



**The Maharaja Sayajirao University of Baroda**  
**Syllabus (Master of Science in Botany)**  
**IMPLEMENTED FROM – 2018**

<b>COURSE CODE</b>		<b><u>SEMESTER – I</u></b>	<b>CREDITS</b>
BOT	2101	Prokaryotes, Phycology, Mycology and Mycorrhizal Biotechnology	(4)
BOT	2102	Bryophyta, Pteridophyta and Gymnosperms	(4)
BOT	2103	Angiosperm Systematics	(4)
BOT	2104	Cell Biology	(4)
BOT	2105	Practical	(3)
BOT	2106	Practical	(3)
BOT	2107	Seminar	(2)
		<b><u>SEMESTER – II</u></b>	
BOT	2201	Developmental Biology	(4)
BOT	2202	Developmental Processes	(4)
BOT	2203	Basic Molecular Biology and Biophysics	(4)
BOT	2204	Analytical Techniques	(4)
BOT	2205	Practical	(3)
BOT	2206	Practical	(3)
BOT	2207	Field Work (Botanical Excursion)	(2)
		<b><u>SEMESTER – III</u></b>	
BOT	2301	Plant Physiology – I	(4)
BOT	2302	Plant Ecology – I	(4)
BOT	2303	Gene Structure and Gene Regulation	(4)
BOT	2304	Plant Resources & Biotechnology	(4)
BOT	2305	Optional Paper – I Biodiversity and Ecological Informatics	(4)
BOT	2306	Optional Paper – I Plant Tissue Culture - I	(4)
BOT	2307	Optional Paper – I Climate Change	(4)
BOT	2308	Optional Paper – I Phytochemistry-I	(4)
BOT	2309	Optional Paper – I Angiosperm Taxonomy – I	(4)
BOT	2310	Practical	(3)
BOT	2311	Practical	(3)
BOT	2312	Optional Practical – I Biodiversity and Ecological Informatics	(1)
BOT	2313	Optional Practical – I Plant Tissue Culture - I	(1)
BOT	2314	Optional Practical – I Climate Change	(1)
BOT	2315	Optional Practical – I Phytochemistry - I	(1)
BOT	2316	Optional Practical – I Angiosperm Taxonomy – I	(1)



<b>SEMESTER – IV</b>			
BOT	2401	Plant Physiology – II	(4)
BOT	2402	Plant Ecology – II	(4)
BOT	2403	Molecular Genetics	(4)
BOT	2404	Optional Paper II Global Change Biology	(4)
BOT	2405	Optional Paper II Plant Tissue Culture II	(4)
BOT	2406	Optional Paper II Population Biology	(4)
BOT	2407	Optional Paper II Angiosperm Taxonomy- II	(4)
BOT	2408	Optional Paper II Phytochemistry - II	(4)
BOT	2409	Dissertation	(2)
BOT	2410	Practical	(3)
BOT	2411	Practical	(3)
BOT	2412	Viva-voce	(2)
BOT	2413	Optional Practical Global Change Biology	(1)
BOT	2414	Optional Practical Plant Tissue Culture II	(1)
BOT	2415	Optional Practical Population Biology	(1)
BOT	2416	Optional Practical Angiosperm Taxonomy- II	(1)
BOT	2417	Optional Practical Phytochemistry - II	(1)
<b>Total Credits</b>			<b>100</b>



## The Maharaja Sayajirao University of Baroda Syllabus (Master of Science in Botany)

### Distribution of Credits for M.Sc. (Botany) Course

Courses	No of papers*	Semesters				Total
		I	II	III	IV	
		<b>Credits</b>				
Theory (Core)	4/3	16	16	16	12	60
Theory Optional Paper	4	-		4	4	08
Practical	-	6	6	6	6	24
Optinal practical	-	-	-	1	1	02
Seminar	-	2	-	-	-	02
Fieldwork	-	-	2	-	-	02
Dissertation	-	-	-	-	2	02
Viva- voce					2	02
<b>Total</b>		<b>24</b>	<b>24</b>	<b>26</b>	<b>26</b>	<b>100</b>

1. Evaluation will be 40% internal and 60% based on Final Semester Exam.
  2. Grade point system of evaluation will be followed as Passed by the Faculty of Science for declaration of results.
  3. To get admission in III Semester the student will have to clear all the papers (Courses) in I Semester.
  4. The written reports / photographs/ materials collected/ submission of charts, models, CD are encouraged for each Seminar, Field work; these will be evaluated in respective Semester.
- \*Each theory paper is of 4 credits.



# The Maharaja Sayajirao University of Baroda Syllabus (Master of Science in Botany)

## SEMESTER – I

### BOT-2101

#### Prokaryotes, Phycology, Mycology and Mycorrhizal Biotechnology

##### Unit - I Prokaryotes

- Occurrence, structure and examples of Archaea, Bacteria and Actinomycetes
- Ultrastructure of Eubacteria, Cyanophycean and Actinomycetes cells.
- Reproduction in Bacteria and Cyanobacteria, Comparison with other microbes (Viruses, Viroids, Phytoplasma and Prions).
- Thallus organization in members of Cyanobacteria: *Gloeotheca*, *Lyngbya*, *Phormidium*, *Gloeotrichia*, *Rivularia*, *Stigonema*, *Tolypothrix*, *Spirulina*.
- Nitrogen fixation

##### Unit- II Phycology

- Principles and systems of classification of Algae
- Comparative account of algal pigments, food reserves, flagellation, chloroplasts and eye spots; their taxonomic importance.
- Range of thallus, methods of reproduction, life cycles patterns and evolutionary trends in the following groups:
  - Chlorohyta
  - Phaeophyta
  - Rhodophyta
- Edible algae

##### Unit - III Mycology

- Classification of Fungi (Ainsworth 1973 & Alexopoulos *et al.*, 1996)
- Vegetative structure of thallus: Types of septa, Ultrastructure of fungal cell. Range of thallus structure in different groups of fungi (with structure of 2 representatives in each group).
- Fungal associations: parasitic, saprophytic, symbiotic (Lichens), endophytic.
- Development of conidia in Mitosporic fungi. Asexual reproduction and parasexual hybridization.
- Sexual reproduction in fungi including formation of Asco and Basidiocarps.
- Role of fungi in food and medicine.
- Fungi present in air-enumeration, identification and biodeterioration studies.
- Fungal spore germination, factors effecting germination (Physical and nutritional).

##### Unit - IV Mycorrhizal Biotechnology

- Study of soil mycoflora, rhizospheric and nonrhizospheric fungi, enumeration, R/S ratio.
- Biocontrol of pathogens, mechanisms involved, role of *Pseudomonas fluorescense* in disease control.
- Common genera of AM Fungi: *Glomus*, *Gigaspora*, *Sclerocystis*, *Acaulospora*.
- Types of mycorrhizae, ectomycorrhizae associated with *Pinus* and *Eucalyptus*.
- Commercial mycorrhizal preparations, impact on growth performance of crops.
- Mycorrhizal symbiosis, identification and distribution. Microbial consortium, isolation, multiplication and molecular approaches used for monitoring of introduced mycorrhizal fungi.
- Uses in forestry, horticulture and bioremediation of heavy metals.



