Department of Studies in Botany
University of Mysore, Manasagangotri, Mysore- 570 006

M.SC. BOTANY (CBCS) FOUR SEMESTER PROGRAMME

III. Papers prescribed to be offered to the students of 2013-14 onwards

I Semester (2013-14 onwards)

Sl. NO.	Title of the Course	Hard Core/ Soft Core/ Open Elective	Number of Credits			
			L	T	P	Total
1	Microbiology and Plant Pathology Theory & Practical	**Hard Core- 1.1**	**2**	**1**	**1**	**4**
2	Algae, Bryophytes, Pteridophytes and Gymnosperms-Theory & Practical	**Hard Core- 1.2**	**2**	**1**	**1**	**4**
3	Taxonomy of Angiosperms and Economic Botany – Theory & *Practical + **Field Study/ Tour	**Hard Core- 1.3**	**2**	**1**	**3 (*1+2**)**	**6**
4	*Any **TWO** of the Soft Core subjects to be selected by the Candidate (1) Mycology (2) Phycology (3) Plant Pathology	**Soft Core - 1.1**	**2**	**1**	**1**	**4**
5		**Soft Core- 1.2**	**2**	**1**	**1**	**4**
6		**Soft Core- 1.3**	**2**	**1**	**1**	**4**

** Field Study/Tour: The student should undertake a field trip of minimum of three days and shall submit the report at the time of Practical examination

II Semester (2013-14 onwards)

Sl. NO.	Title of the Course	Hard Core/ Soft Core/ Open Elective	Number of Credits			
			L	T	P	Total
1	Reproductive Biology of Angiosperms and Plant Morphogenesis-Theory & Practical	**Hard Core- 2.1**	**2**	**1**	**1**	**4**
2	Genetics, Plant Breeding and Evolutionary Biology- Theory & Practical	**Hard Core- 2.2**	**2**	**1**	**1**	**4**
3	*Any **TWO** of the Soft Core subjects to be selected by the Candidate (1) Plant Anatomy and Histochemistry (2) Ethnobotany and IPR (3) Economic Botany	**Soft Core- 2.1**	**2**	**1**	**1**	**4**
4		**Soft Core- 2.2**	**2**	**1**	**1**	**4**
5		**Soft Core- 2.3**	**2**	**1**	**1**	**4**
6	Plant Diversity and Human Welfare	**Open Elective- 2**	**2**	**1**	**1**	**4**

III Semester (2013-14 onwards)

Sl. NO.	Title of the Course	Hard Core/ Soft Core/ Open Elective	Number of Credits			
			L	T	P	Total
1	Plant Physiology and Biochemistry Theory & Practical	**Hard Core- 3.1**	**2**	**1**	**1**	**4**
2	Molecular Biology- Theory & Practical	**Hard Core- 3.2**	**2**	**1**	**1**	**4**
3	*Any **TWO** of the Soft Core subjects to be selected by the Candidate	**Soft Core- 3.1**	**2**	**0**	**1**	**3**
4	(1) Plant Molecular Genetics (2) Evolutionary Biology	**Soft Core- 3.2**	**2**	**0**	**1**	**3**
5	(3) Plant Biotechnology	**Soft Core- 3.3**	**2**	**0**	**1**	**3**
	Plant Propagation Techniques	**Open Elective-3**	**2**	**1**	**1**	**4**

IV Semester (2013-14 onwards)

Sl. NO.	Title of the Course	Hard Core/ Soft Core/ Open Elective	Number of Credits			
			L	T	P	Total
1	Ecology, Conservation Biology and Phytogeography- Theory & Practical	**Hard Core- 4.1**	**2**	**1**	**1**	**4**
2	***Project Work	**Hard Core- 4.2**	**0**	**2**	**6**	**8**
3	*Any **ONE** of the Soft Core subjects to be selected by the Candidate	**Soft Core- 4.1**	**2**	**1**	**1**	**4**
4	(1) Molecular Plant Pathology (2) Biodiversity and Conservation Biology	**Soft Core- 4.2**	**2**	**1**	**1**	**4**
5	(3) Seed Technology	**Soft Core- 4.3**	**2**	**1**	**1**	**4**
6	(4) Plant Genetic Engineering	**Soft Core- 4.4**	**2**	**1**	**1**	**4**
7	Plant Biotechnology **OR** Medicinal Botany	**Open Elective- 4**	**2**	**1**	**1**	**4**

***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 report which will be evaluated as per University norms.

Note: *Minimum requirements for Soft Core Courses: Candidates should have Bachelor Degree with Botany as one of the optional.

**OPEN ELECTIVE COURSES - [Semester - wise]

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

I SEMESTER- HARD CORE 1.1
Microbiology and Plant Pathology

Theory

Unit 1: Virology- An Overview of Virology; Classification of viruses-ICTV and Baltimore System. Origin and evolution of viruses; Mechanism of replication of DNA and RNA viruses; Molecular mechanism of viral multiplication in plant and animals. Genome diversity in viruses; Cultivation and Purification and Detection of Viruses. Viroids - Structure and Multiplication; Prions, Prion diseases- Mechanism of Multiplication of Prions.

Unit 2:Bacteriology- An Overview of Bacteriology; Bergey's Manual of Determinative and Sytematic Bacteriology; Bergey's Manual Trust; C R Woese Three domain classification of Bacteria. Archeabacteria and Eubacteria - Diversity and Evolution; Brief account of Actinomycetes; Actinomycetes and economic importance; Nutritional types of bacteria (Autotrophs, Heterotrophs and Symbionts); Growth of bacteria. Recombination in bacteria (transformation, transduction and conjugation); General characters of Actinomycetes ; Mycoplasma; Economic importance of bacteria.

Unit 3: Mycology- An overview of Mycology; Fungal diversity, Present status of fungi, habit or modes of life; Modern Classification of Fungi: Outline classification of fungi. Nutrition in fungi-Saprotrophs, Biotrophs, Necrotrophs; Symbiotrophs. Evolutionary trends among fungi; Reproduction - Asexual, Sexual methods, Evolution of sex in fungi, Heterothallism and Parasexuality Fungal sex hormones. Fungal Genetics, Comparative account of thallus structure and spore producing organs, interrelationship, life cycle pattern and phylogeny of the following groups Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Economic importance of Fungi.

Unit 4: Plant Pathology- Concept 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 Mechanism in Plants; Plant Disease Epidemics and Plant Disease forecasting; Plant disease management; Plant Diseases- Spike Disease, Citrus canker, Late Blight of Potato, Downy Mildew of Bajra, Blight of paddy, Tikka disease of ground nut, Head smut of Sorghum. Powdery mildew of cucurbits, Phloem Necrosis of Coffee, Root Knot of Disease of Mulberry. Disease management-An overview; Engineered resistance to viral, bacterial, fungal and insect diseases of crop plants.

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 substrates.
11) Study of the following diseases: Sandal Spike Disease, Citrus canker, Late Blight of Potato. Downy Mildew of Bajra, Blight of paddy, Tikka disease of ground nut, Grain smut of Sorghum. Powdery mildew of cucurbits, Phloem Necrosis of Coffee, Root Knot of Disease of Mulberry
12) Study of effect of pathogens on seed germination and vigour index by paper towel method.

References:

1) Madigan, Mortinko and Parker (2000), Brock Biology of Microorganisms: Prentice Hall.
2) Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology; (1992). WCB Publishers.
3) Wagner, E.K., and Hewlett, M.J. 2004. Basic Virology. Blackwell Science Ltd. II Edition, USA.
4) Burnet, F.M. and Stanley W.M. 1970. Biochemical, biological and biophysical properties, Vol. General Virology, Academic press, NY London.
5) Kodo, C.I. and Agarwal, H.O. 1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, NY.
6) Conrat, F.H., Kimball, P.C. and Jay, L. (1988) Virology. Prentice Hall, Englewood Chiff, New Jercy.
7) Jawaid A. Khan and Jeanne Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Food Products Pres, NY
8) Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. John Wiley & Sons.
9) Singh R S (1973). Plant Disease. Oxford and IBH Pub.Co. New Delhi.
10) Agrios G N (1994). Plant Pathology 2nd Edn. Academic Press NY.

11) Rangaswamy G and Mahadevan A 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
12) Mehrotra R S –1983-Plant Pathology Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.

