



**GULBARGA UNIVERSITY**  
**DEPARTMENT OF BOTANY**

**M Sc BOTANY**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**SEMESTER SYLLABUS**  
**&**  
**SCHEME OF INSTRUCTION/EVALUATION**

***(W E F ACADEMIC YEAR 2017-18 ONWARDS)***

**MARCH 2017**

## **PREAMBLE**

*Botany- the Plant Science today is a fusion of the traditional components with the modern aspects of molecular biology and biotechnology. Over the years, botany has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. The plant biologists, with global recognition of the need for conservation, have contributed significantly in assessing plant diversity. The plant taxonomists have explored newer dimensions for the classification of plants. In recent years new insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical researches. The challenging areas of teaching and research have emerged today in many areas of botany. The Department of Post-Graduate Studies and Research in Botany established after the foundation of Gulbarga University, Kalaburagi in fulfillment of the long-standing needs and aspirations of the people of Hyderabad Karnataka aims in achieving academic excellence in its innovative teaching and research programs diversifying into emerging and interdisciplinary areas of Plant Sciences. Further it is essential for the postgraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the subcellular level. A revision of the curriculum, keeping in view both the advances in the subject area and the students of this region will have the benefit of a balanced course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and environmental botany. All these aspects have been carefully crafted and spread over four semesters. The present course curriculum is proposed to provide an opportunity to the students to engage themselves with the learning of modern theories, tools and techniques in plant sciences; further applied courses have also been incorporated keeping in mind employment potential. These courses shall provide the botany students hands on experience and professional inputs. The present curriculum, on the whole, is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in botany with the new curriculum will be a complete botanist at postgraduate level. The well organized curricula including basic as well as advanced concepts in the plant sciences shall inspire the students for pursuing higher studies in botany with greater employability for becoming an excellent academician, researcher and an entrepreneur.*

The M Sc in Botany is a two-year course spread over four semesters comprising theory and practicals. The eligibility, intake, attendance and examination are governed by the university course regulations.

### COURSE STRUCTURE: M SC BOTANY

| MASTER OF SCIENCE (M SC) BOTANY: SEMESTER CBCS & CAGP SCHEME |                                   |        |           |
|--|-----------------------------------|--------|-----------|
| II- Semester   |                                   |        |           |
| Code   | Title of the course               | L: T:P | Credits   |
| <b>Hard Core</b>   |                                   |        |           |
| HCT 2.1  | Ecology and Environmental Biology | 4:0:0  | 4         |
| HCT 2.2  | Plant Anatomy and Embryology      | 4:0:0  | 4         |
| <b>Soft Core(Any One)</b>                                    |                                   |        |           |
| SCT 2.3.1  | Medicinal and Aromatic Plants     | 4:0:0  | 4         |
| SCT 2.3.2  | Methods in Plant Sciences         |        |           |
| <b>Open Elective</b>   |                                   |        |           |
| OET 2.4  | Biofertilizers and Biopesticides  | 4:2:0  | 6         |
| <b>Practicals</b>  |                                   |        |           |
| HCP 2.5  | Ecology and Environmental Biology | 0:0:2  | 2         |
| HCP 2.6  | Plant Anatomy and Embryology      | 0:0:2  | 2         |
| SCP 2.7.1  | Medicinal and Aromatic Plants     | 0:0:2  | 2         |
| SCP 2.7.2  | Methods in Plant Sciences         |        |           |
| <b>Total for Second Semester</b>                             |                                   |        | <b>24</b> |

Lecture (L): Tutorial (T): Practical/Practice (P)

*Note: A Compulsory Botanical Study Tour shall be undertaken by the students at the end of the M Sc First Semester*



## M Sc BOTANY SEMESTER-II: THEORY COURSES

### BOT: HCT 2.1 ECOLOGY AND ENVIRONMENTAL BIOLOGY

#### **Preamble**

*The paper deals with ecology and environmental biology giving their concept, components, classification and characters. The students on exposure to this paper would learn the structure and function of different ecosystems in particular and the atmosphere in general and become aware of the climatic change, environmental issues, environment protection and conservation.*

#### **Unit-I**

[16 hrs]

Ecosystem: Concept and components; Tropic structure; Diversity and characters of major ecosystems- Aquatic, Terrestrial; Productivity- Primary production and measurement of primary productivity; Energy flow in ecosystems; Biogeochemical cycles- Water, Carbon, Nitrogen, Sulphur and Phosphorus.

