JSS Mahavidyapeetha

JSS College of Arts, Commerce and Science

(Autonomous, NAAC "A" grade, College with Potential for Excellence)

Ooty Road, Mysuru-25

Choice - Based Credit System (CBCS) Syllabus

M.Sc. Degree

BOTANY

Programme outcome:

The M.Sc. Botany programme aims to give confidence for students to take dependability for developing themselves throughout their studies at our College and will reflect the following post-graduate attributes.

PO1: Knowledge and understanding of the range of plant biology in terms of structure, function and environmental relationships.
PO2: Think logically and organize tasks into a structured form and assimilate knowledge and ideas based on wide reading of text books and through the internet.
PO3: Transfer of appropriate knowledge and methods from one topic to another within the subject.
PO4: Carry out practical work, in the field and in the laboratory, with minimal risk.
PO5: Apply the scientific knowledge of basic science, life sciences and fundamental process of plants to study and analyse any plant form.
PO6: Conduct investigations of complex problems by the use research-based knowledge on an independent term project
PO7: Apply reasoning informed by the contextual knowledge to assess plant diversity, and the consequent responsibilities relevant to the biodiversity conservation practice.

Program Specific Outcomes

At the completion of M.Sc. in Botany the students are able to:

PSO1. Evaluate the position of plant in the broad classification of systematics and in phylogenetic level.
PSO2. Explain different types, structure, life cycles of viruses, fungi, bacteria. And identify the plant diseases in field.
PSO3. Apply different life-science subjects like Genetics, Biochemistry, Biotechnology, Microbiology, Environmental Science to the analysis of relevant plant science.
PSO4. Use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth.
PSO5. Use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
PSO6. Explain how Plants function at the level of the gene and genome.
PSO7. Explain physiological adaptations, development, reproduction and mode of life cycle followed by different forms of plants.
PSO8. Relate the physical features of the environment to the structure of populations, communities, and ecosystems.
PSO9. Take up world-wide research opportunities to pursue PhD programme, and more knowledgeable to qualify UGC-CSIR, NET, K-SET and other competitive exams.

SEMESTER- I: **Credits: 22**

No	Paper Code	Course code	Title of the course paper	Hrs/wk L: T: P	Credits
1.	HARD CORE 1.1	BOA 010	Microbiology and Plant Pathology-Theory & Practical	2:2:2	4
2	HARD CORE 1.2	BOA 020	Algae, Bryophytes, Pteridophytes and Gymnosperms-Theory & Practical	2:2:2	4
3	HARD CORE 1.3	BOA 030	Taxonomy of Angiosperms and Economic Botany – Theory & Practical. # Field Study/ Tour	2:2:2	4+2=6
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 shall undertake a field trip of minimum of three days and shall submit the herbarium and report for evaluation for 02 credits (HC).

SEMESTER- II: **Credits: 20**

No	Paper Code	Course code	Title of the course paper	Hrs/wk L: T: P	Credits
1.	HARD CORE 2.1	BOB 010	Reproductive Biology of Angiosperms and Plant Morphogenesis-Theory & Practical	2:2:2	4
2	HARD CORE 2.2	BOB 020	Cell Biology and Genetics-Theory & Practical	2:2:2	4
3	HARD CORE 2.3	BOB 030	Plant Breeding and Evolutionary Biology– Theory & Practical	2:2:2	4
4	SOFT CORE 2.1		*To be Selected by the student	2:2:2	4
5	SOFT CORE 2.2		*To be Selected by the student	2:2:2	4
				Total	**12 + 08 = 20**

SEMESTER-III **Credits: 18**

No	Paper Code	Course code	Title of the course paper	Hrs/wk L: T: P	Credits
1.	HARD CORE 3.1	BOC 010	Plant Physiology and Biochemistry -Theory & Practical	2:2:2	4
2	HARD CORE 3.2	BOC 020	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	BOC 640	Plant Propagation Techniques	3:1:0	4
				Total	**08 + 06 + 04 = 18**

SEMESTER-IV **Credits: 18**

No	Paper Code	Course code	Title of the course paper	Hrs/wk L: T: P	Credits
1.	HARD CORE 4.1	BOD 010	Ecology, Conservation Biology and Phytogeography- Theory & Practical	2:2:2	4
2	HARD CORE 4.2	BOD 020	***Project Work		8
3	SOFT CORE 4.1		*To be Selected by the student	2:2:2	4
				Total	**12 + 04= 16**

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

Semester- Wise Credit Pattern:
I Semester = 22 [HC- 12+2=14 + SC-08]
II Semester = 20 [HC- 12 + SC- 08]
III Semester = 18 (HC- 08 + SC- 06 + OE- 04]
IV Semester = 16 (HC-12 + SC- 04]

In total= 46 (HC) + 26 (SC) + 4 (OE)
The Department is offering 76 Credits of M. Sc. Botany (CBCS) Course including ONE Open Elective Course to the outside Department Students.

***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	Course Code	Title of the Soft Course Papers	Hrs/wk L: T: P	Credits
1.	**I Semester**	BOA 210	Phycology	2:2:2	4
		BOA 220	Plant Pathology	2:2:2	4
		BOA 230	Mycology	2:2:2	4
2	**II Semester**	BOB 210	Plant Anatomy and Histochemistry	2:2:2	4
		BOB 220	Economic Botany	2:2:2	4
		BOB 230	Ethnobotany and IPR	2:2:2	4
3	**III Semester**	BOC 210	Plant Biotechnology	2:0:2	3
		BOC 220	Evolutionary Biology	2:0:2	3
		BOC 230	Plant Molecular Genetics	2:0:2	3
		BOC 230	Plant Propagation and Plant Breeding	2:0:2	3
4	**IV Semester**	BOD 210	Seed Technology	2:2:2	4
		BOD 220	Molecular Plant Pathology	2:2:2	4
		BOD 230	Biodiversity and Conservation Biology	2:2:2	4
		BOD 240	Plant Genetic Engineering	2:2:2	4

I SEMESTER- HARD CORE 1.1

Paper code BOA 010: Microbiology and Plant Pathology

Course outcomes:

After completing the course students should,

CO1. Learn the classification and characteristics of viruses, viroids, prions and diseases of it.

CO2. Deliberate in details with examples of Bacteria, archeabacteria, actinomycetes and mycoplasma and its economic importance.