I SEMESTER - HARD CORE 1.2
Algae, Bryophytes, Pteridophytes and Gymnosperms

Theory

Unit 1:Diversity and distribution of algal forms, **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 and other accessory pigments; Colorless algae: *Astasia, Phacus, Hyalophacus;* **Life cycles in algae**: Haplontic; diplontic, isomorphic, heteromorphic: haplobiontic, diplobiontic (phaeophyta & rhodophyta), 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 Byrophytes.

Unit 3:Pteridophytes: Introduction, Classification and phylogeny; Morphology, Anatomy Reproductive Biology and phylogeny: Psilophytes, Lycophytes, Sphenophytes, Filicophyta;Evolution of Sorus, Evolution of Sporangium; Gemetophyte development- Homosporous and Heterosporous ferns; Heterospory and seed habit; Stelar 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, Conifereales, Gnetales, Economic importance of Gymnosperms.

Practicals:

Algae: Study of Diatoms: fresh water forms, Study of planktonic forms of lakes of Mysore city
Mounting of Botrydium from soils; rhizocysts, Chlorophyceae: Ulva; Chaetophora, Phaeophyceae: Sphacelaria, Cystophyllum, Rhodophyceae: Gracilaria, Gelidium, Batrachospermum, Cyanophyceae: Microcystis bloom & estimation of toxin, Economic products of algae: spirulina tablets; agar agar; beta carotene (*Dunaliella salina*), Collection of marine algae and study of diversity from coastal waters, Visit to institutes

Bryophytes: Study of vegetative habit, Anatomy and Reproductive morphology of the Bryophytes- Hepaticopside, Anthocerotopsida and Bryopsida. (Marchantia, Dumortiera Anthoceros, Notothylas, Bryum and Polytrichum)

Pteridophytes: Study of vegetative habit, Anatomy and Reproductive morphology of- *Psilotum, Lycopodium, Isoetes, Ophioglossum, Botrychium, Angiopteris, Pteris, Hymenophyllum, Marselia, Salvinia, Azolla.*

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 - SOFT CORE

Mycology

Theory

Unit 1: An overview of Mycology. Growth forms of fungi. Fungi in biotechnology. Fungi in genetic and applied research. Modern classification, Study of generalized life cycles of Myxomycetes and Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Fungi as parasites of Humans and 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 envirioment. Mutualistic Arbuscular Endomycorrhizal fungi, Yeasts, Fungicolous fungi; Fungi in fresh water habitates. Marine and Estuarine Mycelial Eumycota and Oomycota. Mycetozonoans. 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 assocated with vertebrates. Coprophilous fungi. Anaerobic zoosporic 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 basic solid media /agar slants for routine cultivation of different groups of fungi.
2) Isolation of Slime moulds.
3) Isolation of aquatic fungi.
4) Isolation of fungi by serial dilution technique.
5) 5.-15.Study of the following fungi :
   a) Myxomycetes - Stemonitis.
   b) Chytridiomyces - Chytridium
   c) Plasmodiophoromycetes - Plasmodiophora
   d) Oomycetes - Phytophthora, Sclerospora
   e) Zygomycetes - Mucor, Rhizopus.
   f) Plectomycetes Eurotium / Eupenicillium
   a) Pyrenomycetes - Chaetomium
   b) Discomycetes - Peziza
   c) Hymenomycetes - Pleurotus /Agaricus
   d) Gasteromycetes - Lycoperdon
   e) Ustilaginomycetes – Ustilago

f) Uredinomycetes - Puccinia
g) Hypomycetes - Aspergillus, Penicillium.
h) Dematiacious Hypomycetes - Helminthosporium
i) Coelomycetes - Phomopsis
j) Mycelia sterilia - Rhizoctonia
k) Study of different Lichens

References:

1) Alexopoulas C J & Mims C W –1979 Introductory Mycology III edition,Wiley Eastern.,
2) New Delhi.
3) Deacon, J W –1997- Modern Mycology 3rd Edition, Blackwell Science publishers, London.
4) Mueller, G M; Bills, GF and Foster, M.S. (2004) biodiversity of Fungi, Elsevier Academic Press, new York.

I-SEMESTER - SOFT CORE
Plant Pathology

Theory

Unit-1: Concept of plant disease, Significance 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. Kochs' rules; 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. How Pathogens Attack Plants – Mechanical forces, Microbial enzymes and toxins, Growth regulators; Effect on Physiology of host – Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation.

Unit-2: Genetics of Plant Diseases and Resistance: Genes and Diseases, Mechanism of variability, Stages of variation in pathogens.Types of plant resistance to pathogens. Genetics of virulence in pathogens and of 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, Patterns of epidemics, Mathematical description, Comparison of epidemics, Development of epidemics, Plant Disease forecasting.

Unit-3: Management of Plant Diseases: Exclusion, Eradication, Immunization & developing resistance, Direct protection, Integrated control. Chemical methods of Plant Disease Control. Genetic engineering and crop 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.

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 Bajra and 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.

Practicals:

1) Estimation of foliar infection.
2) Splash liberation of spores from diseased tissue.
3) Estimation of total phenols in diseased and healthy plant tissues.
4) Seed health testing by SBM.
5) Study of the following diseases: Tobacco mosaic, Bacterial blight; Downy mildew of Bajra; Powdery mildew of cucurbits; Grain smut of sorghum; Leaf rust of Coffee; Leaf spot of mulberry; Bunchy top of banana, Grassy shoot of sugar cane.
6) Estimation of polyphenols in diseased and healthy plants.
7) Genetic testing of disease resistance in plants.
8) Study of effect of pathogens on seed germination and vigour index by paper towel method.
9) Study of effect of fungicide on seed-borne pathogens.

References:

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

I 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.

Practicals:

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, 2nd edn. Agrobios, India.
3. Yoganarasimhan S N. Medicinal Plants of India- Vol 1- Karnataka, Interline Publishing Pvt. Ltd.

II-SEMESTER - HARD CORE 2.1
Taxonomy of Angiosperms and Economic Botany

Theory

Unit 1: Taxonomy of Angiosperms: Scope and Principles of Taxonomy, Concept of species; Principles and Aims of ICBN, and IUCN; Methods of preparation, maintenance and significance of Herbarium; Evolutionary tendencies in flower; Experimental taxonomy: Numerical taxonomy, Palynology and taxonomy, Cytology and taxonomy, Phytochemistry and taxonomy, Molecular taxonomy.

Unit 2: Broad outlines of Bentham and Hooker's system, Engler and Prantle system, Hutchinson's system, Takhtajan's system and Cronquist's system of classification;

Unit 3: Salient features, morphological peculiarities, systematic position and affinities of the following families- Magnoliaceae, Papaveraceae, Lineaceae, Sapindaceae, Lythraceae, Santalaceae, Compositae, Asclepiadaceae, Acanthaceae, Nyctaginaceae, Meliaceae, Bignoniaceae, Orchidaceae, Amarillidaceae, Commelinaceae, Juncaceae, Cyperaceae, Dioscoreaceae, Podastemaceae, Balanophoraceae.

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; 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 and submissions for evaluation during practical examination.

References:

1) Cronquist A 1968. The Evolution and classification of flowering plants, Thomas Nelson and Sons Ltd., London.
2) Jeffrey C 1982. 2nd edn. An Introduction to Plant Taxonomy, Cambridge Uni. Press.
3) Jhori B M and Bhatacharjee S P 1994. Taxonomy of Angiosperms. Narosa Publishers, New Delhi.
4) Lawrence GHM 1951. Taxonomy of Vascular Plants. MacMillan, London.
5) Naik N 1984. Taxonomy of Angiosperms, Tata McGraw Hill, New Delhi.
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13) Purseglove, J.W. 1972. Tropical Crops-Monocotyledons and Dicotyledons
14) Thakur, R.S. *et al.*, Major Medicinal Plants.

II- SEMESTER- HARDCORE - 2.2

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; ruminate & 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, pleuripotency, 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 & Meresteme 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.

