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

	III-Semester		
	Hard Core		
HCT 3.1	Genetics, Cell and Molecular Biology	4:0:0	4
HCT 3.2	Plant Physiology and Metabolism	4:0:0	4
	Soft Core(Any One)		
SCT 3.3.1 SCT 3.3.2	Genetic Engineering Bioenergy and Biofuels	4:0:0	4
	Open Elective		
OET 3.4	Medicinal Plants	4:2:0	6
	Practicals		
HCP 3.5	Genetics, Cell and Molecular Biology	0:0:2	2
HCP 3.6	Plant Physiology and Metabolism	0:0:2	2
SCP 3.7.1 SCP 3.7.2	Genetic Engineering Bioenergy and Biofuels	0:0:2	2
	Total for Third Semester		**24**

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-III: CBCS-CAGP SCHEME OF INSTRUCTION/EVALUATION

Sem	Course	Paper	L:T:P	Credits	Teaching hrs/Week	Int Assessment		Semester Exam		Total Marks
						Duration hrs	Marks	Duration hrs	Marks	
III	BOT:HCT 3.1	Genetics, Cell and Molecular Biology	4:0:0	4	4	1	20	3	80	100
	BOT:HCT 3.2	Plant Physiology and Metabolism	4:0:0	4	4	1	20	3	80	100
	BOT:SCT 3.3.1 BOT:SCT 3.3.2	Genetic Engineering Bioenergy & Biofuels	4:0:0	4	4	1	20	3	80	100
	BOT: OET 3.4	Medicinal Plants	4:2:0	4	4	1	20	3	80	100
	BOT: HCP 3.5	Genetic, Cell and Molecular Biology	0:0:2	2	4	1	10	3	40	50
	BOT: HCP 3.6	Plant Physiology and Metabolism	0:0:2	2	4	1	10	3	40	50
	BOT: SCP 3.7.1 BOT: SCP 3.7.2	Genetic Engineering Bioenergy & Biofuels	0:0:2	2	4	1	10	3	40	50

M Sc BOTANY SEMESTER-III: THEORY COURSES

BOT: HCT. 3.1 GENETICS, CELL AND MOLECULAR BIOLOGY

Preamble

The paper concerns genetics, cell and molecular biology exposing the molecular basis of Mendelism, chromosomal theory of sex determination and dealing on inheritance, gene mapping, population genetics, Cell cycle, transposable elements, epigenetics, gene regulations, RNA & Protein synthesis, DNA replication and repair mechanisms and the basic elements of cancer. The paper enhances the level of self-confidence in students and motivates them to understand the recent developments in biological sciences at molecular level.

Unit-I [16 hrs]

Mendelism: Pre-Mendelian, Mendelian and Post-Mendelian genetics; Inheritance: Molecular basis for Mendelism, Chromosomal theory of sex determination, hormonal influence on sex differentiation, dosage compensation, sex determination in plants; Cytoplasmic inheritance and male sterility in plants, gene mapping. Hardy-Weinberg's law: factors effecting allelic frequencies in population- Mutation, migration, nonrandom mating, selection, random genetic drift; Gene: Gene, operon, interrupted genes, gene families, unique and repetitive DNA, C- value paradox.

Unit-II [16 hrs]

Cell cycle: Regulation of CDK-cyclin activities, cellular check points, DNA replication in prokaryotes and eukaryotes, enzymes involved, origin and fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms; Transposable elements: Eukaryotic transposons- Ac/Ds system in maize, P-elements in drosophila and Retro-elements; Transposable elements in man, prokaryotic transposons- Insertion and composite sequences; Epigenetics: Role of environment in DNA methylation and gene expression, significance of epigenetics in inheritance.

Unit-III [16 hrs]

RNA synthesis: Transcription factors, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA

processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA and RNA transport; Protein synthesis: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.

Unit-IV [16 hrs]

Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing. Cancer: Genetic rearrangements in progenitor cells, cancer genes- oncogenes, tumor suppressor genes, apoptosis and virus induced cancer; Cancer and cell cycle, therapeutic interventions of uncontrolled cell growths.

[64 hrs]

References

1. Cell and Molecular Biology-Concept and Experiments: Gerald Karp (2010)
2. Genomes: T A Brown
3. Cell Biology: De Robertis
4. Principles of genetics: Sinnot, Dunne & Dobzhansky (1948)
5. Cell Biology: Smith and Wood
6. Cell and Molecular Biology- Concept and Experiments 2nd Edn: Gerald Karp
7. Genetics: Denial J Fairbanks
8. Concept of Genetics 4th Ed: William S Klung and M R Cummings
9. Genetics: MW Stritckberger
10. Cell and Molecular Biology: P K Gupta
11. Understanding Genetics- A molecular approach: Norman V Rothwell
12. Molecular Biology of Gene: J P Watson

BOT: HCT. 3.2 PLANT PHYSIOLOGY AND METABOLISM

Preamble

The paper deals with plant physiology and metabolism describing the structure of amino acids, proteins and enzymes, carbohydrates, lipids and fatty acids and transport across membranes. The students on reading of this paper would be able to understand the mechanisms of photosynthesis, respiration, growth hormones, temporal organization biological rhythms and plant responses to biotic and abiotic stress.