CO3. Specify the Fungal diversity, life cycle and economic importance of fungi.

CO4. Understand in details of etiology, epidemiology and management of plant disease.

Theory

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

multiplication; Prions - Structure and multiplication. Prion diseases.

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

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

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

Practicals:

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

References:

1) Madigan, M.T. 2012. Brock Biology of Microorgasms, 13th Edn. Benjamin cummings.
2) Willey, J, Sherwood, L. and Woolverton, C.J. 2013. Prescott`s Microbilogy 9th Edn., Mc Graw-Hill Educations.
3) Wagner, E.K, and Hewlett, M.J. 2009. Basic Virology. Blackwell Science Ltd. II Edition, USA.
4) Kodo, C.I. and Agarwal, H.O. 1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, NY.

5) Conrat, F.H., Kimball, P.C. and Jay, L. 1988.Virology. Prentice Hall, Englewood Chiff, New Jercy.
6) Jawaid, A. Khan and Jeanne Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Food Products Press, NY
7) Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 2013. Introductory Mycology 4th Edn. Wiley.
8) Singh, R. S. 2009. Plant Disease. 9th Edn. Oxford and IBH Pub.Co. New Delhi.
9) Agrios, G. N. 2005. Plant Pathology 5th Edn. Academic Press San Diego.
10) Rangaswamy, G. and Mahadevan, A. 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
11) Mehrotra, R. S. 2003. Plant Pathology. 2nd Edn. Tata Mc Graw-Hill Pub. Co. Ltd., New Delhi.
12) Cann, A.J. 2012. Principles of Molecular Virology 5th Edn. Elsevier Ltd.
13) Flint, S.J. Enaquist, L.W., Rancnicllo, V. R. and Skalka, A.M. 2009. Principles of Virology pathogenesis and control 3rd Edn. ASP Press.
14) Hall, R. 2014. Plant virology, 5th Edn. Elsevier USA.
15) Aneja, K.R. 2003. Experiments in Microbiology plant Pathology and Biotechnology, 4th Edn. New age international Publishers.
16) Holt, J.G., Krige, N.R., Sneath., P.H.A. Stuley, J.T. and Williams, S.T. 2010. Bergey`s manual of determinative bacteriology, 9th Edn. Williams and wilkins. USA.

I SEMESTER - HARD CORE 1.2

Course Code BOA 020: Algae, Bryophytes, Pteridophytes and Gymnosperms

Course outcomes:

After completing the course students should,

CO1. Understand the details of diversity, distribution, pigmentation and life cycle of algae.

CO2. Deliberate in depth of Bryophytes life cycle, classification, phylogeny and economic importance.

CO3. Understand the details of Pteridophytes life cycle, classification, economic importance and anatomy.

CO4**.** Write down in details with examples Gymnosperms history, reproduction and interrelationship.

Theory

Unit 1: Diversity and distribution of algae: Unicellular, colonial, filamentous, heterotrichous, parenchymatous, pseudoparenchymatous, siphonous forms in algal classes, General

characteristics and phylogeny: **Pigmentation in algal groups:** Role of photosynthetic and accessory pigments, **Life cycles in algae:** Haplontic, diplontic, isomorphic, heteromorphic; Economic importance of algae.

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

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

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

References:

1) Bower, F.O 1935. Primitive land plants, Macmillan, London
2) Campbell, D.H. 1972 Evolution of land plants (Embryophyta, central Book Department Allahabad
3) Watson, E.V 1971. The structure and life of Bryophytes Hutchinson and Co. Ltd. London
4) Parihar, N.S. 1970 An Introduction to Embryophyta Vol. 1. Bryophyta. Central Book Department Allahabad.
5) Prempuri, 1981. Bryophytes, Morphology, growth and differentiation. Atmaram and sons Delhi.
6) Nayar, M.C., Rajesh, K.P. and Madhusoodanan, P.V. 2005. Bryophytes of Wyanad.
7) Murthy, AVSS. 2005. A text book of algae. IK International Pvt., Ltd., New Delhi.
8) Bold, H. C. and Wynne, M.J. 1978. Introduction to the algae. Structure & reproduction. Prentice Hall.

9) Chapman & Chapman. 1973. The Algae. Macmillan Co., NY
10) Fritsch, F. E. 1935. Structure & reproduction of Algae Vol. I & II. Cambridge Univ. press, London
11) Odum, E.P. Fundamentals of Ecology. III ed. Toppan Co., Ltd., Japan
12) Round, F. E. 1973. Biology of the algae. Edward Arnold Ltd., London
13) Smith, G.M. 1951. Manual of Phycology. Pub. Co. Waltham., Mass.
14) Venkataraman, G.S. et al., 1974. Algae form and function. Today & tomorrow's Pub., New Delhi.
15) South, G. R. & Whittick, A. 1987. Introduction to Phycology. Blackwell Scientific Publication, UK.
16) Hoek, V., Mann, D. G. & Jahns, H. M. 1995. An introduction to Phycology. Cambridge University Press.
17) Biswas, C. and Johri, B. M. 1997. The Gymnosperms. New Age Publishers, New Delhi.
18) Rashid A. 1986. An Introduction to Pteridophytes. Vikas, New Delhi.
19) Sporne K. R. 1969. Morphology of Gymnosperms. Hutchinson University Library, London
20) Sporne K. R. 1969. Morphology of Pteridophytes. Hutchinson University Library, London

I-SEMESTER - HARD CORE 1.3

Course code BOA 030: Taxonomy of Angiosperms and Economic Botany

Course outcomes:

After completing the course students should,

CO1. Understand the principles and applications of Taxonomy of angiosperms.
CO2. Specify the details of major systems of classification of angiosperms.
CO3. Deliberate in details with examples Dicot and monocot family features.
CO4. Specify in details with examples about significance of economic products.

Theory

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

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

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

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

Practicals:

1) Preparation of Herbaria.
2) A field trip to a floristically rich area to study plants in nature.
3) Identification of the flowering plants in and around Mysore using keys, floras and monographs.
4) Field survey for collection of important plants of the region.
5) Study of locally available economic products of plant origin.
6) Medicinal Plants and their uses.

***Field Study**: Every student shall undertake a field study/ Plant collection Tour of Minimum three

days and submit report for evaluation during practical examination.