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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
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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 - SOFT CORE

Plant Anatomy and Histochemistry

Theory

Unit 1: Primary vegetative body of the plant: Stem: Arrangement of tissues, epidermis, cortical bundles, medullary bundles, steles of various types: Leaf-Structure of foliage leaves, petiole and node of dicot leaves, vascular system of moncot leaves, stem-leaf junction of monocots, structure of fern and gymnosperm leaves: Structure of modified leaves-Kranz anatomy and C_4 photosynthesis. Xerophytic and submerged foliage leaves, cataphylls, hypsophylls: Root-Structure of primary root, mucigel, epidermis, exodermis, dimorphic roots, root nodules.

Unit 2: Ultra structure of the cell wall and differentiation. Ultra structure and differentiation of xylem and phloem: tracheary elements and their differentiation, sieve elements and their differentiation. Meristems: Apical meristems, shoot apex of Pteridophytes, gymnosperms and angiosperms, root apex and intercalary meristems. Secondary growth of the plant body: Periderm, variations in wood structure. Anomalous secondary growth in climbers and monocots. Floral anatomy: Flower, flower parts and their arrangement, vascular system, floral meristem, origin and development of floral parts. Pathological Anatomy.

Unit 3: Plant Histochemistry: Minerals, Carbohydrates, Lignins, Polyphenols, Proteins, Nucleic acids and Histones, Lipids, Cutin, Suberin and Waxes, Ascorbic acid. Study of the instruments, their principles and uses (a) Camera lucida, (b) Micrometry (c) Microtomes – sledge Rocking, Rotary (D) Fluorescence microscope (e) Electron Microscope.

Unit 4: Staining technique – Principles of histochemical stains, Killing, fixing & staining of plant tissues; Important reagents & chemicals needed in the fixatives; FAA, Carnoy's fluid, Navashins solution, fleminge**;** Dehydrating agents, mounting media, Double staining,

Saffranin, Fast green, Embedding: TBA method, embedding for electron microscope, Sectioning**,** Whole mounts maceration. Histochemical- PAS Test**,** Sudan black lipids**,** Feulgen reaction – N acids.

Practicals:

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

Reference:

1) Abraham F. 1982. Plant Anatomy. 3rd edn. Pergaon 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.
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6) Esau K 1965, Plant Anatomy, Joh Wiley and Sons, N.Y.
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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.
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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, Karya 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, Agrobiodivesity 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
Genetics, Plant Breeding and Evolutionary Biology

Theory

Unit 1: Genetics: Transmission Genetics: An over view of Mendelian Genetics; Extensions of Mendelian's principles, Quantitative inheritance, Extra nuclear inheritance, Linkage and crossing over, Tetrad analysis and mitotic recombination; construction of linkage maps. **Evolution of gene concept;** Alleles, Pseudoalleles, one mutant one metabolic block, one gene one enzyme concept, one gene one polypeptide concept, complementation test, cistron, muton, recon, rII locus in T4 phage, Intragenic mapping.

Unit 2:Recombination and gene mapping in Bacteria and Viruses: Molecular basis of gene mutation, repair and recombination: Mutation: DNA repair: Recombination: **Genetic and molecular basis of sex determination:** Molecular basis of sex determination and dosage compensation in Drosophila, Coenorhabiditis and man; **Epigenetic inheritance-** Introduction, dosage compensation, types, molecular basis of dosage compensation in Drosophila, man and Coenorhabditis, properties of inactive x chromosome, genome imprinting in xci, stability, applications of xci, genome imprinting, consequences and mechanism, life cycle of imprint, imprinting and diseases and regulation, evolution.

Unit 3:Plant Breeding: An overview of applications of plant breeding for crop improvement with particular reference to mutation breeding, polyploidy breeding, adaptive breeding, protection breeding and quality breeding. NBPGR, Plant Breeders Rights (PBR), transgenic plants (GMO's), somaclonal variation, protoplast fusion, gene transfer techniques, electroporation, electrofusion, biolistics, elite plants- golden rice.

Unit 4:Evolutionary Biology: Nature of Evolution:- Theories of origin of Universe, origin of Earth and origin of life; **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. **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, Polyploidy:** Autotetraploidy, Allotetraploidy and Polyploidy, **Molecular basis of evolution and Neo-Darwinian evolution.**

Practicals:

1) Drosophila Genetics: Study of life cycle of Drosophila, media preparation transfer of flies, identification of sexes, study of mutants.
2) Study of Monohybrid , Dihybrid and Sex-linked inheritance.
3) Polytene chromosome squash preparation.
4) Extraction of eye pigment in Drosophila by paper chromatography method.
5) Calculation of chiasma frequency.
6) Linkage problems- 3 point test cross, tetrad analysis.
7) Contributions of Scientists.
8) Models and Photographs related to evolution.
9) Study of floral biology of crops- typical examples of self and cross pollinated plants.

10) Techniques of Emasculation and hybridization.
11) Pollen viability; germination test and TTC test.
12) Budding, Grafting and layering.

References:

1) A.G. Atherly, J.R. Girton, J.R. Donald. 1999. The Science of Genetics. Saunders College
2) 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.
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11) Strickberger, Monroe W. 2000. Evolution. 3rd 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. 2nd Ed., D. Van Nostrand Company, 450 West 33rd 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.

III- SEMESTER - HARD CORE 3.2

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-pycinic, 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 propecties of phytochrone. Role played in signal transduction pathway stomatal physiology; **Phytosynthesis in higher plants** (i) Photophosphorylation (ii) Calvin cycle (iii) Photorespiration (iv) C_4 – 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_2 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 (Q10) of water uptake
7) Determination of water potential.
8) Estimation of Alpha-amylase activity in germinating seedlings.
9) Estimation of phenols in germinating seedlings.
10) Physiological identification of CAM in plant species.
11) Studies on Hypersensitive Reaction and SAR mechanisms due to biotic/ abiotic stress
12) Separation of chlorophyll pigments/Anthocyanin by TLC
13) Protein analysis by SDS PAGE method.

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.
2) Clayton, R.K. 1980. Photosynthesis: Physical mechanisms and chemical patterns. Cambridge Uni. Press, Cambridge.
3) Cohn, E.E., and Stumf, P.K. 1992. Outlines of Biochemistry. Wiley Eastern Pvt. Ltd.
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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 Phytomorphognesis, Narosa Pub. House, New Delhi.

III- SEMESTER - HARD CORE 3.3
Molecular Biology

Theory

Unit 1: Nature of genetic material: Nucleic acid as genetic material; the primary and secondary structure of DNA and RNA; Organization of the Genetic material in prokaryotes and eukaryotes; mitochondrial and chloroplast DNA organization; **Replication of DNA:** Patterns of replication-experiments of Messelson's and Stahl, Cairns, Tailor, enzymes and proteins of DNA, replicating machinery, mechanism of replication-initiation, elongation and termination in prokaryotes and eukaryotes, fidelity of replication, proof reading mechanism, RNA directed DNA synthesis (reverse transcription).

Unit 2: Expression of Genome: Transcription - RNA polymerase-types, structure and function, mechanism of transcription-initiation, elongation and termination in prokaryotes and eukaryotes. Post transcriptional modifications-RNA processing, capping, polyadenylation, splicing, alternate splicing, exon, shuffling, structural organization of m-RNA, t-RNA and r-RNA, m-RNA transport; **Translation:** t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, the genetic code, deciphering of genetic code, degeneracy and Wobble hypothesis, enzymes, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins;

Unit 3: **Gene regulation in prokaryotes:** Cis regulatory factors, promoters, enhancers, operators, silencers-trans regulatory factors, transcription factors, regulation at transcription initiation-operon concept-Lac operon-positive and negative control, tryp-operon, attenuation, ribosomal proteins as translational repressors, ribo switches, regulation in lytic and lysogenic cycle, induction and maintainance; **Gene regulation in eukaryotes:** Transcription activators, transcriptional repression, gene silencing by modification of histone and DNA (Deacylation and methylation), regulation after initiation of transcription, translational controls, RNA interference, m-RNA localization during development.

Unit 4: **Transposable elements:** Prokaryotic transposons, discovery, structure of IS elements, composite transposons, phage μ eukaryotic transposable elements-transposons discovery, AC-DS elements in maize, cpm/en elements in snapdragon, P elements in Drosophila, retrotransposons-retroviruses and retro transposons, copia and Ty elements, mechanism of transpositions, uses of transposons-as genetic markers, mutagens, transposon tagging for gene isolation and vectors for transformation;

Practicals:

1) Isolation and separation of plasmid DNA.
2) Isolation of plant DNA by CTAB method
3) Estimation of DNA by Diphenyl method
4) Estimation of RNA by Orcinol method
5) Gene expression studies- Bacterial transformations.