#### **Unit-II**

[16 hrs]

Communities: Classification, structure and characteristics- Analytic and Synthetic; Plant succession- Views and types; Climatic climax; Genecology- Concepts, ecotypes and ecads; Soil: Formation, profile and properties; Soil erosion and conservation; Plant interaction- Competition and allelopathy; Water bodies and their classification; Methods and importance of rain water harvesting.

#### **Unit-III**

[16 hrs]

Environmental Biology: Definition, scope and importance; Structure and composition of atmosphere- Lithosphere, Hydrosphere and Biosphere; Pollution- Air, Water and Land- Sources of pollutants and their effects on plants; Management of pollutants; Green house effect, ozone depletion and acid rain; Climate change and its effects on vegetation and crop productivity; Environmental Toxicology: Definition, toxic chemicals, pesticides and insecticides; Bioaccumulation and their effects.

#### **Unit-IV**

[16 hrs]

Environmental monitoring and management- Biological and physicochemical monitoring; Remote sensing and geographical information system; Biodegradation of pollutants. Environmental protection and conservation: Environmental education and awareness, Environmental Protection Acts, Current environmental issues in India

[64 hrs]

#### **References**

1. Fundamentals of Ecology: Odum EP ( 1971)
2. Elements of Ecology and field Biology : Robert Leo, Smith (1980)
3. Concepts of Ecology: Kormondy E J (1989)
4. Ecology and Environment : Sharma PD (1999)
5. A Text book of plant Ecology : Ambasht RS and Ambasht N K (1999)

6. Terrestrial Plant Ecology: Barbour MG, Burk JH and Pitts WD (1987)
7. Ecology : Begon M, Harper JL and Townsend CR ( Blackwell, Oxford 1996)
8. Ecology: Principles and Applications: Chapman JL and Reiss MJ (Cambridge Univ Press 1998).
9. Ecology: Paul, John Wiley & Sons ( New York 1993)
10. Principles of Environment Science: Enquiry and Applications Cunningham WP and Cunningham M A (2<sup>nd</sup> Edn, Tata McGraw Hill, New Delhi 2004)
11. Natural Resource Management: Jha L K (APHA Pubs, New Delhi 1997)
12. Environmental Science: Kemp M J (Tata McGraw-Hill, New Delhi 1997).
13. Fundamentals of Geographical Information Systems: John Michael & N Demers (2008)
14. Ecology of Natural Resources: Ramade F (John-Wiley & Sons, New York 1991).
15. Essentials of Ecology and Environmental Sciences: Rana S V S (Prentice-Hall 2005)

## **BOT: HCT 2.2 PLANT ANATOMY AND EMBRYOLOGY**

### ***Preamble***

*The paper describes plant anatomy and embryology in their historical perspectives giving theories of organisation, ultrastructure and tissue systems in exemplary plant species. The students on learning of this paper would be acquainted with micro as well as mega-sporogenesis, embryogenesis, pollination and fertilization.*

### **Unit-I**

[16 hrs]

Plant Anatomy-Introduction and history; Primary and Secondary cell walls, Ultra structure and chemistry of cell wall; Theories of organization of shoot and root, apical meristems; Ultrastructure and histochemistry of Cambium; Xylem-Ontogeny, Phylogeny, Evolution, ultrastructure and functions; Wood anatomy- Softwood and Hard wood; Phloem-Ontogeny, phylogeny, evolution. Ultrastructure and their functions.

### **Unit-II**

[16 hrs]

Dermal tissue system- types of trichomes & stomata and their importance in plant identification; Anomalous primary and secondary growth in *Achyranthus*, *Nyctanthus*, *Boerhaavia*, *Bougainvillia*, *Aristolochia*, and *Tinospora*.

### **Unit-III**

[16 hrs]

Embryology: Introduction and history; Male gametophyte- Microsporogenesis; Tapetum-Types and functions; Pollen structure and sporopollinin; Female gametophyte- Megasporogenesis; Organization of mature embryo sac, synergids and antipodals; Nutrition of Embryo sac. Pollination- Brief account, Structure, Histo-chemical details of style and stigma; Pollen germination and fertilization.

### **Unit-IV**

[16 hrs]

Endosperm: Structure and development of endosperms; Embryogenesis- Monocot and dicot embryo development; Somatic embryogenesis; Polyembryony and Apomixis; Intra ovarian pollination, *in vitro* pollination and fertilization.