References:

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

I SEMESTER - SOFT CORE
Course code BOA 210: Phycology

Course outcomes:

After completing the course students should,

CO1. Specify in depth of thallus organization and pigmentation in algae.
CO2. Understand the details of life cycles and mass cultivation of algae.
CO3. Deliberate in depth about bloom forming algae and diatomaceous earth.
CO4. Specify the details of Algal community and diverse environment.

Theory

Unit 1: History and development of Phycology in India and contributions; **Thallus organization in algae**: Cyanophyceae; Chlorophyceae; Charophyceae, Euglenophyceae; Xanthophyceae; Bacillariophyceae; Phaeophyceae; Rhodophyceae: Affinities, general characteristics and phylogeny; **Pigmentation in algae:** Structure of chlorophyll a, b, c1, c2, xanthophylls, carotenoids, accessory pigments; Colorless algae: *Astasia, Phacus, Hyalophacus*

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

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

Unit 4: Algal communities of extreme environments: Thermal hot springs; cold springs; snow, ice **Fresh water ecology**: Ecological classification of fresh water organisms; Lentic communities: pond, lake, bog, swamp; lotic communities: streams, rapids, pools, adaptations of stream forms; **Marine Ecology**: Marine Biota; zonation; quantitative study of phytoplanktons; marine communities.

Practicals:

1) Study of Diatoms: fresh water forms
2) Study of planktonic forms of lakes of Mysore city
3) Mounting of Botrydium from soils; rhizocysts
4) Chlorophyceae: Chlorella, Ulva; Chaetophora, Chlorella

5) Phaeophyceae: Sphacelaria, Cystophyllum
6) Rhodophyceae: Gracilaria, Gelidium, Polysiphonia
7) Cyanophyceae: Microcystis, Nostoc, Spirulina
8) Economic products of algae: spirulina tablets; agar agar; beta carotene (Dunaliella salina)
9) Study of diversity of marine algae
10) Visit to institutes

References:

1. Bold, H. C. and Wynne, M.J. 1978. Introduction to the algae. Structure & reproduction. Prentice Hall.
2.. Chapman & Chapman. 1973. The Algae. Macmillan Co., NY
3. Fritsch, F. E. 1935. Structure & reproduction of Algae Vol. I & II. Cambridge Univ. press, London
4.Odum, E.P. Fundamentals of Ecology. III ed. Toppan Co., Ltd., Japan
5. Round, F. E. 1973. Biology of the algae. Edward Arnold Ltd., London
6. Smith, G.M. 1951. Manual of Phycology. Pub. Co. Waltham., Mass.
7. Venkataraman, G.S. et al., 1974. Algae form and function. Today & tomorrow's Pub., New Delhi.

I SEMESTER - SOFT CORE

Course code BOA 220: Plant Pathology

Course outcomes:

After completing the course students should,

CO1. Learn the details of the Concept, causative agents and disease cycle of plant pathogens.
CO2. Specify the details of mechanism of plant resistance to pathogens.
CO3. Deliberate the details of Management of plant diseases.
CO4. Identify in details with examples of diseases in crop plants.

Theory

Unit-1: Concept of plant disease, Economic aspects of plant diseases, Types of plant diseases, Infectious diseases, Non-infectious diseases, Causative Agents of Plant Diseases: Fungi, Bacteria, Mollicutes, Viruses and Viroids, Protozoa and Nematodes, Angiospermic parasites. Development of Plant Pathology, Plant Pathology in Practice- Plant Clinic and Plant Doctor Concept. Parasitism and pathogenicity, Host range of pathogens, Disease triangle, Disease cycle / Infection cycle. Infections and colonization, Weapons of plant pathogens, Effect of pathogen on Physiology of host plant (Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation).

Unit-2: Genes and Diseases, Types of plant resistance to pathogens (Horizontal and Vertical Resistance). 'R' Genes and 'avr' genes, Genetics of virulence in pathogens and resistance in host plants. Breeding for disease resistance. Défense Mechanisms of Plants (Pre-existing structural and chemical defences, Induced structural and biochemical defences). Plant Disease Epidemiology: Elements of an epidemic and development of epidemics, Plant Disease forecasting.

Unit-3: Management of Plant Diseases: Exclusion, Eradication, Cross protection, Direct protection, Integrated disease management, Chemical methods of Plant Disease Control. Biotechnological approaches to plant disease management. Gene Silencing and disease control, Mechanism of gene silencing and control of viral diseases. Engineered resistance to viral, bacterial, fungal and insect diseases of crop plants.

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

Practicals:

1) Isolation of bacterial, fungal, and nematode plant pathogens of crop plants.
2) Study of mineral deficiency diseases of Tomato and French bean.
3) Estimation of foliar infection by Stover's method.

4) Study of spore germination.
5) Estimation of total phenols in diseased and healthy plant tissues.
6) Mycoflora analysis by Standard Blotter Method SBM/agar plating method.
7) – 11) Study of Tobacco mosaic, Bacterial blight; Downy mildew of Maize; Powdery mildew of cucurbits; Grain smut of sorghum; Leaf rust of Coffee; Root Knot of Mulberry. Bunchy top of banana, Grassy shoot of sugar cane, Little leaf of Brinjal; Potao Spindle Tuber Disease (PSTVd)
12) Study of effect of pathogens on seed germination and vigour index.
13) Study of effect of fungicide on seed-borne pathogens.
14) Study of Fungal bio-control agents.

References:

1) Agrios, G. N. 2005. Plant Pathology 5th edn. Academic Press, San Diego.
2) Dickinson, M. 2003. Molecular Plant Pathology, Garland Publishing Inc, CT.
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5) Lane, C.R., Beales P.A. and Hughes, K.J.D. 2012. Fungal Plant Pathogens, CABI Publishing, Wallingford.
6) Mehrotra, R. S., 2003. Plant Pathology, 2nd edn. Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.
7) Rangaswamy, G. and Mahadevan, A. 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
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9) Singh, R. S., 2009. Plant Diseases. 9th edn. Oxford and IBH Pub.Co. New Delhi.
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I SEMESTER - SOFT CORE

Course code BOA 230: Mycology

Course outcomes:

After completing the course students should,

CO1. Learn in details with examples of mycology.
CO2. Deliberate in depth about assessment of fungal diversity.
CO3. Specify in details with examples of micro and macro fungi on plants.
CO4. Understand the details of Fungal association with other living world.