References:

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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.
11) James D. Watson, Tania,. A. Baker, Stephen, P. Bell, Alexander ,Gannm, Michael Levine.2004. Molecular Biology of the gene. 5th Edition, Pearson Education.
12) 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 mictochondrial 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.
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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. 5th 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, Plyploidy 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. 3rd 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. 2nd Ed., D. Van Nostrand Company, 450 West 33rd Street, New York, N.Y. 10001

III-SEMESTER - SOFT CORE

Plant Biotechnology

Theory

Unit 1: Introduction: Plant Biotechnology- Concepts and Scope of plant biotechnology; **Plant Cell and Tissue culture: Culture media and cell culture;** Micropropagation of Plants; Plasticity and totipotency, The culture environment, Plant cell culture media, the plant growth regulators, Culture types – callus, cell suspension cultures, Protoplasts, Root cultures, Shoot tip and Meristem culture, Embryo culture, Microspore culture. Plant regeneration- Somatic embryogenesis, Organogenesis. Applications of plant tissue culture.

Unit 2: Genetic Engineering: Principles and Methodology of genetic engineering; Applications of genetic engineering; transgenic plants and microbes and their applications. **Germplasm Storage:** Plant germplasm storage by Cryopreservation, Advantages of crypreservation. **Molecular maps of Plant genomes:** Plant genome sequencing and data utilization. RFLP Genetic maps in plants for conservation. **Biological control of Pests, Pathogens and weeds:** Biocontrol agents and Biopesticides; Biological control of crop pests; Biological control of Pathogens and weeds. Mycoherbicides.

Unit 3:Biofertilizers: Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Azospirillium, 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. Biofuel production from plants. **Healthcare Products from**

Plants: Anticancer agents from higher Plants. Pharmaceuticals from Fungi. Plant Secondary metabolites and their pharmaceutical applications. Plant vaccines. **Mushroom cultivation:** Edible mushrooms cultivation, 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. **Seaweeds and Marine biotechnology:** Exploring **s**eaweeds for food, fodder, pharmaceuticals and therapeutic agents. **Bioremediation:** Cleaning environment; *In-situ* bioremediation. Phytoremediation. **Biodegradation:** Xenobiotics; Biodegrading agents; Treatment of Toxic pollutants, Advantages of Biodegradation. **Biotechnology of medicinal and aromatic plants:** Cultivation and exploitation 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 shoot tip culture and anther culture.
4) Biological control of insects through -*Bacillus thuringiensis*
5) Industrial production of ethanol from sugar and its estimation alcohol meter.
6) Preparation of biofertilizers such as *Rhizobium* and seed testing.
7) Single cell protein production-Shake flask culture- *Spirulina and Chlamydomonas.*
8) Biogas production from waste from anaerobic digester.
9) 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- OPEN ELECTIVE

Plant Propagation Techniques

Theory

1. Introduction – History, scope and importance of plant propagation
2. Propagation structures with reference to green house equipment and media
3. Seed propagation – The development of seeds, techniques of seed production and handling principles and media
4. Vegetative propagation:
   a) Techniques of propagation by cuttings: Stem cuttings – hard wood, semi hard wood, soft wood and herbaceous, leaf cuttings, leaf bud cuttings, root cuttings.
   b) Biology and techniques of grafting: Whip and tongue, wedge and cleft, bark, side grafting, approach
   c) Techniques of budding: T – budding patch budding, chip budding, ring budding.
   d) Layering and its natural modifications: simple layering, tip layering, mound or stool layering, air layering, compound or serpentine layering and trench layering.

e) Propagation by specialized stems and roots

5. Micropropagation – techniques and applications in forestry and horticulture.
6. Advantage, limitations and applications of vegetative propagation, clones, genetic variation in asexually propagated plants, different methods.
7. 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. Abbottt, 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, Evergreen, Deciduous, 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: Plant Biogeography- The distribution of biomes, Major Terrestrial Biomes; Forests-Tropical Forests, Temperate Forests, Taiga, Grasslands, Savanna, Temperate Grasslands/Prairies, Tundra, Desert, Chaparral; The Changing Ecosystem- Characteristics of disturbances; Fire, Succession and Agriculture practices; Conserving the Earth's Resources: The value of biodiversity, The importance of species abundance, Habitat destruction, Invasive species, Pollution, Protecting habitats and species; Environmental Education Programmes- WWF, UNEP, IUCN, MAB, Biosphere Reserve.

Unit 3: Conservation Biology- Introduction- Endangered Species Act. National Biodiversity Conservation Strategy; Conservation Biology- Science in the Service of Biodiversity. Biodiversity and Its Value. Biodiversity issues, Concerns, Management. Biodiversity- Creation and Destruction, Geologic and Biogeographic Forces, Ecological Processes, Threats, Current Status. Conservation Strategies, Past, Present, and Future- Attitudes about Conservation, Emerging. Conservation Movements, Forging a National Strategy; Selecting Reserves- Biogeography. Representation, Tools for Inventory and Evaluation, Designing; Reserve Networks: History, Size and Scale, Management Considerations; Management of terrestrial, aquatic and mangrove vegetation.

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, pantropial. 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); Invasive alien species as threat to biodiversity.

Practicals:

1) Study of local vegetation by quadrate method.
2) Water analysis for pollution studies.
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) Croiat 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*, 4rd 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]
11) Ricklefs, R. E. 2001. *The economy of nature*. Fifth edition. Freeman, New York, NY, USA.

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, shall submit a Dissertation / report which will be evaluated as per university norms.

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 pathogenecity 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 Transuduction:** 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; genteics oh 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 lypoxygenease 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 2nd Edn. Academic Press NY.
3) Johnston A and Both C – 1983-Plant Pathologists Pocket-book. 2nd 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. Encylopedia of Plant Pathology.Viva Books Pvt.Ltd. New Delhi.

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: Importance of Seed Technology and Seed Testing. Development of Seed Technology in India and importance of Agriculture. Seed Biology: Seed Development; Morphology and Anatomy of Seed- Seed Structure in Angiosperms; Seed Industry: Progress of Seed Industry in India; Seed Programme bases- types involved- basic strategy for product planting and Organization of seed Programmes; General guidelines organization of use programme.

Unit 2: See Production: General Principles- 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 gracing; 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 certified, foundation and breeders seed- germplasm storage

Unit 3: Seed Quality Testing: Sampling, purity, germination, viability, moisture determination; weight determination; testing for cultivar purity; testing of coated seeds, tolerance tables; Molecular biology of seed protein; use of advanced technology for seed testing; seed vigour concepts and methods of evaluation

Unit 4: Seed Certification: Principles and Philosophy of Seed Certification, purpose and procedures, seed etc. 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; NBPGR).

Practicals:

1) Determination of physical purity of seed samples of four field crops.
2) Composition of pure crop seed of sample

3) Determination of moisture content using oven, infrared moisture balance; OSAW universal moisture meter
4) T.T.C. test for seed viability
5) Germination evaluation of various crops- Top of Paper method; Between Paper method and Sand method
6) Evaluation of seedlings in the above methods.
7) Vigour evaluation (a) conductivity test (b) Hiltner's test (c) Performance test (d) accelerated ageing test
8) Identification of common seeds using seed photos, seed manuals, seed atlas
9) Detection of mycoflora of stored seed samples by SMT/ PDA method.

References:

1) Agarawal P K 2006. Principles Of Seed Technology. Indian Council Of Agri. Reasearch, New Delhi.
2) Vanangamudi K; K Natarajan; T Saravanan; N Natarajan; R Umarani; A Bharathi and P Srimathi, 2006Advances in Seed Science and Technology : Vol: III: Forest Tree Seed Technology and Management, Agrobios, New Delhi.
3) Black Michael and Derek Bewley 2000. Seed Technology and Its Biological Basis Wiley-Blackwell (1 Jun 2000)
4) Amarjit S Basra – 2006. Handbook of Seed Science and Technology, The Haworth Press, USA-
5) Lawrence O Copeland – 1995. Principles of Seed Science and Technology- Kluwer Academic Publishers, The Netherlands.
6) Paul Neergaard. 2005. Seed Pathology, Palgrave – Macmillan, Denmark

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. Carbohydates 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, bevergares, biopolymers, antibiotics.