**[64 hrs]**

## References

1. Anatomy and Activities of Plants- A guide to the study of flowering Plants: Clegg CJ and Cox G (1974)
2. Applied Plant Anatomy: Longman Cutler, D F (NY 1978).
3. Plant Anatomy: Experiments and interpretation. Part-1 Cells and Tissues: Cutter E, Edward Arnold (London 1969)
4. Plant Anatomy: Experiments and Interpretation. Part-2. Organs. Cutter E, Edward, Arnold (London 1971)
5. An introduction to plant anatomy: Eames E J and McDaniel's, Mc Grew Hill (NY, London 1947).
6. Plant Anatomy 2<sup>nd</sup> Edn: Esau K (1965)
7. Plant Anatomy 2<sup>nd</sup> Edn: Fahn A, Pregmon (1974).
8. Methods in Plant Histo-Chemistry. Krishnamurthy K V, Vishwanathan S (Madras, 1988).
9. Plant Anatomy: Roy K (New Central Book Pvt Ltd, Calcutta 2006).
10. An Introduction to Embryology of Angiosperms: Maheshwari P (McGrew Hill, New York 1950).
11. The Embryology of Angiosperms: Bhojwani S S and Bhatnagar S P (4<sup>th</sup> rev edn, Vikas, New Delhi 2000).
12. Molecular Embryology of flowering plants: Raghavan V (Cambridge Univ Press, 1997).
13. Embryogenesis in angiosperms- A developmental and experimental studies: Raghavan V (Cambridge Univ Press, NY 1986).
14. Pollen Biotechnology for crop production and improvement: Shivanna K R and Sawhney V K (eds) (Cambridge Univ Press, 1997).

## BOT: SCT. 2.3.1 MEDICINAL AND AROMATIC PLANTS

### **Preamble**

*The course is designed for students to understand the role of plants in traditional health care systems e.g. Ayurveda, Siddha, Unani, Homeopathic and Tibetan systems and to know how the ethno medicine could be the source for developing new modern drugs. Students are not only exposed to cultivation practices of medicinal plants and the impact of microbes on their products but also help build their career.*

### **Unit-I**

[16 hrs]

Ethnobotany and ethnomedicine: History and importance of ethno-botany and ethnomedicine in modern health care system; Basic concepts and development of Traditional systems of medicine- Ayurveda, Tibetan, Unani, Siddha systems and ethno medicines of Hyderabad Karnataka Region.

### **Unit-II**

[16 hrs]

Herbal drugs-Methods of preparation and their use in the treatment of coronary, respiratory, urinary, gastrointestinal, gynecological, nervous, diabetics, cancer and other common disorders; Plants used as general tonics; Medicinal food plants- Cereals, pulses, vegetables and wild food plants.

**Unit-III**

[16 hrs]

Cultivation and microbial association: Cultivation of medicinal and aromatic plants - *Chlorophytum borivillianum*, *Cassia angustifolia*, *Stevia rebaudiana*, *Aloe vera*, *Gloriosa superba*, *Withania somnifera*, *Mentha piperata*, *Ocimum sanctum* and *Cymbopogon flexuosus*. Methods employed in disease and pest control, harvesting and storage of crude drugs; Post-harvest care, deterioration and disintegration of active compounds by microbes.

**Unit-IV**

[16 hrs]

Pharmacognosy- Raw drug analysis, microscopic and macroscopic characteristics; Preliminary chemical analysis of *Mentha piperata*, *Ocimum sanctum*, *Withania*, *Rauwolfia*; Phytochemistry- Classification and properties of alkaloids, steroids, terpenoids, lectins, non-proteinous amino acids; Controversial drugs and IPR related to medicinal and aromatic plants.

[64 hrs]

**References**

1. Anatomy and Activities of Plants- A guide to the study of flowering plants: Clegg CJ and Cox G (1974)
2. Indian Medicinal Plants: Kirtikar KR and Basu B D (1932)
3. Indian Materia Medica Vol I & II: Nadkarni A K(1954)
4. Ayurvedic drugs and their plant sources: Sivarajan V V and Indira B (Oxford &IBH, New Delhi 1994).
5. Pharmacognosy 12<sup>th</sup> edn: Trease G E and Evans W L (Bailliere Tindall, London 1983).
6. Some controversial drugs in Indian Medicine: Vaidya B (Chaukamba Orientalia, Varanasi 1982)
7. Phytochemical Methods: Harborne J. Edr (Chapman & Hall, London 1984).
8. The chemotaxonomy of plants: Smith P M (Edward Arnold, London 1976).