Theory

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

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

Unit-3: Macro fungi and Micro fungi living on plant substrata including fruits. Terrestrial and Lignicolous macrofungi. Lichenized Fungi. Sequestrate Fungi; Micro fungi on wood and plant debris; Endophytic fungi, Saprobic Soil fungi, Fungi in stressful environment. Mutualistic, arbuscular, and endomycorrhizal fungi, Yeasts, Fungicolous fungi; Fungi in fresh water habitats. Marine and estuarine mycelial Eumycota and Oomycota. 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 associated 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 fungal media /agar slants for isolation of different groups of fungi.
2) Isolation of slime moulds.
3) Isolation of aquatic fungi.
4) Isolation of soil fungi by serial dilution technique.
5) Staining of fungi by Cotton blue Tryphan Blue.
6) Study of Myxomycetes.

7) Study of Chytridiomycetes
8) Study of Plasmodiophoromycetes
9) Study of Oomycetes
10) Study of Zygomycetes
11) Study of Ascomycetes
13) Study of Basidiomycetes Study of Deuteromycetes
14) Study of Lichens

References:

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

II SEMESTER - HARDCORE - 2.1

Course code BOB 010: Reproductive Biology of Angiosperms and Plant Morphogenesis

Course outcomes:

After completing the course students should,

CO1. Learn the details of reproductive biology of angiosperms

CO2. Specify in details with examples about Mega sporogenesis, fertilization, endosperm and embryo

CO3. Specify the details of Models and concepts of plant morphogenesis

CO4. Understand in details with examples of plant growth and development, photomorphogenesis

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*

Plant Morphogenesis:

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

References:

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

II- SEMESTER - HARD CORE 2.2
Course code BOB 020: CELL BIOLOGY AND GENETICS

Course outcomes:

After completing the course students should,

CO1. Specify the characteristics of Biomolecules and their interaction.
CO2. Deliberate the details of intracellular organelles.
CO3. Learn in details with examples chromosomal theory of inheritance and gene concept.
CO4. Understand the details of Gene mapping, sex determination and dosage compensation.

Theory

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

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

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

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

Practicals

1. Determination of reducing sugars by Nelson-Somogyim's method.

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

References:

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

II- SEMESTER - HARD CORE 2.3

Course code BOB 030: Plant Breeding and Evolutionary Biology

Course outcomes:

After completing the course students should,

CO1. Learn in depth about plant breeding methods and techniques.
CO2. Understand the details of breeding for specific purposes.
CO3. Learn the details of Nature of evolution.
CO4. Identify the characteristics of variation and speciation.

Theory:

Unit 1 Introduction: Objective and role of plant breeding, The evolution of plant breeding, scope of plant breeding, sciences related to plant breeding, The vavilov concept, Recent trends in plant breeding. **Breeding Methods:** Plant introduction and Acclimatization, Domestication and agriculture, pure line, clonal, mass and progeny selections, recurrent selection, Pedigree, bulk and back cross methods, Heterosis breeding synthetic and composite varieties. **Breeding Techniques:** Mutation breeding, Polyploidy, Hybridization, Tissue culture techniques in crop improvement, protoplast fusion, electrophoration, electro fusion, biolistics, somatic hybridization, Transgenic plants (Gmo's), The role of Gene technology in plant breeding.

Unit 2 Breeding for Specific Purposes: Breeding for disease resistance, insect resistance, drought and salinity, quality trait, multiple cropping systems, Ideotype breeding, breeding for Adaptation. **Crop breeding and seed production:** Breeding field crops, seed production techniques, release of new varieties, intellectual property rights, computer application in plant breeding, Crop breeding Institutes/ centers. Genetic Resources and Germplasm conservation. **Scientific Plant breeding** Green revolution, The elite crop (Golden rice), **Modern Plant breeders:** M.S. Swaminathan, Norman E. Borlaug, N.I. Vavilov.

Unit 3 Nature of evolution: The origin, Theories of Evolution of life, Earth and Universe, condition of the early earth, Emergence of the first living cell, origin of Prokaryotic and Eukaryotic cells, life in the Paleozoic, Mesozoic and coenozoic era. **Development of Evolutionary thoughts,** Ecological context, Before Darwin, Darwinsim, Darwins evolutionary theory, Neo – Darwinism, modern synthesis. **Fossil evidence of Ancient life,** fossilization, Interpreting Geological tombs and fossil record. Evidences from comparative, morphology, Patterns of Development, Comparative Physiology and Biochemistry, Biogeography, Paleontology, Taxonomy, Anatomy and Embryology, plant and animal breeding, Evidence from changing earth and sea. Extinctions. Evolutionary ecology.

Unit 4 Natural Selection : Types of natural selection, selective forces, selection models, sexual selection, selection and nonadaptive characters, Adaptive radiation, Artificial selection, **Variation :** Gene flow, Genetic drift, Gene Mutation – mendelian concept, Chromosomal mutation, Architectural changes in chromosomes, The Hardy – Weinberg law, Polyploidy in plant evolution**, Speciation and origin of higher categories :** Types of speciation, Models of speciation, pattern of speciation, Isolating Mechanism and species formation, signification of speciation. Evolution at the Molecular level; Evolution and biodiversity conservation.

Practicals

(1) Study of floral biology of crops - typical examples of self and cross Pollinated plants.
(2) Selfing and Hybridization techniques - Bagging, Emasculation

(3) Pollen viability : germination test and TTC test

(4) Studying of Centre's of origin of cultivated crops - N.I. Vavilov concept.

(5) Mode of pollination study in different crops

(6) Identification of crop breeding Institutes/ centers, logos

(7) Studying and identification of contributors of plant breeding - M.S. Swaminathan, N.I. Vavilov, Norman . E. Borlaug .

(8) Contributions of scientists to Evolutionary biology

(9) Models and Photographs related to evolution.

(10) Group activity.