Unit 3: Biofertilizers: Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Azospirillium, 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 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.

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. 2nd 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).

[Prof. M.S.Sudarshana]
CHAIRMAN

Annexure – II

University of Mysore
M.Sc. Botany Choice - Based Credit System (CBCS) Modified Syllabus
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.	**HARD CORE 1.1**	Microbiology and Plant Pathology Theory & Practical	2:2:2	4
2	**HARD CORE 1.2**	Algae, Bryophytes, Pteridophytes and Gymnosperms-Theory & Practical	2:2:2	4
3	**HARD CORE 1.3**	Taxonomy of Angiosperms and Economic Botany – Theory & Practical # Field Study/ Tour	2:2:2	4 2
4	**SOFT CORE 1.1**	*To be Selected by the student	2:2:2	4
5	**SOFT CORE 1.2**	*To be Selected by the student	2:2:2	4
			Total	**14 + 08 = 22**

Field Study/Tour: The student should undertake a field trip of minimum of three days and shall submit the herbarium and report for evaluation.

SEMESTER- II: **Credits: 20**

No	Paper Code	Title of the course paper	Hrs/wk L:T:P	Credits
1.	**HARD CORE 2.1**	Reproductive Biology of Angiosperms and Plant Morphogenesis-Theory & Practical	2:2:2	4
2	**HARD CORE 2.2**	Genetics, Plant Breeding and Evolutionary Biology- Theory & Practical	2:2:2	4
3	**SOFT CORE 2.1**	*To be Selected by the student	2:2:2	4
4	**SOFT CORE 2.2**	*To be Selected by the student	2:2:2	4
5	**Open Elective 2.1**	Plant diversity and Human Welfare	2:2:2	4
			Total	**08 + 08 + 04 = 20**

M.Sc. Botany: II Year/ M.Sc. Degree

SEMESTER-III **Credits: 20**

No	Paper Code	Title of the course paper	Hrs/wk L:T:P	Credits
1.	**HARD CORE 3.1**	Plant Physiology and Biochemistry Theory & Practical	2:2:2	4
2	**HARD CORE 3.2**	Molecular Biology- Theory & Practical	2:2:2	4
3	**SOFT CORE 3.1**	*To be Selected by the student	2:0:2	3
4	**SOFT CORE 3.2**	*To be Selected by the student	2:0:2	3
5	**Open Elective 3.1**	Plant Propagation Techniques	2:2:2	4
			Total	**08 + 08 + 04 = 20**

SEMESTER- IV **Credits: 20**

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

***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. Shall submit a report which will be evaluated as per university norms.

Total credits 42 + 28 + 12 = 82

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

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

Sl. No	Semester	Title of the Soft Course Papers	Hrs/wk L:T:P	Credits
1.	**I Semester**	Mycology	2:2:2	4
		Phycology	2:2:2	4
		Plant Pathology	2:2:2	4
2	**II Semester**	Plant Anatomy and Histochemistry	2:2:2	4
		Ethnobotany and IPR	2:2:2	4
		Economic Botany	2:2:2	4
3	**III Semester**	Plant Molecular Genetics	2:2:2	4
		Evolutionary Biology	2:2:2	4
		Plant Biotechnology	2:2:2	4
4	**IV Semester**	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 COURSES - [Semester - wise]**

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

Note: Regulations for Admissions, Examinations, Evaluation and Award of the degree will be as per common regulations of CBCS adopted by the university from time to time.

Prof. K.A. RAVEESHA
CHAIRMAN
Board of Studies in Botany (PG)

I SEMESTER- HARD CORE 1.1

Microbiology and Plant Pathology

Theory

Unit 1: Virology- An Overview of Virology; Classification of viruses-ICTV and Baltimore System. Origin and evolution of viruses; Mechanism of replication of DNA and RNA viruses; Molecular mechanism of viral multiplication in plant and animals. Genome diversity in viruses; Cultivation and Purification and Detection of Viruses. Viroids - Structure and Multiplication; Prions, Prion diseases- Mechanism of Multiplication of Prions.

Unit 2:Bacteriology- An Overview of Bacteriology; Bergey's Manual of Determinative and Sytematic Bacteriology; Bergey's Manual Trust; C R Woese Three domain classification of Bacteria. Archeabacteria and Eubacteria - Diversity and Evolution; Brief account of Actinomycetes; Actinomycetes and economic importance; Nutritional types of bacteria (Autotrophs, Heterotrophs and Symbionts); Growth of bacteria. Recombination in bacteria (transformation, transduction and conjugation); General characters of Actinomycetes ; Mycoplasma; Economic importance of bacteria.

Unit 3: Mycology- An overview of Mycology; Fungal diversity, Present status of fungi, habit or modes of life; Modern Classification of Fungi: Outline classification of fungi. Nutrition in fungi-Saprotrophs, Biotrophs, Necrotrophs; Symbiotrophs. Evolutionary trends among fungi; Reproduction - Asexual, Sexual methods, Evolution of sex in fungi, Heterothallism and Parasexuality Fungal sex hormones. Fungal Genetics, Comparative account of thallus structure and spore producing organs, interrelationship, life cycle pattern and phylogeny of the following groups Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Economic importance of Fungi.

Unit 4: Plant Pathology- Concept 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 Mechanism in Plants; Plant Disease Epidemics and Plant Disease forecasting; Plant disease management; Plant Diseases- Spike Disease, Citrus canker, Late Blight of Potato, Downy Mildew of Bajra, Blight of paddy, Tikka disease of ground nut, Head smut of Sorghum. Powdery mildew of cucurbits, Phloem Necrosis of Coffee, Root Knot of 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 substrates.
11) Study of the following diseases: Sandal Spike Disease, Citrus canker, Late Blight of Potato. Downy Mildew of Bajra, Blight of paddy, Tikka disease of ground nut, Grain smut of Sorghum. Powdery mildew of cucurbits, Phloem Necrosis of Coffee, Root Knot of Disease of Mulberry
12) Study of effect of pathogens on seed germination and vigour index by paper towel method.

References:

1) Madigan, Mortinko and Parker (2000), Brock Biology of Microorganisms: Prentice Hall.
2) Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology; (1992). WCB Publishers.
3) Wagner, E.K., and Hewlett, M.J. 2004. Basic Virology. Blackwell Science Ltd. II Edition, USA.
4) Burnet, F.M. and Stanley W.M. 1970. Biochemical, biological and biophysical properties, Vol. General Virology, Academic press, NY London.
5) Kodo, C.I. and Agarwal, H.O. 1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, NY.
6) Conrat, F.H., Kimball, P.C. and Jay, L. (1988) Virology. Prentice Hall, Englewood Chiff, New Jercy.
7) Jawaid A. Khan and Jeanne Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Food Products Pres, NY
8) Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. John Wiley & Sons.
9) Singh R S (1973). Plant Disease. Oxford and IBH Pub.Co. New Delhi.
10) Agrios G N (1994). Plant Pathology 2nd Edn. Academic Press NY.
11) Rangaswamy G and Mahadevan A 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
12) Mehrotra R S –1983-Plant Pathology Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.

I SEMESTER - HARD CORE 1.2

Algae, Bryophytes, Pteridophytes and Gymnosperms

Theory

Unit 1:Diversity and distribution of algal forms, **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 and other accessory pigments; Colorless algae: *Astasia, Phacus, Hyalophacus;* **Life cycles in algae**: Haplontic; diplontic, isomorphic, heteromorphic: haplobiontic, diplobiontic (phaeophyta & rhodophyta), 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 Byrophytes.

Unit 3:Pteridophytes: Introduction, Classification and phylogeny; Morphology, Anatomy Reproductive Biology and phylogeny: Psilophytes, Lycophytes, Sphenophytes, Filicophyta;Evolution of Sorus, Evolution of Sporangium; Gemetophyte development-Homosporous and Heterosporous ferns; Heterospory and seed habit; Stelar 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, Conifereales, Gnetales, Economic importance of Gymnosperms.