### Suggested Reference Books:

1. Alexopoulos C.J., Mims C.W. and Blackwell M. (1996) Introductory Mycology. John Wiley & Sons, U.K.
2. Arya A. (2009) Diseases of fruit trees. International Book Distributing Co. India, Lucknow.
3. Bessey E.A. (1968) Morphology and taxonomy of Fungi
4. Dube H.C. (2009) An introduction to Fungi. Vikas Pub., New Delhi.
5. Fritsch F.E. (1935) The structure and reproduction of the Algae. Cambridge University Press.
6. Harley, J.L. and Smith S.E. (1983) Mycorrhizal symbiosis. Academic press, London.
7. Muller G.M., Bills G.F. and Foster M.S. (2004) Biodiversity of Fungi. Elsevier, Academic Press.
8. Prescott G.W. (1968) The Algae: A review. Macmillan Publishing Co.
9. Ray R.C. and Ward O.P. (2006) Microbial Biotechnology in Horticulture. Science Publisher, Enfield, N.H. HAS.
10. Read D.J., Lewis D.H., Fitter A.H. and Alexander I.J. (1994) Mycorrhizas in Ecosystems, CAB International
11. Sati S.C. (2006) Recent mycological researches. L.K. International Pub. Housing Pvt. Ltd. New Delhi
12. Smith G.M. (1971) Cryptogamic Botany . Vol I T.M.H. Pub. Co. New Delhi
13. Todd R.L. and Gidenuis J.E. (1984) Microbe – Plant interactions, ASA special publication.
14. Vaidya J.G. (1990) Biology of Fungi. Satyajit Prakashan, Pune
15. Vidyasekaran P. (2004) Concise encyclopedia of plant pathology

## BOT-2102

### Bryophyta, Pteridophyta and Gymnosperms

#### Unit – I Bryophyta

- Morphological and structural diversity of Bryophytes
- Origin, evolution and fossil history of Bryophytes
- Distribution, classification and general account of
  - Marchantiophyta (Marchantiales and Jungermanniales)
  - Anthocerotophyta (Anthocerotales)
  - Bryophyta (Sphagnales, Funariales and Polytrichales).
- Progressive sterilization of sporogenous tissue;
- Ecological and economic importance,
- Bryophyte diversity in India and Gujarat.

#### Unit - II Pteridophyta

- General characters
- Theories regarding origin of vascular cryptogams
- Alternation of generations and Telome theory
- Evolution of sorus and sporangia, Heterospory and seed habit
- Stellar evolution
- Representative living and fossil members of the group Psilophyta, Lepidophyta, Calamophyta and Pterophyta

#### Unit - III Gymnosperms

- General characters, classification of Gymnosperms, geological time scale.
- Origin of Gymnosperms, fossilization and fossil types.
- Morphological and anatomical variations of major fossil and living members grouped under different orders.
- Life cycle of *Welwitschia*

#### Unit - IV Recent Researches is in Cryptogams and Gymnosperms

- Apogamy and Apospory in Pteridophytes and Bryophytes and their experimental regulation.



- Recent researches in Pteridophytes and Gymnosperms
- Position and brief account of *Takakia*, *Taxus*, *Gnetum* and *Biota*.
- Gymnosperms as sources of wood, resin and drugs.

### Suggested Reference Books

1. Arnold, C.R. (1972) An Introduction to Paleobotany. New York.
2. Bower, F. O. (1935) - Primitive Land Plants. London
3. Chopra, R.N. (2005) Biology of Bryophyta.
4. Chopra, R.N. and Kumra, P.K. (1978) Biology of Bryophytes.
5. Coulter, J.M & Chamberlin, C.J. (1903) Morphology of gymnosperms.
6. Delevoryas, T. (1962) Morphology and Evolution of fossil plants.
7. Eames, A.J. (1950) Morphology of vascular plants (lower groups). New York
8. Foster, A.S. and Gifford, E.M. (1989) Comparative morphology of vascular plants.
9. Kashyap S.R. (1929) Liverworts of Western Himalayas and Punjab Plains. Punjab Univ. Pub. Lahore
10. Parihar, N.S. (1984) An Introduction to Embryophyta Vol. I Bryophyta. Central book Depot, Allahabad
11. Puri, P. (1973) Bryophytes a broad perspective.
12. Rashid A. (2001) Pteridophyta. Vikas Pub. House Pvt. Ltd. New Delhi
13. Schuster, R.M. (1983) Manual of Bryology Vol. I & II.
14. Smith, G.M. (1971) Cryptogamic Botany Vol. II. T.M.H. Pub. Co. Ltd. New Delhi
15. Sporne, K.R. (1975) Morphology of Pteridophytes.
16. Sporne, K.R. (1965) The morphology of Gymnosperms.
17. Watson, E.V. (1971) The structure and life of Bryophytes. Hutchinson & Co. London

## BOT- 2103 Angiosperm Systematics

### Unit – I Classification and Botanical Nomenclature

- Brief history of classification
- System of classification : Engler & Prantl's system, Hutchinson's system and Cronquist's system.
- Adaptation and morphological peculiarities in Angiosperms
- Botanical Nomenclature
- Botanical Survey of India (B.S.I) & Botanical Gardens
- Floras
- Recent herbarium techniques

### Unit – II Taxonomic Studies

- Taxonomy and phylogeny of families in
- Parietales of Bentham & Hooker
- Geraniales of Bentham & Hooker
- Centrospermae of Engler and Prantle
- Gentianales of Bentham & Hooker

### Unit – III Polypetalae

- Study of the following Polypetalae families with special reference to their phylogeny, geographical distribution and plants of economic importance and common examples especially belonging to western India
- Ranunculaceae, Nymphaeaceae, Violaceae, Papaveraceae, Polygalaceae, Portulacaceae, Elatinaceae, Zygophyllaceae, Geraniaceae, Simaroubiaceae, Rhamnaceae, Sapindaceae, Rosaceae, Combricaceae, Lythraceae, Begoniaceae, Ficoidaceae.

### Unit – IV Gamopetalae, Monochlamydae and Monocots



- Study of Gamopetalae, Monochlamydae and Monocotyledon families with special reference to their phylogeny, geographical distribution and economic importance and common examples especially belonging to western India. Plumbaginaceae, Oleaceae, Salvadoraceae, Loganiaceae, Gentianaceae, Boraginaceae, Lentibulariaceae, Bignoniaceae, Nyctaginaceae, Chenopodiaceae, Polygonaceae, Santalaceae, Casuriniaceae, Commelinaceae and Cyperaceae.

### **Suggested Reference Books:**

1. Benson, L.D. (1979). Plant classification. 2nd edition.
2. Cronquist, A. (1988). The evolution and classification of flowering plants.
3. Davis, P.H. and Heywood V.H. (1967). Principles of Angiosperm Taxonomy.
4. Erdtman, G. (1971). Pollen morphology and plant taxonomy.
5. Goldberg, A. 1986. Classification, evolution and phylogeny of the families of Dicotyledons.
6. Harborne, J.B. and Turner. B.L. (1984). Plant Chemosystematics.
7. Heywood, V.H. and Moore D.M. (1984). Current concepts in Plant Taxonomy.
8. Hutchinson, J. (1969). Evolution and phylogeny of flowering plants. Dicotyledons: Facts and Theory.
9. Radford, A.E. Dickison, W.C. Massey J.R., Bell C.R. (1974). Vascular Plant Systematics. Harper and Row, New York
10. Daniel, M. (1997) - The changing landscape of Plant Sciences - Taxonomy & Ecology, Bishen Singh M. Pal Singh, Dehradun,

## **BOT-2104 Cell Biology**

### **UNIT- I Membrane Structure and Function**

- Structural models, composition and dynamics, transport of ions and macromolecules, pumps, membrane Carbohydrates and their significance in cellular recognition
- Cellular junctions and adhesions, structure and functional significance of plasmodesmata.

### **Unit-II Mitochondria and Chloroplast**

- Mitochondria – structure, organization of respiratory chain complexes, ATP synthase, structure – function relationship, biogenesis of mitochondria, origin and evolution.
- Chloroplast – structure, structure-function relationship, chloroplast biogenesis, origin and evolution.

### **Unit- III Nucleus and E.R. System**

- Nucleus – Structure and function of nuclear envelope, lamina and nucleolus, macromolecular trafficking chromatin organization and packaging, ribosomes and
- Cytoskeleton and cellular motility – organization and role of microtubules and microfilaments, cell shape and motility.
- Endomembrane system – Structure and function of microbodies, golgi apparatus, lysosomes and E.R. Membrane maturation and specialization.