References:

1) A.G. Atherly, J.R. Girton, J.R. Donald. 1999. The Science of Genetics. Saunders College Publishers. Fortworth.
2) A.J.F. Griffith, W.M. Gelbart, J.H. Muller and R.C. Lewintin. 1999. Modern Genetic analysis. W.H. Freeman and co. N.Y.
3) D. Hartl. 1991. Basic Genetics. II edn. Jones and Barlett Publishers Inc. Boston.
4) D.J. Fairbanks and W.R. Anderson. 1999. Genetics the continuity of life. Brooks's/Cole publishing company. California.
5) R.J. Brooker. 1999. Genetics –analysis and principles. Addison Wesley Longman Inc. California.
6) Snustad, D.P., Simmons, M.J. and Jenkins, J.R. 1997. Principles of Genetics. Hohn Wiley & son's inc. N.Y.
7) T.A. Brown. 1989. Genetics a molecular approach. Van Nostrand Reinhold (intn) Co., Ltd. London.
8) Tamarin, 1985. Principles of Genetics. V. edn. WC Brown publ. Co.
9) Winchester, A.M. 1969. Genetics. III edn. Oxford and IBH, New Delhi.
10) Strickberger, Monroe W. 2000. Evolution. 3rd Ed., Jones & Bartlett Publishers, Inc. 40 Tall PineDrive Sudbury, MA 01776, United States of America
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12) 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
13) Chopra, V.L. 2000. Plant Breeding- theory and practices. Oxford and IBH Publishing Co. Pvt. Ltd.
14) Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of Plant Breeding. Narosa Publishing House, New Delhi.

II- SEMESTER - SOFT CORE

Course code BOB 210: Plant Anatomy and Histochemistry

Course outcomes:

After completing the course students should,

CO1. Learn in details of primary vegetative body of the plants.
CO2. Deliberate in details of differentiation in vascular tissues and study of apical meristems in shoot and root.
CO3. Deliberate the characteristics of secondary growth.
CO4. Understand the details of Plant histochemistry.

Theory

Unit 1: Primary vegetative body of the plant: Anatomical features of leaf, stem and root (Both Dicot and Monocot), leaf of fern and gymnosperm. Structure of modified leaves- Kranz anatomy and C4 photosynthesis. Ultrastructure and chemistry of the cell wall, formation of the cell wall and its uses.

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

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

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

Practicals:

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

Reference:

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2) Cariquist S, 1967. Comparative Plant Anatomy- Holt Reinert and Winston, NY.
3) Cutter D G, 1971. Plant Anatomy- Part 1, Cell and Tissues Edward Arnold London.
4) Cutter D G, 1971. Plant Anatomy- Part 1, Cell and Tissues Edward Arnold London. Part- II

5) Eames and McDaniel 1947, II edn., " Plant Anatomy" McGraw Hill, N.Y.

6) Esau K 1965, Plant Anatomy, Joh Wiley and Sons, N.Y.

7) James D Mauseth, 1998. Plant anatomy The Benzamin/ Cummins Publishing Co.Inc.

8) Katherine Esau, 1979, Anatomy of seed plants- first Wiley eastern reprint. New Delhi.

9) Krishnamurthy K. V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers and Publishers) Pvt. Ltd. Madras.

II- SEMESTER - SOFT CORE

Course code BOB 220: Economic Botany

Course outcomes:

After completing the course students should,

CO1. Specify the details of cereals, millets, pulses, oil yielding plants and study of horticultural plants and floriculture.
CO2. Deliberate the characteristics of study of sugar yielding plants, spices and condiments.
CO3. Identify the details of sugar yielding plants, spices and condiments.
CO4. Understand the importance of medicinal plant.

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 - SOFT CORE

Course code BOB 230: Ethnobotany and IPR

Course outcomes:

After completing the course students should,

CO1. Write down in depth of ethnobotany and its significance.
CO2. Write down the characteristics of Modern medicine and ethnobotany.
CO3. Specify the details of methodology in ethnobotany.
CO4. Deliberate in depth ethnobotany and legal aspects.

Theory

Unit 1: Ethnobotany: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Ethnic groups and Ethnobotany: Major and minor ethnic groups or Tribals of India, and their life styles. Forest Vs. ethnic groups; Plants in Tribal life with reference to Magico-religious rituals and social customs. Sacred groves.

Unit 2: Methodology of Ethnobotanical studies: a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places f) Protocols.

Unit 3: Role of ethnobotany in modern Medicine with special examples; Medico-ethnobotanical sources in India with special reference to Karnataka; Tribals Vs. Agriculture: Shifting, Podu and Jhum cultivation. Role of ethnic groups on surrounding environment. Crop Genetic sources. Endangered taxa and forest management (participatory forest management).

Unit 4: Ethnobotany and legal aspects. Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Ethnobotany as a source (recent) of already known drugs: a) *Withania* as an antioxidant and relaxant b) *Sarpagandha* in brain ailments c) *Becopa* and *Centella* in epilepsy and memory development in children d) *Phyllanthus fraternus* in diabetic and viral jaundice e) *Artemisia* as a powerful cerebral antimalarial agent and its possible use in tuberculosis. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Practicals:

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

References:

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
3) Lone et al,. Palaeoethnobotany
4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons

– Chichester

7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
8) Rajiv K. Sinha – 1996. Ethnobotany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur.
9) Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. London.

III- SEMESTER - HARD CORE 3.1
Course code BOC 010: Plant Physiology and Biochemistry

Course outcomes:

After completing the course students should,

CO1. Learn in details with application of Chromatography, Spectroscopy, Electrophoresis and Centrifugation.
CO2. Understand in depth Solute transport and photosynthesis in plants.
CO3. Specify the details of Nitrogen metabolism, proteins and enzymes.
CO4. Understand in depth Stress physiology.

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) C4 – Pathway (Cycle); (v) CAM in plants; Oxidative Phosphorylations; (i) Glycolysis (ii) TCA – Cycle (iii) ET – Chain.

Unit 3: Nitrogen metabolism (i) Molecular mechanism of N2 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) Separation of chlorophyll pigments/Anthocyanin by TLC
8) Protein analysis by SDS PAGE method.
9) Estimation of Alpha-amylase activity in germinating seedling.

References:

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11) Walsh, C.T. 1979. Enzymatic reaction mechanisms. Editors: W.H. Freeman, New York.
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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 3.2
Course code BOC 020: Molecular Biology

Course outcomes:

After completing the course students should,

CO1. Identify the characteristics of Genetic materials and its replication.
CO2. Learn the details of Molecular basis of Mutation, repair and recombination.
CO3. Deliberate the details of RNA formation, processing of RNA and post-RNA.
CO4. Understand in depth of Gene regulation in prokaryotes and eukaryotes.