Practicals:

Algae: Study of Diatoms: fresh water forms, Study of planktonic forms of lakes of Mysore city Mounting of Botrydium from soils; rhizocysts, Chlorophyceae: Ulva; Chaetophora, Phaeophyceae: Sphacelaria, Cystophyllum, Rhodophyceae: Gracilaria, Gelidium, Batrachospermum, Cyanophyceae: Microcystis bloom & estimation of toxin, Economic products of algae: spirulina tablets; agar agar; beta carotene (*Dunaliella salina*), Collection of marine algae and study of diversity from coastal waters, Visit to institutes

Bryophytes: Study of vegetative habit, Anatomy and Reproductive morphology of the Bryophytes- Hepaticopside, Anthocerotopsida and Bryopsida. (Marchantia, Dumortiera Anthoceros, Notothylas, Bryum and Polytrichum)

Pteridophytes: Study of vegetative habit, Anatomy and Reproductive morphology of- *Psilotum, Lycopodium, Isoetes, Ophioglossum, Botrychium, Angiopteris, Pteris, Hymenophyllum, Marselia, Salvinia, Azolla.*

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: Taxonomy of Angiosperms: Scope and Principles of Taxonomy, Concept of species; Principles and Aims of ICBN, and IUCN; Methods of preparation, maintenance and significance of Herbarium; Evolutionary tendencies in flower; Experimental taxonomy: Numerical taxonomy, Palynology and taxonomy, Cytology and taxonomy, Phytochemistry and taxonomy, Molecular taxonomy.

Unit 2: Broad outlines of Bentham and Hooker's system, Engler and Prantle system, Hutchinson's system, Takhtajan's system and Cronquist's system of classification;

Unit 3: Salient features, morphological peculiarities, systematic position and affinities of the following families- Magnoliaceae, Papaveraceae, Lineaceae, Sapindaceae, Lythraceae, Santalaceae, Compositae, Asclepiadaceae, Acanthaceae, Nyctaginaceae, Meliaceae, Bignoniaceae, Orchidaceae, Amarillidaceae, Commelinaceae, Juncaceae, Cyperaceae, Dioscoreaceae, Podastemaceae, Balanophoraceae.

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; 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 and submissions for evaluation during practical examination.

References:

1) Cronquist A 1968. The Evolution and classification of flowering plants, Thomas Nelson and Sons Ltd., London.
2) Jeffrey C 1982. 2nd edn. An Introduction to Plant Taxonomy, Cambridge Uni. Press.
3) Jhori B M and Bhatacharjee S P 1994. Taxonomy of Angiosperms. Narosa Publishers, New Delhi.
4) Lawrence GHM 1951. Taxonomy of Vascular Plants. MacMillan, London.
5) Naik N 1984. Taxonomy of Angiosperms, Tata McGraw Hill, New Delhi.
6) Pullaiah T. 1998. Taxonomy of Angiosperms. Regency Publications, New Delhi.
7) Sharma B D, Singh N P Raghaven S and Deshpande U R. 1984. Flora of India- Series 2: Flora of Karnataka- Analysis. Botanical Survey of India, Department of Environment.
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9) A V S S Sambamurthy. 2005. Taxonomy of Angiosperms. I K International Pvt. Ltd., New Delhi.

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11) Kocchar, S.L. 1998. Economic Botany of Tropics.
12) Kochar, L.S. 1981. Economic Botany in the Tropics, Macmillan
13) Purseglove, J.W. 1972. Tropical Crops-Monocotyledons and Dicotyledons
14) Thakur, R.S. *et al.,* Major Medicinal Plants.

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. Modern classification, Study of generalized life cycles of Myxomycetes and Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Fungi as parasites of Humans and 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 envirioment. Mutualistic Arbuscular Endomycorrhizal fungi, Yeasts, Fungicolous fungi; Fungi in fresh water habitates. Marine and Estuarine Mycelial Eumycota and Oomycota. Mycetozonoans. 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 assocated with vertebrates. Coprophilous fungi. Anaerobic zoosporic 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 basic solid media /agar slants for routine cultivation of different groups of fungi.
2) Isolation of Slime moulds.
3) Isolation of aquatic fungi.
4) Isolation of fungi by serial dilution technique.
5) 5.-15.Study of the following fungi :
   a) Myxomycetes - Stemonitis.
   b) Chytridiomyces - Chytridium
   c) Plasmodiophoromycetes - Plasmodiophora
   d) Oomycetes - Phytophthora, Sclerospora
   e) Zygomycetes - Mucor, Rhizopus.
   f) Plectomycetes Eurotium / Eupenicillium
   a) Pyrenomycetes - Chaetomium
   b) Discomycetes - Peziza
   c) Hymenomycetes - Pleurotus /Agaricus
   d) Gasteromycetes - Lycoperdon

e) Ustilaginomycetes - Ustilago
f) Uredinomycetes - Puccinia
g) Hypomycetes - Aspergillus, Penicillium.
h) Dematiacious Hypomycetes - Helminthosporium
i) Coelomycetes - Phomopsis
j) Mycelia sterilia - Rhizoctonia
k) Study of different Lichens

References:

1) Alexopoulas C J & Mims C W –1979 Introductory Mycology III edition,Wiley Eastern.,
2) New Delhi.
3) Deacon, J W –1997- Modern Mycology 3rd Edition, Blackwell Science publishers, London.
4) Mueller, G M; Bills, GF and Foster, M.S. (2004) biodiversity of Fungi, Elsevier Academic Press, new York.

I-SEMESTER - SOFT CORE

Plant Pathology

Theory

Unit-1: Concept of plant disease, Significance 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. Kochs' rules; 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. How Pathogens Attack Plants – Mechanical forces, Microbial enzymes and toxins, Growth regulators; Effect on Physiology of host – Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation.

Unit-2: Genetics of Plant Diseases and Resistance: Genes and Diseases, Mechanism of variability, Stages of variation in pathogens.Types of plant resistance to pathogens. Genetics of virulence in pathogens and of 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, Patterns of epidemics, Mathematical description, Comparison of epidemics, Development of epidemics, Plant Disease forecasting.

Unit-3: Management of Plant Diseases: Exclusion, Eradication, Immunization & developing resistance, Direct protection, Integrated control. Chemical methods of Plant Disease Control. Genetic engineering and crop 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.

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 Bajra and 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.

Practicals:

1) Estimation of foliar infection.
2) Splash liberation of spores from diseased tissue.
3) Estimation of total phenols in diseased and healthy plant tissues.

4) Seed health testing by SBM.
5) Study of the following diseases: Tobacco mosaic, Bacterial blight; Downy mildew of Bajra; Powdery mildew of cucurbits; Grain smut of sorghum; Leaf rust of Coffee; Leaf spot of mulberry; Bunchy top of banana, Grassy shoot of sugar cane.
6) Estimation of polyphenols in diseased and healthy plants.
7) Genetic testing of disease resistance in plants.
8) Study of effect of pathogens on seed germination and vigour index by paper towel method.
9) Study of effect of fungicide on seed-borne pathogens.

References:

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

Genetics, Plant Breeding and Evolutionary Biology

Theory

Unit 1: Genetics: Transmission Genetics: An over view of Mendelian Genetics; Extensions of Mendelian's principles, Quantitative inheritance, Extra nuclear inheritance, Linkage and crossing over, Tetrad analysis and mitotic recombination; construction of linkage maps. **Evolution of gene concept;** Alleles, Pseudoalleles, one mutant one metabolic block, one gene one enzyme concept, one gene one polypeptide concept, complementation test, cistron, muton, recon, rII locus in T4 phage, Intragenic mapping.

Unit 2:Recombination and gene mapping in Bacteria and Viruses: Molecular basis of gene mutation, repair and recombination: Mutation: DNA repair: Recombination: **Genetic and molecular basis of sex determination:** Molecular basis of sex determination and dosage compensation in Drosophila, Coenorhabiditis and man; **Epigenetic inheritance-** Introduction, dosage compensation, types, molecular basis of dosage compensation in Drosophila, man and Coenorhabditis, properties of inactive x chromosome, genome imprinting in xci, stability, applications of xci, genome imprinting, consequences and mechanism, life cycle of imprint, imprinting and diseases and regulation, evolution.

