Clean gene technology. **Techniques for plant Transformation:** Integration of plant tissue culture in to plant transformation protocols. Introduction, *Agrobacterium* mediated gene transfer, The Ti-plasmid, The process of T-DNA transfer and integration, Practical applications of *Agrobacterium*-mediated plant transformation, Transformation in Planta, Direct gene transfer methods.

**Unit 3:The genetic manipulation of herbicide resistance:** The use of herbicide in modern agriculture, Strategies for engineering herbicide resistance, The environmental impact of herbicide-resistant crops. **The genetic manipulation of pest resistance:** GM strategies for insect resistance The *Bacillus thuringiensis* approach to insect resistance, The Copy Nature Strategy, Insect resistant crops and food safety. **The genetic resistance to plant disease resistance:** Plant pathogen interaction, Natural disease resistance pathways-Overlap between pests and diseases, Biotechnological resistance to disease resistance. Transgenic approaches to viral disease resistance.

**Unit 4:Engineering 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. **The Improvement of crop yield and quality:** The genetic manipulation of fruit ripening, engineering plant protein composition for improved nutrition, The genetic manipulation of crop yield by enhancement of photosynthesis. **Molecular Farming/Pharming:** Metabolic engineering of plants. Carbohydrates and lipids, Molecular farming of proteins, Economic consideration of molecular farming. **Future prospects for GM crops:** The current state of transgenic crops, Concerns about GM crops, the regulations of GM crops and products.

### **Practicals:**

- 1) Isolation of genomic DNA from bacteria/plants and purification by agarose gel electrophoresis.
- 2) Restriction analysis of plasmids, gel purification of DNA, small and large scale purification of plasmids.
- 3) Preparation of competent *E. coli* cells. Bacterial transformation and recovery of plasmid clones.
- 4) Gene cloning in plasmids, analysis of recombinant plasmids.
- 5) DNA amplification by PCR, RT-PCR, Real Time PCR.
- 6) Analysis of DNA and RNA and Protein by Southern and Northern and Western blotting.
- 7) Demonstration: Plant tissue culture-preparation of Murashige and Skoog medium, shoot differentiation in tobacco. Transformation of *Agrobacterium* by triparental mating and by electroporation, *Agrobacterium*-mediated transformation of tobacco, detection of GUS and GFP in transgenic plants. Acclimatization of transgenic plants and maintenance in greenhouse.

### **References:**

- 1) A. Slater, N. Scott and M. Fowler. 2003. Plant Biotechnology: The genetic manipulation of plants. Oxford University Press, Oxford.
- 2) B.B. Buchanan, W. Gruissen and R.L. Jones (eds). 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biology, Rockville, USA.
- 3) J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds). 2000 Plant Biotechnology. Springer Verlag, Heidelberg.
- 4) H.K. Das (ed.) 2004. Text Book of Biotechnology. Wiley India Pvt. Ltd., New Delhi.
- 5) I.Potrykus and G.Spangenberg, 1995 Gene Transfer to plants Springer, Berlin. Heidelberg.
- 6) J. Sambrook, E.F.Fritsch and T.Maniatis 1989. Molecular Cloning - A Laboratory Manual
- 7) Adrian Slater, Nigel Scott and Mark Flower, 2000 Plant Biotechnology -The Genetic Manipulation of Plants,Oxford University Press,).
- 8) J.Draper 1988. Plant Genetic Transformation and Gene Expression Blackwell Scientific Publications, Oxford.
- 9) R.W. Old, S.B.Primrose. 2004. Principles of Gene Manipulation. An Introduction to Genetic Engineering. Fifth Edition, Blackwell Science Publications.

## IV SEMESTER - OPEN ELECTIVE

### Plant Biotechnology

#### Theory

**Unit 1: Introduction:** Definition, Biotechnology and its Branches; Scope of Plant Biotechnology.

**Outline of Genetic Engineering:** Methodology of genetic engineering; Applications of genetic engineering; transgenic plants, animals and microbes and their applications. **Plant Tissue culture:** Micropropagation of Plants; Regeneration of plants from callus; Protoplast Technology and applications, Applications of plant tissue culture, Synthetic seeds.