Unit-I [16 hrs]

Structure of Amino acids, Proteins and Enzymes; Extraction and purification of enzymes; Carbohydrates: Classification and functions; Synthesis and degradation of sucrose; Lipids and fatty acids; Conversion of lipids to carbohydrates in germinating seeds. Membranes: Structure and organization; Transport across membranes- passive and active transport processes.

Unit-II [16 hrs]

Photosynthesis: Mechanisms of electron and proton transport processes. Photophosporylation and ATP synthesis. Kelvin and Hatch-Slack cycles; Crassulacean acid metabolism in plants; Respiration- Overview of plant respiration. Glycolysis, Kreb's cycle, Electron transport chain; Oxidative phosphorylation and ATP synthesis; Photorespiration.

Unit-III [16 hrs]

Plant growth hormones: Biosynthesis, metabolism, transport and physiological effects of ethylene and abscisic acid; A brief account of commercial applications of the growth hormones; Nitrogen metabolism and fixation: Assimilation of Nitrate and Ammonium ions. Molecular mechanism of nitrogen fixation- Role of *Leg* hemoglobin, *nif* and *hup* genes.

Unit-IV [16 hrs]

Temporal organization: Characteristics of biological rhythms-biological clocks, Phytochrome-cellular location and action. Stress physiology: Biotic and abiotic stress, Mechanism of plant responses to drought and cold stresses.

[64 hrs]

References

1. Plant physiology: Lincoln Taiz and Eduardo Zeiger (Sinaur, Massachusetts (1998).
2. Cell Physiology and Biochemistry: Me Elroy W D (Prentice Hall of India 1995).
3. Enzymatic reaction mechanisms: Walsh C T (Freeman, New York 1979)
4. Physiology of ion transport across the tonoplast of higher plants: Birkla B J and Pantanjo (Ann. Rev. Plant Physiol. 47, 159-184, 1996).
5. Plant membranes-Endo and plasma membranes of plant cells: Robinson D G (1985).
6. Transport in plants I. Phloem transport: Zimmermann M H and Milburn J A
7. Electrogenic ion pumps: Spanswick R M (Ann. Rev. Plant Physiol. 32, 267-289, 1981).
8. Photosynthesis- physical mechanisms and chemical patterns: Clayton R K (Cambridge Univ Press 1992)
9. Photosynthesis: Robinowitch E and Govindjee (Wiley, New York 1969).
10. Photorespiration protects C3 plants from photo-oxidation: Kozaki A and Takeba G (Nature, 384, 557-560, 1996).
11. The Phytochrome chromophore I. Photomorphogenesis in plants: Rudier W and Thummlar K (Netherlands 1994).
12. Applied radiobiology and radiation protection: Granier R & Gambini DJ (Ellis, 1990)

BOT: SCT 3.3.1 GENETIC ENGINEERING

Preamble

The paper describes the aspects of genetic engineering with its scope and definition covering recombinant technology, enzymes, cloning vectors, plasmids, bacteriophages, and cosmids. The students upon exposure to this paper would learn about genomic libraries, blotting techniques, polymerase chain reaction, gene transfer methods, molecular basis of spontaneous and induced mutations and their role in evolution.

Unit-I [16 hrs]

Genetic engineering - Definition & meaning; R-DNA Technology- Enzymes: Nucleases, Restriction enzymes(RE), nomenclature of RE, Mode of Action of REs; DNA Ligase, Kinase, Reverse transcriptase; Cloning Vectors- nomenclature and classification, plasmids, bacteriophages and cosmids.

Unit-II [16 hrs]

Blotting techniques: Southern, Northern and Western blotting; DNA Libraries: Construction of genomic library and c-DNA library; Transposable elements: Prokaryotic transposons- Insertion and composite sequences; Applications of transposons in research and health care system. Mutation: Molecular basis of spontaneous and induced mutations and their role in evolution.

Unit-III [16 hrs]

Polymerase Chain Reaction: Principle and components of PCR; Types of PCR- Inverse PCR, Anchored PCR, RT-PCR; Applications of PCR; Molecular Markers- Restriction Fragment Length Polymorphism(RFLP), Amplified Fragment Length Polymorphism (AFLP), Random Amplified Polymorphic DNA (RAPD).