Unit 3:Plant Breeding: An overview of applications of plant breeding for crop improvement with particular reference to mutation breeding, polyploidy breeding, adaptive breeding, protection breeding and quality breeding. NBPGR, Plant Breeders Rights (PBR), transgenic plants (GMO's), somaclonal variation, protoplast fusion, gene transfer techniques, electroporation, electrofusion, biolistics, elite plants- golden rice.

Unit 4: Evolutionary Biology: Nature of Evolution:- Theories of origin of Universe, origin of Earth and origin of life; **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. **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, Polyploidy:** Autotetraploidy, Allotetraploidy and Polyploidy, **Molecular basis of evolution and Neo-Darwinian evolution.**

Practicals:

1) Drosophila Genetics: Study of life cycle of Drosophila, media preparation transfer of flies, identification of sexes, study of mutants.
2) Study of Monohybrid , Dihybrid and Sex-linked inheritance.
3) Polytene chromosome squash preparation.
4) Extraction of eye pigment in Drosophila by paper chromatography method.
5) Calculation of chiasma frequency.
6) Linkage problems- 3 point test cross, tetrad analysis.
7) Contributions of Scientists.
8) Models and Photographs related to evolution.
9) Study of floral biology of crops- typical examples of self and cross pollinated plants.
10) Techniques of Emasculation and hybridization.
11) Pollen viability; germination test and TTC test.

12) Budding, Grafting and layering.

References:

1) A.G. Atherly, J.R. Girton, J.R. Donald. 1999. The Science of Genetics. Saunders College
2) 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.
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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.
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11) Strickberger, Monroe W. 2000. Evolution. 3rd 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. 2nd Ed., D. Van Nostrand Company, 450 West 33rd 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: Stem: Arrangement of tissues, epidermis, cortical bundles, medullary bundles, steles of various types: Leaf-Structure of foliage leaves, petiole and node of dicot leaves, vascular system of moncot leaves, stem-leaf junction of monocots, structure of fern and gymnosperm leaves: Structure of modified leaves-Kranz anatomy and C_4 photosynthesis. Xerophytic and submerged foliage leaves, cataphylls, hypsophylls: Root-Structure of primary root, mucigel, epidermis, exodermis, dimorphic roots, root nodules.

Unit 2: Ultra structure of the cell wall and differentiation. Ultra structure and differentiation of xylem and phloem: tracheary elements and their differentiation, sieve elements and their differentiation. Meristems: Apical meristems, shoot apex of Pteridophytes, gymnosperms and angiosperms, root apex and intercalary meristems. Secondary growth of the plant body: Periderm, variations in wood structure. Anomalous secondary growth in climbers and monocots. Floral anatomy: Flower, flower parts and their arrangement, vascular system, floral meristem, origin and development of floral parts. Pathological Anatomy.

Unit 3: Plant Histochemistry: Minerals, Carbohydrates, Lignins, Polyphenols, Proteins, Nucleic acids and Histones, Lipids, Cutin, Suberin and Waxes, Ascorbic acid. Study of the instruments, their

principles and uses (a) Camera lucida, (b) Micrometry (c) Microtomes – sledge Rocking, Rotary (D) Fluorescence microscope (e) Electron Microscope.

Unit 4: Staining technique – Principles of histochemical stains, Killing, fixing & staining of plant tissues; Important reagents & chemicals needed in the fixatives; FAA, Carnoy's fluid, Navashins solution, fleminge**;** Dehydrating agents, mounting media, Double staining, Saffranin, Fast green, Embedding: TBA method, embedding for electron microscope, Sectioning**,** Whole mounts maceration. Histochemical- PAS Test**,** Sudan black lipids**,** Feulgen reaction – N acids.

Practicals:

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

Reference:

1) Abraham F. 1982. Plant Anatomy. 3rd edn. Pergaon 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.
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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.
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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
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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, Karya 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, Agrobiodivesity 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-pycinic, 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 propecties of phytochrone. Role played in signal transduction pathway stomatal physiology; **Phytosynthesis in higher plants** (i) Photophosphorylation (ii) Calvin cycle (iii) Photorespiration (iv) C_4 – 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_2 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 (Q10) of water uptake
7) Determination of water potential.
8) Estimation of Alpha-amylase activity in germinating seedlings.
9) Estimation of phenols in germinating seedlings.
10) Physiological identification of CAM in plant species.
11) Studies on Hypersensitive Reaction and SAR mechanisms due to biotic/ abiotic stress
12) Separation of chlorophyll pigments/Anthocyanin by TLC

13) Protein analysis by SDS PAGE method.

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.
2) Clayton, R.K. 1980. Photosynthesis: Physical mechanisms and chemical patterns. Cambridge Uni. Press, Cambridge.
3) Cohn, E.E., and Stumf, P.K. 1992. Outlines of Biochemistry. Wiley Eastern Pvt. Ltd.
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.
6) Mukherji, S., and GHosh, A.K. 1996. Plant Physiology. New Central Book Agency Pvt. Ltd. Kolkatta, India.
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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.
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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 Phytomorphognesis, Narosa Pub. House, New Delhi.

III- SEMESTER - HARD CORE 3.2

Molecular Biology

Theory

Unit 1: Nature of genetic material: Nucleic acid as genetic material; the primary and secondary structure of DNA and RNA; Organization of the Genetic material in prokaryotes and eukaryotes; mitochondrial and chloroplast DNA organization; **Replication of DNA:** Patterns of replication-experiments of Messelson's and Stahl, Cairns, Tailor, enzymes and proteins of DNA, replicating machinery, mechanism of replication-initiation, elongation and termination in prokaryotes and eukaryotes, fidelity of replication, proof reading mechanism, RNA directed DNA synthesis (reverse transcription).

Unit 2: Expression of Genome: Transcription - RNA polymerase-types, structure and function, mechanism of transcription-initiation, elongation and termination in prokaryotes and eukaryotes. Post transcriptional modifications-RNA processing, capping, polyadenylation, splicing, alternate splicing, exon, shuffling, structural organization of m-RNA, t-RNA and r-RNA, m-RNA transport; **Translation:** t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, the genetic code, deciphering of genetic code, degeneracy and Wobble hypothesis, enzymes, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins;

Unit 3: **Gene regulation in prokaryotes:** Cis regulatory factors, promoters, enhancers, operators, silencers-trans regulatory factors, transcription factors, regulation at transcription initiation-

operon concept-Lac operon-positive and negative control, tryp-operon, attenuation, ribosomal proteins as translational repressors, ribo switches, regulation in lytic and lysogenic cycle, induction and maintainance; **Gene regulation in eukaryotes:** Transcription activators, transcriptional repression, gene silencing by modification of histone and DNA (Deacylation and methylation), regulation after initiation of transcription, translational controls, RNA interference, m-RNA localization during development.

Unit 4: **Transposable elements:** Prokaryotic transposons, discovery, structure of IS elements, composite transposons, phage μ eukaryotic transposable elements-transposons discovery, AC-DS elements in maize, cpm/en elements in snapdragon, P elements in Drosophila, retrotransposons-retroviruses and retro transposons, copia and Ty elements, mechanism of transpositions, uses of transposons-as genetic markers, mutagens, transposon tagging for gene isolation and vectors for transformation;

Practicals:

1) Isolation and separation of plasmid DNA.
2) Isolation of plant DNA by CTAB method
3) Estimation of DNA by Diphenyl method
4) Estimation of RNA by Orcinol method
5) Gene expression studies- Bacterial transformations.

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, NewYork NY f 0016, USA.
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
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5) Malaciniski, G.M. and Freidfelder, D. 1998. Essentials of Molecular Biology 3rd Edition. Jones and Bartlet 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.
11) James D. Watson, Tania,. A. Baker, Stephen, P. Bell, Alexander ,Gannm, Michael Levine.2004. Molecular Biology of the gene. 5th Edition, Pearson Education.
12) 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 mictochondrial 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.
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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. 5th 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, Plyploidy 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. 3rd 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. 2nd Ed., D. Van Nostrand Company, 450 West 33rd Street, New York, N.Y. 10001

III-SEMESTER - SOFT CORE

Plant Biotechnology

Theory

Unit 1: Introduction: Plant Biotechnology- Concepts and Scope of plant biotechnology; **Plant Cell and Tissue culture: Culture media and cell culture;** Micropropagation of Plants;

Plasticity and totipotency, The culture environment, Plant cell culture media, the plant growth regulators, Culture types – callus, cell suspension cultures, Protoplasts, Root cultures, Shoot tip and Meristem culture, Embryo culture, Microspore culture. Plant regeneration- Somatic embryogenesis, Organogenesis. Applications of plant tissue culture.