### **Unit-IV Cell cycle, PCD and Cell signaling**

- Cell cycle and PCD and Cells – Overview, cell cycle control in Pro and Eukaryotic systems, heck points, inter and intracellular, PCD, Proteolytic intracellular regulators. Mechanism of cell division (physical, biochemical).
- Cell signaling – types, general principles of cell communication, signaling through cell surface receptors, enzyme linked cell surface receptors signaling pathways for proteolysis, signaling in plants.

### **Suggested Reference Books:**

1. De Robertis, E. M.F. (1970) Cell and Molecular Biology
2. Sharma A. (1976) The chromosomes.



3. Sharma, A.K. and Sharma A. (1980) Chromosome Techniques: Theory and Practice.
4. Powar, C.B. (1997) Cell Biology. Himalaya Pub. House
5. Gupta, P.K. (1997) Genetics.
6. Sinnott, E.W., Dunn, L.C. and Dobzhansky, T. (1986) Principles of Genetics. Mc Graw- Hill Book Co. Inc. New York
7. Swanson, C.P. and Webster, (4th Ed. 1976) The Cell.
8. Swanson, C.P., Merz, T. and Young, W.J. (1978) Cytogenetics, The chromosomes, in Division, Inheritance and Evolution.
9. Strickeberger, M.W. (1996) Genetics.
10. Suzuki, D.T. and Griffith, A.J. (1986) An Introduction to Genetic Analysis.
11. Jinks, J.L. (1980) Extra chromosomal inheritance.

## Semester-II

### BOT – 2201 Developmental Biology

#### Unit- I Cell Wall and Apical Organization in Flowering Plants

- **Cell Wall:** Structural components of different layers, Chemistry of cell wall Structure of cellulose micro fibril, arrangement of cellulose molecules within the fibrils, Formation of cellulose and matrix, Polysaccharides, Lignification, Growth and adjustments
- **Shoot and Root Apex:** Histological constitutions, Ultra structure of meristem, apical ontogenesis, differential growth of at the apex.
- **Procambium – cambium:** Procambium – cambium continuum, Ultra structure of Procambium and Cambium, Dormant cambium, active cambium, factors affecting cambial activity. Initiation in shoot, leaf and buds, latitudinal and longitudinal growth.

#### Unit – II Vascular and Secretory Tissue

- **Ultra structure of vascular tissue and vascularization :**  
Ontogenetic characteristics of the first vascular tissues i.e. xylem and phloem, Cellular composition & patterns of development of phloem and xylem,  
**Transfer cells:** Structure, distribution, functions
- **Secretory Structures in Plants:** Gum – resin ducts, laticiferous cells and their ultrastructure, Glandular trichomes ultrastructure
- **Wood:** Characteristic features and identification

#### Unit-III Structural variations and Ontogenesis in leaf and reproductive parts

- **Structure of leaf :** Dicot -Hydrophytic, Xerophytic, Mesophytic,
  - Monocot, Gymnosperms
  - Stomata (Ultrastructure and development)
  - Histogenesis of monocot and dicot leaf
- **Structure of floral plants:** Ontogeny of flower, histology of sepals & petals, histology of stamen & ovary.
- **Seed and fruits:** Structural variations in pericarp, seed, seed appendages.

#### Unit – I Plant Embryology

- Branches of Embryology- descriptive, comparative and experimental
- Microsporangia, development, Development of wall layers of anther, Role of tapetum, Pollen mitosis, wall morphogenesis
- Female gametophyte, physiological and ultrastructural aspect, embryo sac components.
- Pollen pistil interactions, physiological studies, fertilization
- Sexual incompatibility, pollen and stigmatic factors, methods to overcome incompatibility, Self incompatibility, Genetic basis of self incompatibility, physiology and biochemistry of incompatibility
- Endosperm, role of haustoria, endosperm culture
- Embryo development, role of suspensor, polyembryony





### **Suggested Reference Books:**

1. Beck C. (2005) An introduction to plant structure and development: Plant Anatomy for the 21<sup>st</sup> Century. University Press, Cambridge.
2. Bhojwani SS and Bhatnagar S.P. (2002) The Embryology of Angiosperms, Vikas Publications, New Delhi.
3. Cutter E.G.(1987) Plant Anatomy. Edwards Arnold Publishers Ltd.
4. Evert R.F. (2006) Esau's Plant Anatomy. A John Wiley & Sons. Inc. Publication
5. Fahn A. (1979) Secretory tissues in plants. Academic Press London.
6. Fahn A. (1997) Plant Anatomy. Aditya Books(P) Ltd., New Delhi
7. Foster A.S. and Gifford E.M.(1974) Comparative morphology of vascular plants
8. Johri B.M. Ambegaokar K.B. and Srivastava P.S. (1992) Comparative Embryology of Angiosperms Vol. I & II Springer
9. Robert F. (1998) The shoot apical meristem : Its growth and development. Lyndon.
10. Shivanna K.R. and Johri, B.M. (1985) The Angiosperm Pollen: Structure and Function.

## **BOT – 2202 Developmental Processes**

### **Unit - I Basic concepts of development**

- Potency, commitment, specification, induction, competence,
- Determination. Differentiation.
- Morphogenetic gradients cell fate and cell lineages.
- Mutants and transgenics in analysis of development.

### **Unit – II Growth and Differentiation (AGJ)**

- Measurement of growth, localization of growth.
- Levels of differentiation- channelization of development.
- Patterns of differentiation, cell differentiation and environmental factors.
- Structural basis of polarity, axial, radial and dorsiventral polarity.

### **Unit – III Morphogenetic Factors and Environment**

- Effects of light, temperature other physical factors,
- Mechanical factors.
- Biological rhythm. Vernalization. Photoperiodism florigen concept.
- Programmed cell death and senescence

### **Unit – IV Dormancy and Plant Movements**

- Dormancy concepts and terminology
- Seed longevity and germination. Types of seed dormancy, bud dormancy.
- Plant movements – Nastic and tropic movements.

### **Suggested Reference Books:**

1. Leopold A. C. and Kriedemann P.E (1978) Plant Growth and development. T.M.H. Pub. Co. New Delhi
2. Taiz L. and Zeiger E. ( 2006) Plant Physiology, Fourth Edition, Sinauer Associates Inc Publishers Massachusetts.

## **BOT – 2203 Basic Molecular Biology and Biophysics**

### **Unit - I Biophysics**

- Structure of atoms, molecules and chemical bonds,



- Stabilizing interaction and such as Van Der Waals' forces, hydrogen bonding and hydrophobic interaction
- Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics)

### Unit - II Biophysics

- Proteomics, Conformation of proteins (Ramachandran plot, Secondary ( $\alpha$ -helix, 310 Helix etc.) tertiary and quaternary structure, domains, motifs and folds). Conformation of nucleic acid structures, tRNA, nucleosomes.

### Unit - III Nucleic Acid Techniques

- DNA, RNA isolation,
- Southern blotting, Northern, Western Blotting

### Unit - IV DNA Analyses

- Cloning, Colony hybridization
- Preparation of probes
- DNA sequencing, Microarrays

### Suggested Reference Books:

1. Kumar H.D. (1983) Molecular Biology and Biotechnology, Vikas publishing house Pvt. Ltd. New Delhi
2. Turner P.C., Mc lennan A.G., Bates A.D. and White M.R.H.(1998) Molecular Biology, Viva Books Pvt. Ltd New Delhi.
3. Butler J.A.V. (1968) Gene control in the living cell, George Allen Unwin Ltd.
4. Cherayil J.D.(1984) The gene and the genetic code, Bangalore
5. Sinha U. and Sinha S.(1992) Cytogenetics, Plant breeding and Evolution , Delhi
6. Levine Louis (1969) Biology of the gene, Toppan Comp. Japan.
7. Nelson P. (2003) Biological Physics: Energy, Information, Life Freeman
8. Daniel M. (1990) Basic biophysics for Biologists, Agrobotanical Pub. Bikaner
9. Rodney C.W. ( 2002) Biophysics : An introduction

## BOT- 2204 Analytical Techniques

### Unit – I Biostatistics (SKG)

- Regression Correlation, ANOVA t-test.
- Chi-square test.
- Sampling, Theoretical Distribution Probability.
- Use of Computers in statistical analyses.