**BOT: SCT 2.3.2 METHODS IN PLANT SCIENCES****Preamble**

*The paper explains the basic principle, construction and working of optical microscopes, chromatographic techniques, electrophoresis, spectrophotometers; polymerase chain reaction, mass spectrometer and x-ray diffraction spectrometer etc. The students on learning of these techniques would gain experimental skills for application of these methods to biological analysis*

**Unit-I**

[16 hrs]

Microscopy- Micrometry, different types of microscopes & their working. Microbial techniques: Sterilization methods; Isolation from soil, air, water and other substrates; Fungal and bacterial stains; Culture media; Aerobiological techniques: Spore sampling techniques- Slides, Petri plates, vertical cylinder, Anderson sampler and Burkard spore trap.



**Unit-II**

[16 hrs]

Chromatography: Principles, working and application of Paper chromatography, Thin layer Chromatography (TLC), Column Chromatography, Gas Chromatography, HPLC. Centrifugation- Centripetal & Centrifugal forces; sedimentation coefficient, factors affecting sedimentation; Different types of centrifuges.

**Unit-III**

[16 hrs]

Working and principle of pH meters: Glass electrode, Reference electrode, Combination Electrode pH meters; Electrophoresis: Basic principles, components of an Electrophoretic unit, factors affecting electrophoretic mobility; Different types of Electrophoresis and their applications

**Unit-IV**

[16 hrs]

Spectroscopy: Principle of Beer- Lamberts law; Colorimetry, flame photometry & UV-VIS spectrophotometer; Polymerase Chain Reaction- Principle and working mechanisms; Applications of PCR techniques. Principles and applications of MS, UV, IR and XRD spectrometer

**[64 hrs]****References**

1. Genome Analysis – A Laboratory manual Vol.-I: Analyzing DNA-Birren *et al.* (Panima, New Delhi/Blore 2006).
2. Principles of gene manipulation- An introduction to genetic engineering: Bold R W and Primerose S B (Black Well, London)
3. Introduction to plant Biotechnology: Oxford and IBH, New Delhi.
4. Experimental Biology-A Laboratory Manual: Datta A (Narosa, New Delhi 2009).
5. Research methodology for Biological Sciences: Gurumani N (2006).
6. Microscopy and microtechniques: Marimuthu R (2011)
7. Principles and Methods of plants molecular Biology, Biochemistry and Genetics: Pratibha Devi (Agrobios, India 2000).
8. Molecular Biology and Biotechnology-A practical manual: Purohit SD (Apex Pubs, Jaipur 2007)
9. Gel electrophoresis of Nucleic acid – A practical approach. III edition Rick Wood D and Hames B D (Oxford. New York 1990)
10. Plant Secondary Metabolites: Shukla Y M, Dhruve J J, Patel N J, Bhatnagar R, Talati J G and Kathiria K (New India, Delhi 2009).
11. Bioinstrumentation: Veera kumara ( MJP Publication 2006)
12. Microbiology of Atmosphere: Gregery P H (Leonard Hill, Bucks 1961)
13. Fungal spores, their liberation and dispersal: C T Ingold (Oxford Univ Press, London 1971)
14. Principle of diagnostic techniques in Plant Pathology CAB International: Fox R T V. (Wallingford, UK. 1993).
15. Plant Pathology and Tissue culture: V. N. Pathak (Wiswa Prakashan, New Delhi 1993)

## BOT: OET. 2.4.1 BIOFERTILIZERS AND BIOPESTICIDES

### Preamble

The paper introduces plants used as biofertilizers and biopesticides giving their role in the field applications with both advantages and limitations. The students on reading this material would be versatile in the use and application of these plant based biofertilisers and biopesticides for crop improvement and protection

### Unit-I

[16 hrs]

Biofertilizers– Definition and classification; Role of biofertilizers in modern agriculture- Advantages and constraints; Bacterial biofertilizers- General account of *Azospirillum*, *Azotobacter*, *Frankia*, *Phosphobacteria* and *Rhizobium*. Mass production of *Azospirillum*, *Azotobacter* and *Phosphobacteria*.