Unit-IV [16 hrs]

Gene Transfer Methods: *Agrobacterium* mediated genetic transformation; Transfer of genes using physical delivery methods; Poly ethylene glycol mediated and Liposome mediated DNA uptake; Micro injection and Micro projectile bombardment. Trans genes and Transgenic plants: Marker genes; Reporter genes.

[64 hrs]

References

1. Principles of gene manipulation- An introduction to genetic engineering: Bold R W and Primerose S B (Black Well, London)
2. Plant Cell Culture – A practical Approach: Dixan R A and Ganzales R A (1994).
3. Hand Book of Plant Cell Culture vol.-1: Evans et al.,(Macmillan, New York 1983)
4. Plant Cell, Tissue and Organ Culture Fundamental method: Gambarg O L and Phillips (Naraosa, New Delhi 1996).
5. Introduction to plant tissue culture 2nd edition: Razdhan M K (Oxford & IBH, New Delhi 2003).
6. Applied and Fundamental Aspects of Plant cell, tissue and organ culture: Reinert J and Bajaj Y P S (Narosa, New Delhi 1988).
7. Plant Secondary Metabolites: Shukla Y M, Dhruve J J, Patel N J, Bhatnagar R, Talati J G and Kathiria K B (New India, New Delhi 2009).
8. Cell culture and somatic cell genetics of plants vol.-II: Vasil I K (Academic, INC. New York 1985)
9. Introduction to plant biotechnology: Chawla, H. S. (IBH, New Delhi 2002)

BOT: SCT 3.3.2 BIOENERGY AND BIOFUELS

Preamble

The paper outlines bioenergy and biofuels discussing non-replenishable and replenishable energy sources, world energy crisis, principles of energy conservation, and utilization in ecological and sociological perspectives. The student on exposure to this paper would learn about biomass systems, conversion technologies, advanced biofuels, sustainability criteria and the future of biofuels.

Unit-I [16 hrs]

A brief history of various energy sources; Non-replenishable and replenishable energy sources; Present and future needs; Depletion of conventional energy sources-World energy crisis; Alternate systems based on non-conventional methods; Principles of energy conservation, utilization and prospects of bioenergy sources; Problems and viable solutions of energy utilization in ecological and sociological perspectives.

Unit-II [16 hrs]

Bioenergy- An overview of major biofuels and routes to their production; Biomass-definition and sources; Biomass systems, assessment, utilization and conservation; Types of conservation of biomass; Pretreatment and compaction- drying, wood chips, briquette and pellet production; Modification of plants and biomass crops to enhance biomass production.

Unit-III [16 hrs]

Forestry as an energy source- Forest biomass and residues; Energy and chemical characterization of forestry biomass; Agricultural energy crops and residues; Energy and chemical characterization of agricultural biomass and residues; Microalgae- cultivation methods, ponds, photobioreacters and biofuel extraction.

Unit-IV [16 hrs]

Biomass energy conversion technologies: Thermochemical- Combustion, gasification, pyrolysis and torrefaction; Biological- anaerobic conversion and biogas generation, enzymatic conversion and liquid fuel production; Energy crops for biofuel production- Sunflower, Soybean, Castor, and Jathropa- cultivation and harvesting techniques; Advanced biofuels- Biobutenol, bioethenol and biodiesel; Sustainability criteria and the future of biofuels.

[64 hrs]

References

1. Non-conventional energy sources: G. D. Rai
2. Renewable energy: Soreson
3. Principles of energy conversion: A Culp
4. Bio-renewable resources: Engineering new products from agriculture: Robert C Brown (Wiley-Blackwell)
5. Biomass for renewable energy, fuels and chemicals: Donald Klass (Academic press)
6. Gasoline, Diesel and Ethanol biofuels from gasses and plants: Ram B Gupta & Ayhan Demirbas (Cambridge Univ Press)

7. Biofuels engineering process technology: Cave Drapcho, John Nghiem and Terry Walker (McGraw Hill)
8. EPA Biofuels Educational module-I: D T Allen, R E Hebner and M E Webber (Univ Texas)

BOT: OET. 3.4 MEDICINAL PLANTS

Preamble

The paper introduces the medicinal plants covering the plants used in Ayurveda, Tibetan, Unani, Siddha and Homoeopathic system of medicines including their classification and diseases. The students exposed to this paper would learn about the plants used in herbal remedies for several ailments, significance of ethno-botany and ethno-medicine in modern health care system and also methods of improving the traditional knowledge on medicinal plants.