### Unit – II Separation Techniques

- Chromatography – Principles, application methodology and types of planar and column chromatography.
- HPLC, GC, HPTLC, Flash Chromatography, Ion-exchange, Affinity and Gel chromatography.
- Electrophoresis – Principles and applications of paper, gel, SDS PAGE, 2DPAGE.

### Unit – III Spectrometry

- Principles and instrumentation, UV/visible/IR Spectrophotometry,
- ORD & CD, ESR and NMR.
- Atomic absorption spectrometer.
- Mass spectrometry, GC-MS, LC-MS.

### Unit – IV Microscopy

- Light Microscopy - Magnification and resolution.
- Dark field, phase contrast, fluorescence, atomic force, con-focal and polarization microscopy - Principles and application.



- Scanning and transmission electron microscopy - principle, components of SEM and TEM, processing of objects for observation (negative staining, shadowing and freeze fraction techniques).

**Suggested Reference Books:**

1. Freund, J.E. (1977) Modern Elementary Statistics.
2. Goveday R. (1978) A first course in Statistics.
3. Gupta, S.P. and Gupta, M.P (1979) Business statistics.
4. Rangaswamy, R. (1986) A Text book of Agricultural Statistics.
5. Daniel, M. (1990) Basic Biophysics for Biologists. Agrobotanical Publishers, Bikaner
6. Berlyn, G.P. and Miksche, J.P. (1976) Botanical Microtechnique and Cytochemistry.
7. Jensen, W.A. (1962) Botanical histochemistry.
8. Southworth, H.M. (1982) Introduction to modern microscopy.
9. Willard, H.H., Meritt, L.L., Dean, J.A. and Settle, F.A. (1986) Instrumental Methods of Analysis.
10. Plumer, D.T. (1979) An Introduction to Practical Biochemistry.
11. Winson, K. and Walker, J.M. (1996) Principles & Techniques of Practical Biochemistry



## **Semester – III**

### **BOT –2301 Plant Physiology – I**

#### **Unit – I Photosynthesis and Photorespiration**

- Light harvesting complexes; mechanisms of electron transport;
- Photo protective mechanisms; CO<sub>2</sub> fixation – C<sub>3</sub>, C<sub>4</sub> and CAM pathways;
- Photorespiration

#### **Unit-II Stress Physiology - I**

- Introduction, Motivation for studying plant stress physiology,
- General concepts in Plant stress Physiology, Function types
- General comments on biotic stresses.

#### **Unit-III Stress Physiology - II**

- Biotic Factors and Plant Stress Physiology, Nutrient Deficiency Stress and
- Plant Growth and Development: Nutrient Absorption by Roots, Cellular and whole plant,
- Nutrient Distribution, Physiological functions of Essential Elements and Salinity Stress.

#### **Unit-IV Solute Transport and Photoassimilate Translocation**

- Uptake, transport and translocation of water, ions, solutes and macromolecules from soil,
- Through cells, across membranes,
- Through xylem and phloem; transpiration;
- Mechanisms of loading and unloading of photoassimilates.

#### **Suggested Reference Books**

1. Chopra, V.L. and Paroda, R.S. (1988) Approaches for incorporating drought and salinity resistance in crop plants, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
2. Hopkins W. G. ( 2008) Introduction to Plant Physiology . Wiley
3. Nilsen, L. & Orcutt, (1998.) Physiology of plants under stress : Abiotic factors, John Wiley & Sons, Inc., USA
4. Taiz L. and Zeiger E. ( 2006) Plant Physiology, Fourth Edition, Sinauer Associates Inc Publishers Massachusetts.
5. Treshow, M. (1970) Environment and plant response, Mc Graw Hill, New York

### **BOT– 2302 Plant Ecology – I**

#### **Unit – I Applied Ecology**

- Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

#### **Unit – II Population Ecology**

- Characteristic of population; population growth curves; population regulation; life history strategies (r and k selection); concept of metapopulation- demes and dispersal; interdemic extinctions, age structured populations.

#### **Unit – III Experimental Ecology**



- Experimental approaches to studying a population, Ecological experiments and a research activity in community ecology
- Experimental ecology of Food webs.
- Experimental approaches to the study of evolution
- Ecosystem modeling – conceptual model, working model Auxiliary variables and foresters diagram

#### **Unit – IV Conservation biology**

- Principles of conservation, major approaches to management, Indian case studies on conservation / management strategy (Project Tiger, Biosphere reserves.)

#### **Suggested Reference Books:**

1. Weil R.R. ( 2007) The Nature and Properties of Soils, The Prentice Hall Pub.
2. Krebs C.J. ( 2008) Ecology: The Experimental Analysis of Distribution and abundance, Benjamin Cummins
3. Gotelli N.J. ( 2008) A Primer of Ecology, Sinauer

### **BOT–2303**

#### **Gene Structure and Gene Regulation**

**Unit-I Historical and general aspects-** Basic discoveries in molecular genetics, Mendelian laws, linkage analysis and gene mapping, chromosome theory of heredity, model organisms for genetic studies. Conjugation, transduction and transformation, gene mapping in bacteria.

**UNIT II Genome organization pro and eukaryotes and it's replication-** replication of bacterial and eukaryotic genomes, diversity in DNA polymerases, replication of plasmids, control of plasmid copy number. repair and retrieval systems. - Genes and gene number, law of constancy and c-value paradox gene amplification, distribution of repeat and transposable elements and their function. Mobile genetic elements- Structure and function of transposable elements, mechanisms of transposition, special features of retro transposons.

**Unit-III Regulation of transcription in prokaryotes-** RNA and it's synthesis, Operon concept, promoters and terminators, positive and negative control of transcription, RNA polymerases and sigma factors, control of termination.

**Regulation of gene expression in eukaryotes-** Gene architecture, promoter architecture, regulator sequences, general transcription factors enhancers and mechanism of their action, RNA polymerases, heterogeneous nuclear RNA, cap structure and function, polyadenylation, transcription factors, DNA binding and activation domains.

**Unit-IV Split gene concept and RNA processing-** Introns and exons, size, distribution & evolution, RNA splicing, catalytic RNA, alternative splicing, RNA stability.

**Genetic code and translation-** Deciphering the genetic code, codon bias, tRNAs, ribosomes, initiation & termination of translation, translational and post translational controls, attenuation.

#### **Suggested Reference Books**

1. Sambrook, J., Fritsch, E.F. and Maniatis (1989). Molecular Cloning, Cold Spring Lab Press.
2. Old, R.W. and Primrose, S.B. (1991). Principles of Gene Manipulations: an Introduction to Genetic Engineering, Blackwell Scientific Publications.
3. Friefelder, D. (1990). Molecular Biology. Narosa Publishing House. New Delhi
4. Lehninger, A.L. (1993). Principles of Biochemistry, CBS Publishers & Distributors
5. Howell. S.H. (1998). Molecular genetics of Plant development. Cambridge University Press.
6. Mehta, S.L., Lodha, M.L. and Sane, P.V. (1993). Recent advances in Plant Biochemistry.
7. Daniel J. Fairbanks and W. Ralph Anderson Brookscole, (2001). Genetics- the continuity of life. Wordsworth publishers.
8. Lewin. B (2005) Genes IX Oxford University Press.