Theory:

Unit 1: Nature of genetic material: nucleic acids as genetic material, nucleic acid primary and secondary structure and types, **Organization of chromosomes and genes in prokaryotes and eukaryotes**- operon, interrupted genes, gene families, unique and repetitive DNA, heterochromatin, euchromatin, transposons, mitochondrial and chloroplast genome organization, Transposable elements in prokaryotes and eukaryotes, genetic and evolutionary significance, **DNA replication**- patterns, Messelson and Stahl and Taylor's experiment, enzymes of replication, mechanism of DNA replication in prokaryotes and Eukaryotes, proof reading and error correction mechanisms

Unit 2: Molecular mechanism of mutation, repair and recombination:- Mutation-DNA damage by spontaneous mutations, physical and chemical mutagens and their molecular mechanisms, **Repair mechanisms**- direct reversal of damage, base and excision repair, recombinational repair, SOS repair, translesion repair synthesis, transcription coupled repair, **Recombination**-homologous recombination, models of recombination, mechanisms, protein machinery of homologous recombination, genetic consequence of homologous recombination, gene conversion, site specific recombination, mechanism and biological significance, non homologous recombination- transposition, molecular mechanisms of transposition-conservative, replicative and retrotransposition

Unit 3: RNA synthesis, processing and translation: transcription activators and repressors, promoters, RNA polymerases and transcription factors, mechanism of transcription in prokaryotes and eukaryotes, **RNA processing**- capping, polyadenylation, splicing, alternative splicing, RNA editing, exon shuffling and RNA transport, **Translation and processing**- ribosomes, tRNA aminoacylation, aminoacyl tRNA synthetase, genetic code, wobble hypothesis, deciphering of the code, translation mechanism , translation proof reading, translation inhibitors and post translation modifications

Unit 4: Regulation of gene expression in Prokarytes: Operon concept, regulation at transcription initiation- lac and trp operon control, regulation of lytic and lysogenic cycles in lambda phage, regulation beyond transcription initiation-premature termination- trp operon, ribosomal proteins as translational repressors, riboswitches, **Regulation of gene expression in eukaryotes**-transcription activators and repressors, regulation after transcription initiation-alternative splicing, translational control in ferretin and tranferrin mRNA, RNA interference, role of chromatin in regulation of gene expression and gene silencing.

Practicals:

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

References:

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4. Lodish, H. Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell,J. 2000. Molecular Cell Biology 4th Edition. W.H. Freeman and Co. New York, USA
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.

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11. Molecular Biology of the gene. 5th Edition, Pearson Education.Philip M Gilmartin and Chris Bowle.2002. Molecular Biology of Plants. Vol 1 & 2 Oxford University Press.

III- SEMESTER- SOFT CORE

Course code BOC 210: Plant Biotechnology

Course outcomes:

After completing the course students should,

CO1. Understand in depth about plant tissue culture and its techniques
CO2. Specify in details about haploid production and its significance
CO3. Understand the details of Suspension culture and its techniques
CO4. Learn the details of Biofertilizers, extraction of biofuels and bioremediation

Theory

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

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

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

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

Practicals:

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

References:

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

III- SEMESTER- SOFT CORE

Course code BOC 220: Evolutionary Biology

Course outcomes:

After completing the course students should,

CO1. Learn in depth Nature of evolution and history.

CO2. Identify the development of evolutionary thoughts and its theory.

CO3. Specify the characteristics of variations, speciation and details of polyploidy.
CO4. Understand the characteristics of Mathematics in evolution.

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

Course code BOC 230: Plant Molecular Genetics

Course outcomes:

After completing the course students should,

CO1. Specify the details of genetic tools of plants, with reference to gene regulation and sequencing.

CO2. Understand in depth responses of genes during stress condition and molecular development of flowers.

CO3. Identify the details of the Biology and Genetics of *Agrobacterium tumefaciens*.
CO4. Identify in details with application of Proteomics, Genomics and Bioinformatics.

Theory

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

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

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

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

Practicals:

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

References:

1) Buchmann, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. ASPP Press, USA
2) Ausubel, F.M., Brent, R., Kingston, R.E., Moore, D.D., Seidman, J.G., Smith, J.A., and Struhl, K. 2005. Current protocols in molecular biology. Current Edition.
3) Brown, T.A. 2000. Essentials of Molecular Biology. Vol. I & II, Oxford University Press.
4) Potrykus, I., and Spangenberg, G. 1995. Gene transfer to plants. Springer, Berlin, Heidelberg.
5) Watson, J.D., and Baker, T.A., Bell, S.P. Gannm, A. and Levine, M. 2004. Molecular Biology of

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

III- SEMESTER- SOFT CORE

Course code BOC 240: Plant Propagation and Plant Breeding

Course outcomes:

After completing the course students should,

CO1. Learn the techniques of Seed propagation, cutting, budding and micropropagation.

CO2. Specify in details with application of plant genetic resources and selection of self-pollinated crops.

CO3. Understand the types of plant breeding, fertility regulation mechanisms and genetic basis of heterosis.

CO4. Learn in details with application of crop improvement by breeding, tissue culture method and molecular approaches.

Theory

Unit -1 **Introduction -** History, Scope and importance of Plant propagation, Propagation structures with reference to greenhouse equipment and media. **Seed Propagation** – The development of Seeds, techniques of seed production and handling principles and media. Vegetative Propagation: **Techniques of propagation by cuttings –** hard wood, Semi hard wood. Soft wood and herbaceous, leaf cuttings, leaf bud cuttings, root cuttings. Biology and techniques of grafting: Whip and tongue, wedge and cleft, bark, slide grafting approach. **Techniques of budding:** T – budding patch budding, chip budding, ring budding. Layering and its natural modifications: Simple layering, tip layering, Mound or stool layering, air layering, Compound or Serpentine layering and trench layering. Propagation by specialized stems and roots. **Micro propagation –** techniques and applications in forestry and horticulture Advantage, limitations and applications of vegetative propagation, clones, genetic variation in asexually propagated plants, different methods. Propagation methods of some selected plants – Citrus, grape, mango, mulberry, hibiscus, rose, croton, Eucalyptus.