**Unit 2: Germplasm storage:** Plant germplasm storage by Cryopreservation, Advantages of cryopreservation. **Biological control of Pests, Pathogens and weeds:** Bio-control agents and Biopesticides; Biological control of crop pests; Biological control of Pathogens and weeds. Mycoherbicides. **Gene Therapy:** Gene therapy methods and applications. **Fermentation Technology:** Industrial production of economically important products-acids, enzymes, amino acids, beverages, biopolymers, antibiotics.

**Unit 3: Biofertilizers:** Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Azospirillum, Blue Green Algae, VAM and Azolla. **Single cell proteins (SCP):** Health benefits and advantages of single cell proteins- Spirulina, Chlorella, Scenedesmus; Yeast as SCP. **Biofuels:** Biofuels production; Ethanol, Biogas, Hydrogen and their applications. **Mushroom cultivation:** Important edible mushrooms, Nutritive and medicinal value of edible mushrooms; Cultivation and Advantages.

**Unit 4: Biological waste treatment and reuse of wastes:** Waste treatment, Steps, Reuse of wastes; Conversion of wastes in biogas; Ethanol and compost. **Bioremediation:** Cleaning environment; Insitu bioremediation. **Biodegradation:** Xenobiotics; Biodegrading agents; Treatment of Toxic pollutants, Advantages of Biodegradation. **Biomining:** Bioleaching, microbes involved in bioleaching; Advantages of Biomining.

#### Practicals:

- 1) Biotechnology lab design and requirements.
- 2) Micropropagation of Plants through shoot tip culture.
- 3) Biological control of Pathogens- Control of *Fusarium* by *Trichoderma*.
- 4) Industrial production of ethanol from sugar and its estimation.
- 5) Preparation and applications of biofertilizers such as *Rhizobium*.
- 6) Study of Single cell proteins (SCP)- Spirulina, Chlorella and Yeast.
- 7) Biogas production from waste from anaerobic digester.
- 8) Mushroom cultivation *Pleurotus* or *Agaricus*.
- 9) Visit to Waste treatment facility and studying Steps involved in treatment.
- 10) Bioremediation

## **References:**

- 1) Narayanswamy S (1994) Plant Cell and Tissue Culture. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
- 2) Razdan M K (2004) Introduction to plant tissue culture. 2<sup>nd</sup> edn. Oxford and IBH Publishing CO. Pvt. Ltd., New Delhi.
- 3) Plant Biotechnology: The genetic manipulation of plants. 2003. A. Slater, N. Scott and
- 4) Plant Biotechnology. 2000. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds). Springer Verlag, Heidelberg.
- 5) Text Book of Biotechnology. 2004. H.K. Das (ed). Wiley India Pvt. Ltd., New Delhi.
- 6) Plant Biotechnology -The Genetic Manipulation of Plants, Adrian Slater, Nigel Scott and Mark Flower, Oxford University Press, (2000).



## IV SEMESTER- OPEN ELECTIVE

### Medicinal Botany

#### Theory

**Unit 1:** History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, anchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations.

**Unit 2:** Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; *In situ* conservation: Biosphere reserves, sacred groves, National Parks; *Ex situ* conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

**Unit 3:** Sources of financial aids for medicinal plant cultivation: Aims and objectives, Functions and activities of the board, Schemes and Projects for Financial assistance, Funding of projects; Procedure for processing project proposal for approval, Implementation and monitoring.

**Unit 4:** Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

#### Practical's:

- 1) Taxonomy of some important medicinal plants: Anticancerous plants; Antidiabetic plants; Hepatoprotective plants ; Antiacidic plants
- 2) Taxonomy of fruits, vegetables, ornamental plants and aromatic plants.
- 3) Taxonomy of any two endemic medicinal plants.
- 4) Propagation of medicinal plants by cutting, layering, grafting and budding.
- 5) Acquaint of some important medicinal plants in and around Mysore.
- 6) In vivo crude extraction of two important medicinal plants and preliminary phytochemical analysis.
- 7) Soxhlet extraction of any two medicinal plant roots.

## **References:**

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2<sup>nd</sup> edn. Agrobios, India.
3. Yoganarasimhan, S.N. Medicinal Plants of India- Vol 1- Karnataka, Interline Publishing Pvt. Ltd.