## BOT-2304 Plant Resources and Biotechnology

### Unit- I Plant Resources - 1

- **Beverages:** Alcoholic and non-alcoholic, active principles and other ingredients.
- **Hallucinogens:** Nitrogen containing and non-nitrogenous hallucinogens and their narcotics-active principles
- **Rubber and gutta:** plant resources and its composition
- **Plant derived fibers and products**
- **Gums and Mucilages**

### Unit II Plant Resources- 2

- **Colouring agents:** Edible and non-edible dyes - chemistry and their resource plants
- **Flavouring agents:** Spices and aromatic oil resources
- **Sweetening agents:** Glycosides and their resource plants
- **Pharmaceutical Fixed oils and Fats**
- **Biofuel:** petrocrops, bioethanol, biodiesel and green diesel

### Unit-III Plant cell and tissue culture

Basic concepts, principle and scope, general introduction, totipotency, cellular differentiation, competency, determinism, requirements of tissue culture facilities, culture media, composition of media, phytohormones, initiation and maintenance of cultures, fundamental aspects of morphogenesis and somatic embryogenesis, callus and cell suspension cultures, growth measurements.

### Unit- IV Protoplast culture & somatic hybridization

Protoplast isolation, culture and usage, somatic hybridization methods and applications, cybrids and somatic cell genetics.

**Genetic transformation-** Agrobacterium-plant interaction, virulence, Ti & Ri plasmids, opines and their significance, T-DNA transfer, disarming the Ti plasmid mediated gene delivery

**Environmental biotechnology-** Soil reclamation and phytoremediation, metal and pollutant detoxification

### Suggested Reference Books:

1. Hill, A. (1952) Economic Botany.
2. Scherry, R.W. (1972) Plants for man.
3. Simpson, B. and Ogorzaly, M.C. (1986) Economic Botany.
4. Sabnis, S.D. and Daniel, M. (1990) A Phytochemical Approach to Economic Botany.
5. Trease, G.E. and Evans, W.C. (1978) Pharmacognosy.
6. Harborne, J.B. (1984) Phytochemical Methods.
7. Daniel, M. (1991) Methods in Plant Chemistry and Economic Botany.
8. Kochhar, S.L. (1981) Economic Botany of the Tropics.
9. Dubey R.C. (1998) A text book of Biotechnology S. Chand and Company, Delhi
10. Jensen W.A. (1965) The plant Cell Macmillan and Co. London
11. P.K.Gupta (2002) Plant Biotechnology, Rastogi Publications.
12. M.K Razdan(2005) An Introduction to Plant Tissue Culture, Oxford & IBHpublications
13. Tzfira, Tzvi; Citovsky, Vitaly (2008) Agrobacterium: From Biology to Biotechnology, Springer
14. H. S. Chawla(2002), An Introduction to plant biotechnology, Science Publisher.



## Optional Papers – I

### **BOT – 2305**

### **Biodiversity and Ecological Informatics**

#### **Unit - I Biodiversity**

- **Introduction to biodiversity**–Definition, Introduction to biological diversity, and global biodiversity, biodiversity Indices , Importance
- Biogeographical classification of India, India as a mega-diversity nation, Hot-spots of biodiversity.
- Floristic diversity of India and adjacent region, endemism value.
- **Overview** of Biodiversity Softwares

#### **Unit-II Biodiversity Informatics and Ecological Informatics**

- **Biodiversity Informatics:** Databases, National, Regional and Global Diversity Information Systems and Networks and Documentation of the wealth of the world's plant species Documenting and mapping biological diversity,
- **Ecological Informatics:** Introduction: The ecosystem concept, Ecosystem Function, Ecosystem Succession, Models of Ecosystem Succession
- **Electronic Catalogues:** Environmental Data and Information Management
- **Environmental Geomatics** - GIS, RS and other Spatial Information Technologies

#### **Unit-III Monitoring**

- **Threats to biodiversity:** habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.
- **Effects of human activities on environment :** Agriculture, Housing, Industry, Mining and Transportation activities and Climate change
- **Technologies:** assess, forecast, monitoring the recovery of the damaged ecological systems. Instrumentation techniques.
- **Approach to Biodiversity :** National Biodiversity Strategy and Action Plan for monitoring Diversity , National Biodiversity Authority, Wildlife Protection Act, International Conventions and initiatives -CBD, UNFCCC, CITES, WCS, GBIF, IUCN and important institutions.

#### **Unit-IV Conservation**

- **Conservation:** Definition, Methods of conservation of living resources; red and green data books, world conservation strategy.
- **Conservation of biodiversity :** In-situ and Ex-situ conservation of biodiversity , Constitutional Framework for Biodiversity, Wildlife Protection Act, International Conventions and initiatives
- **Environmental Management:** Fundamentals-Sustainable Development and Basics of Environmental Impact Assessment,
- **Environmental Protection and Environmental Laws** - Role of Government, Initiatives by Non-governmental Organizations (NGO), Problems of law enforcement, Environmental Education. Acts, Patents, IPRS, Role of NGOs,

#### **Suggested Reference Books:**

1. Atkinson, P.M. and Tate, N.J.(Eds.) 1999 Advances in remote sensing and GIS analysis., Wiley, New York.
2. Environmental Science and Engineering – Meenakshi, Prentice Hall India.
3. Environmental Studies – Benny Joseph – Tata McgrawHill-2005
4. Environmental Studies – Dr. D.L. Manjunath, Pearson Education-2006.
5. Environmental studies – R. Rajagopalan – Oxford Publication – 2005.
6. Gunther, O. 1998 Environmental Information Systems. Berlin, New York, Springer.
7. Gupta, N. Dass, *Environmental Accounting*, Wheeler Publishing, New Delhi, 1997.
8. Odum, E.P. 1983 Basic Ecology. Saunders International Edition, Japan.
9. Pandey, G.N., *Environmental Management*, Vikas Publishing House, New Delhi, 1997.



10. Phillipson, J. 1972 Ecological Energetics, Edward Arnold.
11. Principles of Environmental Science and Engineering – P. Venugoplan Rao, Prentice Hall of India.
12. Recknagel, F. 2002 Ecological Informatics: Understanding Ecology by Biologically-Inspired Computation. Springer, New York.
13. Text book of Environmental Science & Technology – M. Anji Reddy – BS Publication.
14. Uberoi, N. K., *Environmental Management*, Excel Books, New Delhi, 2000.

## **BOT – 2306 Plant Tissue Culture – I**

### **UNIT – II Plant propagation**

- Clonal propagation : axillary bud proliferation
- Factors affecting shoot multiplication
- Preparation & Requirements for field transfer of *in vitro* plants,
- Greenhouse & Net-house for hardening
- Transplantation to the field
- Indexing of Pathogens

### **Unit- IV Somatic embryogenesis and Synthetic Seeds**

- Somatic embryogenesis in Dicotyledons and Monocotyledons
- Factors influencing embryogenesis
- Practical applications
- Repetitive embryogenesis
- Synthetic seeds

### **Unit- III Androgenesis and Haploid Production**

- Introduction
- Techniques of anther culture
- Factors influencing anther culture
- Techniques for isolated pollen culture
- Diploidisation of haploids to produce homozygous plants
- Pathways of Androgenesis
- Applications of Haploids in plant breeding
- Haploidy through alternative sources
- Problems associated with haploid production

### **Unit- IV Somatic embryogenesis and Synthetic Seeds**

- Dicotyledons
- Monocotyledons
- Factors influencing embryogenesis
- Practical applications
- Repetitive embryogenesis
- Synthetic seeds

### **Suggested Reference Books**

1. Ignacimuthu, S. (1997) - Applied Plant Biotechnology, Tata McGraw-Hill.
2. Narayanaswamy, S. (2005) - Plant Cell & Tissue Culture, Tata McGraw-Hill.
3. Reinert, J. & Bajaj, YPS. (1977) - Applied & Fundamental Aspects of Plant, Cell Tissue and Organ Culture, Springer-Verlag.
4. Amirato, PV, Evans DA, Sharp WF & Bajaj YPS (1990) - Handbook of Plant Cell Culture, Vol. 1 to 5 McGraw Hill Publishing Co.
5. Bhojwani SS & Razdan MK (1983) - Plant Tissue Culture: Theory & Practice, Elsevier Science Publications.
6. Razdan MK (2005) - Plant Tissue Culture.
7. Mehta AR & Bhatt PN (1990) - Handbook of Tissue Culture Methods and Application, Academic Book Centre, Ahmedabad.
8. Vasil IK (1988) - Cell Culture and Somatic Cell Genetics of Plants, Vol. 1 to 6.