Unit -2 **Introduction:** Historical events related to plant breeding, objectives of plant breeding, salient achievements of plant breeding, Agencies engaged in Plant breeding. **Plant Genetic resources, Origin, Conservation and Utilization :** Centers of origin of crop plants, Exploration and collection of plant Genetic Resources, Evaluation of Germplasm collection, Documentation, Conservation of plant Genetic Resources, Utilization of Genetic Resources. **Application of selection of self – pollinated crops :** The theory of pure line selection – Genetic basis, Sources of Genetic variation in pure lines, the land variety (races). **Medellian Consequences of Planned hybridization in self – pollinated crops :** Early experiments on hybridization in plants, planned hybridization. **Quantitative Inheritance :** Basis of Genetic Analysis, Analytical procedure, Interpretation of Estimated parameters. Applications of Biometrical Genetics in plant breeding.

Unit -3 **Types of Plant breeding Methods**: Pedigree Method, Bulk population breeding method, the single seed descent method, Back cross Method, **Fertility regulating Mechanisms :** Manual or Mechanical control, Genetical control, Incompatibility, Male sterility, Genetic engineering for Male sterility, chemical control, **Genetic Basis of Heterosis :** Introduction, effects of Heterosis, Interbreeding depression, Conventional theories of Heterosis, Biometrical approach to Heterosis, breeding for Heterosis. **Synthetic and composite varieties :** Genetic basis, procedure for developing **synthetic and composite varieties :** Genetic basis, procedure for

developing synthetic varieties, Assessment of General combining ability. **Breeding for resistance to disease and insect pests :** The host, the pathogen, types of Genetic Resistance, Genetic basis of Host – pathogen Interaction, breeding methodology, development of multi varieties, breeding for Horizontal resistance, combining 'VR' and 'HR'.

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

Practicals

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

References:

1. 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.

III- SEMESTER- OPEN ELECTIVE
Course code BOC 640: Plant Propagation Techniques

Course outcomes:

After completing the course students should,

CO1. Learn the details of importance of plant propagation.

CO2. Understand different vegetative propagation techniques like cuttings, grafting, budding and layering.

CO3. Learn the techniques of budding and layering.

CO4. Deliberate in details with examples of micropropagation in forestry and horticulture plants

Theory

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

Unit- 2: Vegetative propagation: Techniques of propagation by cuttings: Stem cuttings – hard wood, semi hard wood, soft wood and herbaceous, leaf cuttings, leaf bud cuttings, root cuttings; Biology and techniques of grafting: Whip and tongue, wedge and cleft, bark, side grafting, approach.

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

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

Practicals

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

References:

1) Abbott, A.J. and Atkin, R.K. (9eds.) 1987 Improving vegetatively propagated crops. Academic press, New York.

2) Bose, T.K., Sadhu, M.K., & Das, P., 1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
3) Hartmann and Kester, 1983. Plant propagation
4) Hartmann, H.T., Kester E.D., Davis, F.T., and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.
5) Krishnamurthy. H.M. 1981. Plant Growth substances including application in Agriculture.
6) L.M. Pierik 1987. In vitro culture of Higher plants Murtinus Nijhoff pub. Dordrecht.
7) M.K. Razdan 1994. An Introduction to Plant tissue culture, Oxford and IBH Pub. Co., PVT. Ltd., Bombay and Calcutta.
8) Mac Donald, B. 1987. Practical woody plant propagation for nursery growers. Portland, OR: Timber press.
9) Sadhu, M.K. 1989. Plant propagation Wiley eastern Ltd. N. Delhi.

IV- SEMESTER- HARD CORE 4.1

Course code BOD 010: Ecology, Conservation Biology and Phytogeography

Course outcomes:

After completing the course students should,

CO1. Deliberate in depth scope of ecology and their interaction.
CO2. Learn in details with examples of habitat ecology and environmental education programmes.
CO3. Specify the details of Biodiversity and conservation biology and protected area of India
CO4. Learn in depth of Phytogeography and remote sensing.

Theory

Unit 1: Introduction and scope of Ecology- Plants and the environment- plant adaptation, ecotypes**;** Life Cycles and Life History- Life span, Plant growth, Frequency of reproduction, Life history strategies; Habitat Ecology- Fresh Water and Marine water ecology (ecosystems), Wetlands and their Characteristics; Plant Communities and Ecosystems- Species diversity, Community structure, Ecosystem function; Interactions among Plants- Competition, Commensalism and Parasitism, Mutualisms, Herbivory.

Unit 2: Habitat ecology & Environment - The distribution of biomes, Major Terrestrial Biomes; Forests-Tropical Forests, Temperate Forests, Taiga, Grasslands, Savanna, Temperate Grasslands/Prairies, Tundra, Desert, Chaparral, Management of terrestrial, aquatic and mangrove vegetation; The Changing Ecosystem- Characteristics of disturbances; Fire, Succession and Agriculture practices; Pollution, Protecting habitats and species; Environmental Education Programmes- WWF, UNEP, IUCN, MAB.

Unit 3: Biodiversity & Conservation Biology- Science in the Service of Biodiversity. Biodiversity and its value. Biodiversity issues, Concerns, Management. Biodiversity Hot spots. Biodiversity-Creation and Destruction, Threats & current status of biodiversity. Invasive alien species as threat to biodiversity. Conservation Strategies, Past, Present, and Future-Attitudes about Conservation, Conservation Movements; Endangered Species Act. 2002(GOI) National Biodiversity Conservation Strategy; Geologic and Biogeographic Forces, Selecting Reserves-Biogeography, Representation, Tools for Inventory and Evaluation; Protected area Network of India- History, size and scale & management.

Unit 4: Phytogeography- Physical features of the world, India & Karnataka. Climatic zones, tectonics, continental movements; Types of plant distribution – discontinuous distribution - land bridge theory, continental drift, polar oscillation, shifting of poles, glaciation: continuous distribution-cosmopolitan, circumpolar, circumboreal, circumaustral, 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).

Practicals:

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

References:

1) Polunin N 1961, Introduction to plant geography
2) Good R.D. 1974, Geography of the flowering plants.
3) James H. Brown, Biogeography, II Edition 1998.
4) Cain SA 1944, Foundations of plant Geography.
5) 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*, 4 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

Course code BOD 020: Project Work

Course outcomes:

After completing the course students should,

CO1. Learn the details of literature survey and methodology in research.
CO2. Learn the method of Writing scientific reports and developing knowledge in publications.
CO3. Understand in details of Multiple research methodology and justification of data.
CO4. Understand the current trends in research and implementation of new techniques.