### Unit-II

[16 hrs]

Cyanobacteria (BGA) as biofertilizers - General account of *Anabaena*, *Cylindrospermum*, *Gloeocapsa*, *Lyngbya*, *Nostoc*, *Plectonema* and *Tolypothrix*. Symbiotic association of cyanobacteria; Field application of cyanobacterial inoculants; *Azolla* as biofertilizer.

### Unit-III

[16 hrs]

Mycorrhizae as biofertilizer - General account and applications of mycorrhizae; Methods of collection, wet sieving, decanting and inoculums production; Culturing of mycorrhizae; Application of mycorrhizae; *Trichoderma* as biofertilizer.

### Unit-IV

[16 hrs]

Biopesticides- their application; Advantages over chemical pesticides; Biocontrol of plant diseases; Fungal and Bacterial biopesticides- *Trichoderma* and *Bacillus thuringiensis*; Bioinsecticides- Insecticidal plants, bacteria and fungi as insecticides.

[64 hrs]

### References

1. A Textbook of Biotechnology: Dubey R C (Chand & Co, New Delhi 2008).
2. Recent Developments in Nitrogen Fixation: Newton W E *et al.*, (Academic, NY 1977)
3. The Biology of *Frankia* and *Actinorhizal* Plants: Schwintzer C R and Tjepkema J D (Academic, San Die go, USA 1990).
4. Nitrogen Fixation : Stewart W D P and Gallon J R (Academic Press, New York 1980)
5. Advances in Agricultural Microbiology: Subba Rao N S (Oxford & IBH, New Delhi 1982).
6. Soil Microbiology. 4th ed. Soil Microorganisms and Plant Growth: Subba Rao N S (Oxford & IBH, New Delhi (2002).
7. Microbial Interactions in Agriculture and Forestry vol-I: Subba Rao N S and Dommergues, Y R (Oxford & IBH, New Delhi 1998).
8. Mycorrhiza : Verma A (Springer Verlag Berlin 1999)
9. Mycorrhizae: Wallanda *et al.* (Backley's Pubs, Netherlands).

## M Sc BOTANY SEMESTER-II: PRACTICALS

### **BOT: HCP. 2.5 Ecology and Environmental Biology**

1. Determination of leaf area by Planimeter method
2. Determination of available soil moisture by Moisture meter.
3. Determination of stomatal index
4. Determination of organic content of soil.
5. Determination of Soil pH using pH meter.
6. Determination of DO in water.
7. Determination of minimum size of the quadrat by species area curve method.
8. Study frequency of herbaceous plants by applying law of frequency.
9. Study plant abundance and density by quadrat method.
10. Meteorological instruments and their working principles.

### **BOT: HCP. 2.6 Plant Anatomy and Embryology**

1. Preparation of Fixatives and Stains
2. Preparation of double stained permanent slides.
3. Preparation and Identification of Transverse Section of the following plants: *Tridax procumbens*, *Boerhaavia diffusa*, *Bougainvillea spectabilis*, *Achyranthes aspera*, *Nyctanthus arbo-terrestris*, *Calotropis procera*, *Aristolochia indica*, *Tinospora cordifolia*.
4. Preparation and identification of the following wood based on T.S, T.L.S and RLS sections: *Michelia champaka*, *Dalburgia sisoo*, *Tectona grandis* (Teak), *Azadirachta indica* (Neem).
5. Anomalous Primary Structure and Secondary growth with reference to following: *Nyctanthus*, *Acyranthus*, *Boerhavia*, *Leptadina*, *Piper*.
6. Preparation of Microtome sections and staining procedures
7. Identification of different developmental stages of Embryo sac.
8. Identification of different developmental stages of Anther.
9. Histo-chemical staining: Cellulose, Callose, Chitin, PAS reaction and Lignin.

**Note:** Submission of 10 permanent slides

### **BOT: SCP. 2.7.1 Medicinal and Aromatic Plants**

1. Identification of medicinal plants
2. Preliminary tests for the occurrence of secondary metabolites
3. Separation of Alkaloids (TLC)
4. Estimation of Phenols
5. Estimation of essential oils
6. Identification of raw drugs- Pharmacognostic studies.
7. Identification of controversial drugs.

**BOT: SCP. 2.7.2 Methods in Plant Science**

1. Demonstration of sterilization methods
2. Isolation of bacteria and fungi from soil and plant parts
3. Demonstration of serial dilution technique
4. Plasmid culture
5. Demonstration of pH meter, UV-Visible spectra, Chromatography and PCR.
6. Chromatography-separation of pigments