9. Kalyan kumar De (2007), Plant Tissue Culture, New Central Book Agency.
10. U. Kumar (2001), Methods in Plant Tissue Culture: Agrobios

## **BOT – 2307 Climate Change**

### **Unit – I Understanding earth and its climate**

- Climate system (Sun, Atmosphere, Ocean, Ice)
- Energy balance of the earth, Increase in CO<sub>2</sub> concentration.
- Effect of climate change on plant yield and loss of biodiversity.

### **Unit – II Natural Climate Change**

- Available history (tilting on earth on its axis: Milution Meklintosch theory)
- Ice core records, Ice age
- Ocean sediments
- Terrestrial deposits

### **Unit – III Human Influence on Climate Change**

- Human Race and Climate change
- Human influence on climate processes
- Energy utilization, Renewable sources of energy.

### **Unit – IV Green Cities**

- Measures to reduce the climate change
- Climate related summits
- Policy regulations
- Carbon credits, phasing out of CFC.

### **Suggested Reference Books**

1. Tropical Forests and Global Atmospheric Change (Oxford Biology) (Paperback) Yadvinder Malhi (Editor), Oliver Phillips (Editor) Oxford 2005
2. Global Change and Terrestrial Ecosystems (International Geosphere-Biosphere Programme Book Series) (Paperback), Brian H. Walker (Editor), Will Steffen (Editor) Plant Responses to Air Pollution and Global Change (Hardcover)
3. Kenji Omasa (Editor), Isamu Nouchi (Editor), Luit J. De Kok (Editor) Springer 2006

## **BOT – 2308 PHYTOCHEMISTRY -I**

### **Unit – I Traditional Medicinal System**

History, Alternative system of Medicine: Principles of Traditional Chinese system, Indian system of medicine, Ayurveda, Siddha system, Unani system, Homeopathy, Aromatherapy -their merits and demerits.

Ayurveda and Herbal Drug Development: Formulations and properties of Ayurvedic dosage forms (Asava, Arishta, Churna, Bhasma).

SOPs and QC parameters of the formulations-legal aspects.

Regulatory Controls on Herbal Medicine, Quality, Safety and Efficacy of Herbal Medicines. WHO scenario: Demand for medicinal plants and herbal plants. Trends in worldwide trade of medicinal plants (International and Indian trade). Export potential of Indian medicinal plants and role of medicinal plants in National economy.

**Unit II Crude Drug Analysis** - Definition and Classification of Drugs of natural origin.



**Drug Adulteration and analysis**-Organoleptic, Microscopical, Chemical, physical and Biological analysis. (Macroscopic and microscopic examination, moisture content, TLC, Determination of ash, extractable matter, volatile oils, bitterness value, tannins).

Determination of pesticidal residue, Arsenic and heavy metals, microorganism and aflatoxin.

Quality and purity of crude drugs as per WHO.

Pharmacopoeia, Intrinsically toxic constituents of herbal ingredients: Herbal ingredients that may cause adverse effect,

### Unit – III Primary Metabolites

**Primary and secondary metabolites from medicinal plants** - therapeutic importance and biological effects. Factors affecting secondary metabolites in medicinal plants.

**Drugs containing Carbohydrates and Derived products**- Agar, Acacia gum, Gum tragacanth, Isapaghula, Starch

**Tannins:** Black catechu, Myrobalan, Gall

**Lipids:** Castor oil, Neem oil, Bran oil, Gualtheria oil

**Proteins:** Gelatin, Spirulina, Soyabean-Lecithin, L-Dopa (Kauancha)-Mucuna pruriens

**Neutraceuticals:** General introduction, classification, herbs as functional foods, Dietary fibres, cereals and grains, health drinks, antioxidants.

**Extraction methods:** Qualitative & Quantitative Analysis of carbohydrates, proteins and amino acids, lipids, steroids and fatty acids.

### Unit-II Alkaloids

Definition, Distribution, Occurrence, Properties, Classification, Extraction (Qualitative and quantitative analysis), Isolation and test of Alkaloids and Glycosides. Identification and structure Elucidation

**Drug containing Alkaloids:** Introduction, Definition, History, Classification (Tropane alkaloids, Indole alkaloids, Quinoline alkaloids, Isoquinoline alkaloids, Steroidal alkaloids), Occurrence in nature, Properties, Source plants: Belladonna, Datura, Stramonium, Hyoscyamus, Indole, Nux vomica, Vinca, Lobelia, Tobacco, Areca nuts, Ipecac, Opium, Veratrum, Coffee, Tea, Cocoa, Aconite, Ephedra, Colchicum.

**Drug containing Glycosides:** Introduction, Classification (Cardiac glycosides, Anthracene glycosides, pyridine and piperidine, and other alkaloids), Distribution, Chemical tests of Glycosides, isolation, Source plants: Liquorice, Senna, Aloe, Stevia, Rhubarb, Digitalis, Thevetia, Squill, (Red and Indian), Dioscorea, Brahmi, Ginseng, Almond, Mustard, Ginkgo, Ammi, Psoralea, Bearberry, Picrorhiza, Chirata, Quassia, Andrographis,

Medicinal plants as future source of new drugs: Approaches to discovery and development of natural products as potential new drugs. Isolation of active entity from medicinal plants.

Selection and optimization of lead compounds for further development with suitable examples of plant-derived drugs viz. Vinblastin, Vincristine, Nicotine.

### Suggested Reference Book

1. Robinson, T. (1981). The Organic Constituents of Higher Plants. Cordus Press, Mass.
2. Stumpf, P.K. and Conn. E.E. (1980). The Biochemistry of Plants. Vol.1-14, Academic Press, London.
3. Daniel, M. (2005). Medicinal Plants : Chemistry and Properties Oxford & IBH Publishers, New Delhi.
4. Evans, W.C. 2002. Trease and Evans Pharmacognosy. W.B. Saunders. London.
5. Harborne, J.B. (1984) Phytochemical Methods, AP. London
6. Anonymous 2002. Quality control methods for medicinal plant materials. World Health Organisation, Geneva, A.I.T.B.S. Publishers & Distributors, Delhi.
7. Trease and Evans



## BOT – 2309 Angiosperm Taxonomy- I

### Unit – I Plant preservation and identification

- Some modern methods of plant preservation; special methods for preservation of natural colours of plant parts, various wet methods.
- Plant identification:  
Various methods of identification, analytical keys, synopsis, flora, revision, monograph  
World monographs and floras of different parts of the world. Indian floras and floristic works.

### Unit – II Taxonomic research and methodology

- Taxonomic categories. Plant nomenclature: History of Botanical Nomenclature. Detailed study of the latest Code, Name changes, Requirements for naming a new species, Hybrid names, Cultivated plants

### Unit – III Plant classification

- History of Angiosperm classification from herbals to the present day. Principles of taxonomy. Evolution of Taxonomic characters. Detailed studies upto family level of the Cronquist's classification of Magnoliophyta. Other recent systems of classification.

### Unit – IV Phylogeny of Angiosperms and families

- Different theories regarding the origin of Angiosperms. Study of the following Angiosperm families with special reference to their systematic position and phylogeny: Degeneriaceae, Winteraceae, Trochodendraceae, Dilleniaceae, Menispermaceae, Resedaceae, Bixaceae, Caryophyllaceae, Guttiferae (Clusiaceae), Moringaceae, Saxifragaceae, Crassulaceae, Cactaceae and Campanulaceae.