Unit 2: Genetic Engineering: Principles and Methodology of genetic engineering; Applications of genetic engineering; transgenic plants and microbes and their applications. **Germplasm Storage:** Plant germplasm storage by Cryopreservation, Advantages of crypreservation. **Molecular maps of Plant genomes:** Plant genome sequencing and data utilization. RFLP Genetic maps in plants for conservation. **Biological control of Pests, Pathogens and weeds:** Biocontrol agents and Biopesticides; Biological control of crop pests; Biological control of Pathogens and weeds. Mycoherbicides.

Unit 3:Biofertilizers: Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Azospirillium, 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. Biofuel production from plants. **Healthcare Products from Plants:** Anticancer agents from higher Plants. Pharmaceuticals from Fungi. Plant Secondary metabolites and their pharmaceutical applications. Plant vaccines. **Mushroom cultivation:** Edible mushrooms cultivation, 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. **Seaweeds and Marine biotechnology:** Exploring **s**eaweeds for food, fodder, pharmaceuticals and therapeutic agents. **Bioremediation:** Cleaning environment; *In-situ* bioremediation. Phytoremediation. **Biodegradation:** Xenobiotics; Biodegrading agents; Treatment of Toxic pollutants, Advantages of Biodegradation. **Biotechnology of medicinal and aromatic plants:** Cultivation and exploitation 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 shoot tip culture and anther culture.
4) Biological control of insects through -*Bacillus thuringiensis*
5) Industrial production of ethanol from sugar and its estimation alcohol meter.
6) Preparation of biofertilizers such as *Rhizobium* and seed testing.
7) Single cell protein production-Shake flask culture- *Spirulina and Chlamydomonas.*
8) Biogas production from waste from anaerobic digester.
9) 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- OPEN ELECTIVE

Plant Propagation Techniques

Theory

1. Introduction – History, scope and importance of plant propagation.
2. Propagation structures with reference to green house equipment and media
3. Seed propagation – The development of seeds, techniques of seed production and handling principles and media
4. Vegetative propagation:
   a) Techniques of propagation by cuttings: Stem cuttings – hard wood, semi hard wood, soft wood and herbaceous, leaf cuttings, leaf bud cuttings, root cuttings.
   b) Biology and techniques of grafting: Whip and tongue, wedge and cleft, bark, side grafting, approach
   c) Techniques of budding: T – budding patch budding, chip budding, ring budding.
   d) Layering and its natural modifications: Simple layering, tip layering, mound or stool layering, air layering, compound or serpentine layering and trench layering.
   e) Propagation by specialized stems and roots
5. Micropropagation – Techniques and applications in forestry and horticulture.
6. Advantage, limitations and applications of vegetative propagation, clones, genetic variation in asexually propagated plants, different methods.
7. Propagation methods of some selected plants – Citrus, Grape, 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. Micropropagation: Preparation of media, preparation of explants, culture, initiation of shoot, multiplication (demonstration)
8. Pot & green house implants (demonstration)

References:

1. Abbottt, 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, Evergreen, Deciduous, 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: Plant Biogeography- The distribution of biomes, Major Terrestrial Biomes; Forests-Tropical Forests, Temperate Forests, Taiga, Grasslands, Savanna, Temperate Grasslands/Prairies, Tundra, Desert, Chaparral; The Changing Ecosystem- Characteristics of disturbances; Fire, Succession and Agriculture practices; Conserving the Earth's Resources: The value of biodiversity, The importance of species abundance, Habitat destruction, Invasive species, Pollution, Protecting habitats and species; Environmental Education Programmes- WWF, UNEP, IUCN, MAB, Biosphere Reserve.

Unit 3: Conservation Biology- Introduction**-** Endangered Species Act. National Biodiversity Conservation Strategy; Conservation Biology- Science in the Service of Biodiversity. Biodiversity and Its Value. Biodiversity issues, Concerns, Management. Biodiversity- Creation and Destruction, Geologic and Biogeographic Forces, Ecological Processes, Threats, Current Status. Conservation Strategies, Past, Present, and Future- Attitudes about Conservation, Emerging. Conservation Movements, Forging a National Strategy; Selecting Reserves- Biogeography. Representation, Tools for Inventory and Evaluation, Designing; Reserve Networks: History, Size and Scale, Management Considerations; Management of terrestrial, aquatic and mangrove vegetation.

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, pantropial. 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); Invasive alien species as threat to biodiversity.

Practicals:

1) Study of local vegetation by quadrate method.
2) Water analysis for pollution studies.
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) Croiat 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*, 4rd 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]
11) Ricklefs, R. E. 2001. *The economy of nature*. Fifth edition. Freeman, New York, NY, USA.

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, shall submit a Dissertation / report which will be evaluated as per university norms.

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 pathogenecity 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 Transuduction:** 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; genteics oh 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 lypoxygenease 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 2nd Edn. Academic Press NY.
3) Johnston A and Both C – 1983-Plant Pathologists Pocket-book. 2nd 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. Encylopedia of Plant Pathology.Viva Books Pvt.Ltd. New Delhi.

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: Importance of Seed Technology and Seed Testing. Development of Seed Technology in India and importance of Agriculture. Seed Biology: Seed Development; Morphology and Anatomy of Seed- Seed Structure in Angiosperms; Seed Industry: Progress of Seed Industry in India; Seed Programme bases- types involved- basic strategy for product planting and Organization of seed Programmes; General guidelines organization of use programme.

Unit 2: See Production: General Principles- 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 gracing; 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 certified, foundation and breeders seed- germplasm storage

Unit 3: Seed Quality Testing: Sampling, purity, germination, viability, moisture determination; weight determination; testing for cultivar purity; testing of coated seeds, tolerance tables; Molecular biology of seed protein; use of advanced technology for seed testing; seed vigour concepts and methods of evaluation

Unit 4: Seed Certification: Principles and Philosophy of Seed Certification, purpose and procedures, seed etc. 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; NBPGR).

Practicals:

1) Determination of physical purity of seed samples of four field crops.
2) Composition of pure crop seed of sample
3) Determination of moisture content using oven, infrared moisture balance; OSAW universal moisture meter
4) T.T.C. test for seed viability
5) Germination evaluation of various crops- Top of Paper method; Between Paper method and Sand method
6) Evaluation of seedlings in the above methods.
7) Vigour evaluation (a) conductivity test (b) Hiltner's test (c) Performance test (d) accelerated ageing test
8) Identification of common seeds using seed photos, seed manuals, seed atlas
9) Detection of mycoflora of stored seed samples by SMT/ PDA method.

References:

1) Agarawal P K 2006. Principles Of Seed Technology. Indian Council Of Agri. Reasearch, New Delhi.
2) Vanangamudi K; K Natarajan; T Saravanan; N Natarajan; R Umarani; A Bharathi and P Srimathi, 2006Advances in Seed Science and Technology : Vol: III: Forest Tree Seed Technology and Management, Agrobios, New Delhi.
3) Black Michael and Derek Bewley 2000. Seed Technology and Its Biological Basis Wiley-Blackwell (1 Jun 2000)
4) Amarjit S Basra – 2006. Handbook of Seed Science and Technology, The Haworth Press, USA-
5) Lawrence O Copeland – 1995. Principles of Seed Science and Technology- Kluwer Academic Publishers, The Netherlands.
6) Paul Neergaard. 2005. Seed Pathology, Palgrave – Macmillan, Denmark

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. Carbohydates 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, bevergares, biopolymers, antibiotics.

Unit 3: Biofertilizers: Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Azospirillium, 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 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.

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. 2nd 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, panchamahabhutas, 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.

Practicals:

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, 2nd edn. Agrobios, India.
3. Yoganarasimhan S N. Medicinal Plants of India- Vol 1- Karnataka, Interline Publishing Pvt. Ltd.

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