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

IV- SEMESTER- SOFT CORE

Course code BOD 210: Seed Technology

Course outcomes:

After completing the course students should,

CO1. Learn the details of Development of seed science and technology.
CO2. Deliberate the details of General principles of seed production.
CO3. Specify in details of Seed quality testing and its applications.
CO4. Understand the Seed certification and plant variety protection.

Theory

Unit 1: An introduction to Seed Science and Technology and its Goals, Development of Seed Technology Industry in India. Seed as basic input in agriculture, Seed Biology: Seed development, morphology and anatomy of dicot and monocot seeds. Seed structure and functions. Seed programmes and organizations: Seed village concept, seed production agencies, seed industry and custom seed production in India. International Seed Science and Technology Organizations.

Unit 2: General Principles of seed production in self and cross pollinated and vegetatively propagated crops; Hybrid seed production; Maintenance of inbred lines and breeders seeds; Synthetic and composite seeds; Improved seed and their identification. Germplasm Banks, Seed Processing: Harvesting- seed drying, seed cleaning and 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, Seed treatment.

Unit 3: Seed quality Testing: Devices and tools used in seed testing. ISTA and its role in seed testing. Seed Sampling: Physical purity and heterogeneity test. Seed moisture content: importance and determination and methods, Viability and Vigour Testing, Genetic purity testing: objective and criteria for genetic purity testing, Seed health Testing: field and seed standards; designated diseases, objectionable weeds - significance of seed borne diseases, Seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes. Testing of GM seeds and trait purity. Preparation and dispatch of seed testing reports; storage of guard samples; application and use of seed standards and tolerances.

Unit 4: Seed Certification: Principles and Philosophy of Seed Certification, purpose and Procedures, National Seed Programme: National Seed Corporation- agencies responsible for achieving self reliance in seed production and supply of quality of seeds (State Seeds Corporation; National Seed Development Council- Central Seed Committee; Seed market surveys, seed industry in relation to global market , concept of WTO, GATT, IPR, Plant Variety Protection and its significance; UPOV and its role.

Practicals:

1) Determination of physical purity of seed samples.
2) Determination of composition of pure seed.
3) Determination of seed Heterogeneity.
4) Visual examination of dry seeds for disease symptoms. (Any five).
5) Determination of moisture content by hot air oven method.

6) Determining seed viability by T.T.C. test.
7) Determination of seed germination by TP/BP/Sand method.
8) Evaluation of seedlings vigour by BP/Sand methods.
9) Seed vigour evaluation by (a) conductivity test (b) Hiltner's test (c) Performance test (d) accelerated ageing test.
10) Examination of suspensions obtained from washings of seed.
11) Infection sites studied by planting seed components.
12) Detection of seed-borne fungi and their characters of five seed borne pathogens.
13) Identification of common seeds using seed photos, seed manuals, seed atlas.
14) Visit to seed industries/seed companies to understand seed processing.

References:

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

IV- SEMESTER- SOFT CORE

Course code BOD 220: Molecular Plant Pathology

Course outcomes:

After completing the course students should,

CO1. Understand the details of molecular diagnosis of plant diseases and pathogenicity.
CO2. Identify the characteristics of Pathogenesis and signal transduction.
CO3. Deliberate the details of Plant disease and resistance.
CO4. Deliberate in depth of Host pathogen interaction and management of disease by biotechnological methods.

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 Transduction:** Recognition of the pathogen by the host, transmission of the alarm signal to the host Défense providers. Necrotic Défense 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

Course code BOD 230: Biodiversity and Conservation Biology

Course outcomes:

After completing the course students should,

CO1. Specify the classification and characteristics of Genetic, species, Agro, ecosystem diversity of plants.
CO2. Deliberate the details of values, uses and loss of biodiversity.
CO3. Learn the characteristics of Conservation and management of plant biodiversity.
CO4. Understand the details of Biodiversity and biotechnology.

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

Course code BOD 230: Plant Genetic Engineering

Course outcomes:

After completing the course students should,

CO1. Deliberate the details of Genetic engineering and its tools.
CO2. Understand the characteristics of Binary vectors for plant transformation and its techniques.
CO3. Specify in depth about Genetic manipulation in herbicide, pest and plant disease resistance.
CO4. Learn the details of improvement of crops for yield, quality and stress tolerance.

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.

JSS College of Arts, Commerce and Science

(Autonomous, NAAC "A" grade, College with Potential for Excellence)

Ooty Road, Mysuru-25

SCHEME OF EXAMINATION/ASSESSMENT

MODEL QUESTION PAPER (THEORY)

M.Sc., Degree ------Semester Examination May/June-20--

BOTANY

Course/Paper: ……

Course/Paper Code……..

Time: 3 Hrs **Max Marks: 70**

Instructions: 1) Answer all questions.
2) Draw neat and labelled diagrams wherever necessary.

I. Answer the following; (14 MCQs of 1 Marks each) **14 X 1 = 14**

3 from Unit I
4 from Unit II
3 from Unit III
4 from Unit IV

II.

2 from Unit I with internal choice **10 X 1 = 10**
2 from Unit I with internal choice **4 X 1 = 4**

III.

2 from Unit II with internal choice **10 X 1 = 10**
2 from Unit II with internal choice **4 X 1 = 4**

IV.

2 from Unit III with internal choice **10 X 1 = 10**
2 from Unit III with internal choice **4 X 1 = 4**

V.

2 from Unit IV with internal choice **10 X 1 = 10**
2 from Unit IV with internal choice **4 X 1 = 4**

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SCHEME OF PRACTICAL EXAMINATION/ASSESSMENT

MODEL QUESTION PAPER (PRACTICALS)

M.Sc., Degree I Semester Examination May/June-2018

BOTANY

Course/Paper: ……

Course/Paper Code…….

Time: 3 Hrs **Max Marks: 70**

Q I. Conducting Experiment/Micro-preparation /Plant identification	15
Q II. Minor experiment/ Demonstrations/ Procedure Writing	10
Q III. Critically comments (3x5 Marks)	15
Q IV. Identification 5x2 Marks)	10
Q V. Viva-voce examination	10
Q VI. Class Records/ Submissions	10