### Suggested Reference Books

1. Benson, L.D. (1979). *Plant classification*. 2nd edition.
2. Cronquist, A.(1988). *The evolution and classification of flowering plants*.
3. Davis, P.H. & Heywood V.H 1967. *Principles of Angiosperm Taxonomy*.
4. Erdtman,G. (1971). *Pollen morphology and plant taxonomy*.
5. Goldberg, A. (1986). Classification, Evolution and Phylogeny of the families of Dicotyledons.
6. Harborne, J.B. & Turner B.L. (1984). *Plant Chemosystematics*.
7. Heywood, V.H. & Moore D.M. (1984). *Current concepts in Plant Taxonomy*.
8. Hutchinson, J. (1969). *Evolution and phylogeny of flowering plants Dicotyledons: Facts and Theory*.
9. Metcalfe, C.R. & Chalk L. (1979). *Anatomy of the Dicotyledons*. 2nd ed.
10. Radford, A.E. *et. al.* (1974). *Vascular plant systematics*.
11. Daniel, M. (2009) *Taxonomy : Evolution at Work*, Narosa Publishers, New Delhi
12. Judd *et all.*, (2004) *Plant Systematics: a Phylogenetic Approach*

## Semester - IV

### BO- 2401 Plant Physiology – II

#### Unit - I Respiration

- Glycolysis, Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase

#### Unit- II Nitrogen Metabolism & Enzymes

- Nitrate and ammonium assimilation; amino acid biosynthesis.
- Nif gene, nod gene-Structure, function and regulation.
- Enzymes – Structure, function and kinetics.



### **Unit– III Plant Hormones**

- Biosynthesis, storage, breakdown and transport; physiological effect and mechanisms of action.

### **Unit – IV Sensory Photobiology**

- Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

### **Suggested Reference Books:**

1. Chopra, V.L. & Paroda, R.S. 1988. Approaches for incorporating drought and salinity resistance in crop plants, Oxford & IBH Publishing Co. Pvt. Ltd., ND
2. Treshow, M. 1970. Environment and plant response, Mc Graw Hill, NY
3. Taiz, L. and E. Zeiger. 2002. Plant Physiology, 3<sup>rd</sup> ed. Sinauer Associates Inc Publishers Massachusetts.
4. Nilsen, L. & Orcutt, 1998. Physiology of plants under stress : Abiotic factors, John Wiley & Sons, Inc., USA
5. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins (Paperback),~ Nicholas C. ,Price,Nicholas C. Price (Author), Oxford 1999.

## **BO – 2402 Plant Ecology – II**

### **Unit – I Community Ecology**

- Nature of communities; community structure and attributes; pattern & community stability; levels of species diversity and its measurement; edges and ecotones.

### **Unit – II Species diversity and Species interaction**

- Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

#### **Ecological succession**

- Types, mechanisms; changes involved in succession concept of climax.

### **Unit – III Ecosystem**

- Structure and function; energy flow and mineral cycling (CNP); Primary production and decomposition; structure and function of different ecosystems.

### **Unit – IV Biogeography**

- Theory of island biogeography and its implications, Major biomes their features and composition; biogeographical zones of India.

### **Suggested Reference Books:**

1. Weil R.R. (2007) The Nature and Properties of Soils. Pub. Prentice Hall pubs
2. Krebs C.J. ( 2008) Ecology: The Experimental Analysis of Distribution and Abundance, Benjamin Cummins
3. Gotelli N.J. (2008) A Primer of Ecology. Sinauer Pub.
4. Odum E. P. (1971) Fundamentals of Ecology



## BOT – 2403 Molecular Genetics

**Unit I Principles and rules of recombinant DNA technology-** Restriction enzymes and nucleic acid modifying enzymes, choice of vectors, plasmids, phages, cDNA and genomic libraries, isolation of genes, PCR and its applications.

**Unit- II Gene transfer through vectors & G. MOs:** Binary vectors and their utility,  
**Direct gene transfer-** PEG mediated, electroporation, particle bombardment and alternative methods, screenable and selectable markers, characterization of transgenics, chloroplast transformation.

**Strategies for introducing biotic & Abiotic stress resistance / tolerance-** Bacterial resistance, viral resistance, fungal resistance, insects & pathogen resistance, herbicide resistance, drought, salinity, thermal stress, flooding and submergence tolerance.

**Unit - III Molecular mapping-** Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers, construction of genetic and physical map, gene mapping and cloning.

**Marker assisted selection –** Quantitative and qualitative traits, MAS for genes of agronomic importance viz. insect resistance, grain quality & grain yield.

**Genomes and comparative genomics-** High throughput genome sequencing, Arabidopsis and rice genomes, genome annotation and synteny.

**Unit-IV Gene silencing,** knock out mutants, gene tagging, gene trapping, approaches to proteome analysis, dynamic modulation of protein structure and function, structure to function virtual organism.

**Bioinformatics & Functional genomics and proteomics-** Approaches to analyse differential expression of genes- ESTs, SAGE, microarrays and their applications.

**Biosafety, IPR & Ethical issues-** IPR, Patents, trade secrets, copyright, trade marks, PGR, GATT, TRIPPS, patenting of biological material, PBRs and farmers rights, biosafety & containment practices.

### Suggested Reference Books:

1. Marshall, A.G. (1978). Biophysical Chemistry, Principles Techniques and applications John Wiley and Sons, N.Y.
2. Sambrook, J., Fritsch, E.F. & Maniatis (1989). Molecular Cloning, Cold Spring Lab Press.
3. Old, R.W. & Primrose, S.B. (1991). Principles of Gene Manipulations: an Introduction to Genetic Engineering, Blackwell Scientific Publications.
4. Friefelder, D. (1990). Molecular Biology. Narosa Publishing House.
5. Lehninger, A.L. (1993). Principles of Biochemistry, CBS Publishers & Distributors
6. Ignacimuthu, S. (1996). Basic Biotechnology, Tata McGraw-Hill.
7. Mehta, S.L., Lodha, M.L. & Sane, P.V. (1993). Recent Advances in Plant Biochemistry.
8. Lewin. B (2005) Genes IX Oxford University Press.



## **Optional Papers - II**

### **BOT - 2404 Global Change Biology**

**Unit – I** Paleoclimate – Historical changes corresponding variations seen in Biota  
Inferences for future trajectories

**Unit – II** The ozone hole and uv B radiation  
Differences between Northern and southern hemispheres  
Biological effects of uv radiation  
Montreal protocol

**Unit – III** Biological sources and sinks for air pollutants and green house gases

**Unit – IV** Biological feedback and mitigation  
Impact of climate change on terrestrial systems  
Changes affecting plant production

#### **Suggested Reference Books**

1. Tropical Forests and Global Atmospheric Change (Oxford Biology) Oxford 2005
2. Walker B. H. and Steffen W.( 2008) Global Change and Terrestrial Ecosystems International Geosphere-Biosphere Programme Book Series, Wiley .
3. Omasa K. Nouchi I. Luit J. De Kok (2006) Plant Responses to Air Pollution and Global Change. Springer

### **BOT- 2405 Plant Tissue Culture–II**

#### **Unit - I Somaclonal Variation**

- Introduction
- Source material and culture condition
- Molecular basis of variation
- Isolation of variants
- Factors affecting somaclonal
- Application

#### **Unit – II Cell Culture and Secondary Metabolites**

- Introduction
- Dynamics of aspects of plants cells for plant products cultured *In Vitro*.
- Factors affecting biosynthetic potential
- Batch cultures
- Large scale cultures

#### **Unit – III Techniques to Enhance Secondary Metabolites *In Vitro***

- Immobilisation
- Biotransformation
- Use of fungal elicitors
- Hairy root cultures

#### **Unit – IV Germ-plasm Conservation**

- Modes of Conservation
- Materials used for conservation
- Cryopreservation – different methods
- Cryoprotectants



- Factors affecting freezing
- Storage strategies
- Assessment of successful cryopreservation

### Suggested Reference Books

1. Narayanaswamy, S. (2005) - Plant Cell & Tissue Culture, Tata McGraw-Hill.
2. Bhojwani SS & Razdan MK (1983) - Plant Tissue Culture: Theory & Practice, Elsevier Science Publications.
3. Reinert, J. & Bajaj, YPS. (1977) - Applied & Fundamental Aspects of Plant, Cell Tissue and Organ Culture, Springer-Verlag.
4. Razdan M.K. (2005) - Plant Tissue Culture.
5. Vasil I.K. (1988) Cell Culture and Somatic Cell Genetics of Plants, Vol. 1 to 6.
6. Kalyan kumar De (2007), Plant Tissue Culture, New Central Book Agency.
7. U. Kumar (2001), Methods in Plant Tissue Culture: Agrobios
8. Staba J.E. (1982), Plant Tissue Culture As a source of Biochemicals., CRC Press.