Unit-I [16 hrs]

Introduction: Medicinal plants-Basic concepts and their uses in Ayurveda, Tibetan, Unani, Siddha and Homoeopathic system of medicines; Classification of medicinal plants; Diseases of medicinal plants.

Unit-II [16 hrs]

Medicinal value of food plants: A few examples- cereals, pulses, spices, fruits, vegetables and wild food plants; Medicinal and nutritive values of mushrooms.

Unit-III [16 hrs]

Herbal remedies: Plants used for treatment of blood circulation, respiratory, urinary intestinal, nervous disorders, diabetics, cancer, jaundice, skin, and hair ailments. Plants in gynecological disorders and infertility. Plants used as general tonics.

Unit-IV [16 hrs]

Ethno-botany and ethno-medicine: Importance of ethno-botany and ethno-medicine in modern health care system; Methods of collecting traditional information and knowledge on medicinal plants.

[64 hrs]

References

1. Indian Medicinal Plants: Kirtikar K R and Basu B D (1932)
2. Indian Materia Medica vol. I & II: Nadkarni A K (1954)
3. Ayurvedic drugs and their plant sources: (Oxford & IBH, New Delhi)
4. Pharmacognosy: G E and Evans W L (12th edn, Baillie Tindal, London 1983)
5. Some controversial drugs in Indian Medicine: Vaidya B Chaukamba (Oriental Varanasi 1982)
6. Natural Products: Mann J, Davidson R S, Hobbs J B, Benthorpe D V and Longman (Scientific, Essex).
7. The Chemotaxonomy of Plants: Smith P M, Edward Arnold (London 1976).
8. Hand Book of Medicinal Plants: Prajapati, Purohit, Sharma and Kumar. (Source Book, Agrobios, India 2007).
9. Phytochemical methods: Harborne J, Ed Chapman & Hall (London 1984)

10. Ethno-botany and Medicinal Plants of Indian Subcontinent: Maheshwari J K (Scientific, India 2000).
11. A Hand Book of Medicinal plants-A complete Source Book: Prajapati *et al.* (Agrobios, Jodhpur, India 2003).
12. Compendium of Medicinal Plants vol. I & II. CDIR (Lucknow Publication & Information Directorate, New Delhi 1991)

M Sc BOTANY SEMESTER-III: PRACTICALS

BOT: HCP. 3.5 Genetic, Cell and Molecular biology

1. Preparations of fixatives and stains
2. Mitotic and meiotic divisions
3. Micrometry in chromosomal studies
4. Structural and numerical changes induced by EMS and Colchicine
5. Genetic problems
6. Karyotypes
7. Cultivation of *E.coli*
8. Isolation of DNA from prokaryotes
9. Isolation of DNA from eukaryotes
10. Quantification of DNA.
11. Electrophoretic separation of DNA.
12. Electrophoretic separation of enzymes/Protein

BOT: HCP: 3.6 Plant Physiology and Metabolism

1. Estimation of proteins in seeds by Lowry's method.
2. Estimation of the activity of lipase in seeds,
3. Quantitative estimation of carbohydrates by Benedict's and DNS method.
4. Estimation of total fat content in seeds
5. Demonstration of experiments on growth hormones.
6. Determination of water potential of tissue by plasmolytic/gravimetric method.
7. Quantitative estimation of calcium by EDTA method.
8. Study of Kranz anatomy in C4 plant leaves.
9. Quantitative estimation of Chl a, Chl b and total chlorophyll in plant tissues.
10. Study of absorption spectrum of plant chlorophylls.
11. Determination of diurnal fluctuation in TAN of CAM plants.
12. Demonstration experiment on growth hormones/effect of red and far red light on seed germination.

BOT: SCP. 3.7.1 Genetic Engineering

1. Isolation of DNA from plants using CTAB method and quantification of DNA.
2. Isolation of plasmid DNA by alkalysis method and its separation by electrophoresis.

3. Restriction digestion of DNA.
4. Amplification of DNA using PCR technique
5. Development of RAPD technique using random primers.
6. Genetic transformation using *Agrobacterium tumifaciens*.
7. Genetic transformation using *Agrobacterium rhizogenesis* and development of hairy roots.

BOT: SCP: 3.7.2 Bioenergy and Biofuels

1. Assessment of rate of photosynthesis in plants
2. Estimation of chlorophyll pigments in algae
3. Identification of biomass plants
4. Extraction of oils from plant material
5. Viscosity tests on oils and fuels
6. Evaluation carbohydrates from biofuel feedstocks
7. Identification of biomass plants
8. Analysis of enzymatic breakdown of cellulosic material
9. Enzymatic hydrolysis of lignocellulosic substrates
10. Conversion of cellulosic biomass to ethanol
11. Conversion of vegetable oil to biodiesel.