## BOT - 2406 Population Biology

- Unit – I** Plant population dynamics  
Single species; Multiple species; Population growth; Population regulation, Meta-population and Spatial dynamics
- Unit – II** Population coherence – Rules of cooperation  
Diversity and stability in ecological community
- Unit – III** Competition and coexistence predator – prey interactions  
Host-parasite interactions
- Unit – IV** Ecology and Food Production  
Initiative for ensuring food security

### Suggested Reference Books

1. Dhawan V. (2004) Biotechnology for food and nutritional security. The Energy and resource Institute, New Delhi
2. Hastings A. (1996) Population Biology: Concepts and Models. Springer
3. May, L.R. and Mclean A. (2007) Theoretical Ecology: Principles and Applications Oxford
4. Vandermeer, J.H. and Goldberg D.E. (2003) Population Ecology: First Principles. Princeton

## BOT- 2407 Angiosperm Taxonomy- II

- UNIT – I** Taxonomy as a synthetic science,  
Taxonomic evidences, Morphology, Anatomy, Palynology,  
Embryology, Cytology and Phytochemistry.  
Numerical Taxonomy, Cladistics.
- UNIT – II** Intrafamilial classification and controversial taxa of the families included in Parietales B. & H., Malvales B.& H.,  
Sapindales Cronquist, Caryophyllales Cronquist and Gentianales B.& H.
- UNIT – III** Molecular Systematics: Sources of DNA sequence data, Plant genomes, generating DNA sequence data,  
Analysis of DNA sequence data, Molecular characters,  
Restriction site analysis, Nuclear genome mapping



**UNIT – IV** Study of the following Angiosperm families with special reference to their systematic position and phylogeny: Myrsinaceae, Loganiaceae, Gesneriaceae, Pedaliaceae, Phytolaccaceae, Aristolochiaceae, Lauraceae, Loranthaceae, Juglandaceae, Salicaceae, Plantaginaceae, Taccaceae, Dioscoreaceae, Pontederiaceae, Typhaceae and Eriocaulaceae.

### Suggested Reference books

1. Benson, L.D. (1979) *Plant classification*. 2nd edition.
2. Cronquist, A. (1988) *The evolution and classification of flowering plants*.
3. Davis, P.H. and Heywood V.H. (1967) *Principles of Angiosperm Taxonomy*.
4. Erdtman, G. (1971) *Pollen morphology and plant taxonomy*.
5. Goldberg, A. (1986) Classification, Evolution and Phylogeny of the families of Dicotyledons.
6. Harborne, J.B. & B.L. Turner. (1984) *Plant Chemosystematics*.
7. Heywood, V.H. & D.M. Moore. (1984) *Current concepts in Plant Taxonomy*.
8. Hutchinson, J. (1969) *Evolution and phylogeny of flowering plants. Dicotyledons: Facts and Theory*.
9. Metcalfe, C.R. & L. Chalk. 1979. *Anatomy of the Dicotyledons*. 2nd ed.
10. Radford, A.E. et. al. (1974). *Vascular plant systematics*.
11. Daniel, M. (2009) *Taxonomy : Evolution at Work*, Narosa Publishers, New Delhi
12. Judd et al., (2004) *Plant Systematics: a Phylogenetic Approach*

## BOT 2408

### PHYTOCHEMISTRY -II

#### Unit I: Cultivation Practices of Medicinal Plants

Medicinal plants cultivation and its benefits. Factors influencing cultivation. Need and scenario.

**General good agriculture practices for medicinal herbs:** Source, selection and authentication of herbal materials. Collection, harvesting, drying, packaging, storage and preservation of herbal raw materials. Packing, storing, preservation and labeling of finished products.

**GAP** of Chlorophytum borivillanum, Withania somnifera, Rauwolfia serpentina, Andrographis paniculata, Centella asiatica, Aloe vera, Senna Alexandria Artimisia annua Commiphora wightii, and Ocimum sanctum.

**Marine plants as a potential source of drugs:** Definition, Present status, Classification of important bioactive agents from marine sources. General methods of isolation and purification. Study of Marine toxins. Marine biomedical. Conditions for growing and maintaining cultures of Chlorella and Spirulina.

**Fungi in pharmaceuticals:** General methods of isolation, cultivation, purification for Antibiotics, Alkaloids and other pharmaceuticals. Mushroom its use and cultivation using different substrates.

#### Unit II – Pharmacognosy

Definition and scope of pharmacognosy, meaning, origin, history. Pharmacognosy and modern medicine, phytopharmaceuticals.

**Traditional Drugs of India:** (Scientific name, Regional names, Basic morphology, Biological source, Microscopy, chemical constituents, Uses, marketed Formulations and pharmacognosy of the following:

**Root Drugs:** Boerhavia diffusa, Pluchea lanceolata, Chlorophytum borivillanum, Zingiber officinalis, Curcuma longa, Plumbago zeylanica, Withania somnifera, Curculigo orchioides, Acorus calamus

**Stem Drugs:** *Tinospora cordifolia*, *Vitis quadrangularis*,

**Bark Drugs:** *Terminalia arjuna*, *Saraca asoca*, *Holarrhena pubescens*, *Oroxylum indicum* and *Cinnamomum zeylanicum*

**Leaf Drugs:** *Achyranthes aspera* (apamarg), *Adhatoda zeylanica* *Andrographis paniculata*, *Bacopa monnieri*, *Centella asiatica*, *Swertia chirata*, *Convolvulus pluricaulis*, *Senna alexandria*, *Ocimum tenuiflorum* and *Tylophora asthmatica*.

**Fruit Drugs:** *Embillica officinalis*, *Garcinia indica*, *Semecarpus anacardium* (Bhilama), *Terminalia bellerica*, *Terminalia chebula*, *Tribullus terrestris*, *Solanum surattense*, *Embelia ribes*





**Seed Drugs:** *Elettaria cardamomum*, *Mucuna pruriens*, *Linum usitatissimum*, *Plantago ovata*, *Nigella sativa*, *Vernonia anthelmintica*, *Trigonella foenum-graceum*

**Oil Drugs:** *Celastrus paniculata*, *Linum utissimum*

### Unit – III Phenolics

Definition, Distribution, Occurrence, Properties, Classification, Extraction ( Qualitative and quantitative analysis) , Isolation and test of Phenols. Identification and structure Elucidation

Source plants, Uses and Chemistry of the following drugs : Phenolic acids, phenyl propanoids, stilbenes, acetophenones, lignans, coumarins, flavonoids, anthocyanins, tannins and quinones.

Medicinal plants as future source of new drugs: Approaches to discovery and development of natural products as potential new drugs. Isolation of active entity from medicinal plants.

Selection and optimization of lead compounds for further development with suitable examples of plant-derived drugs viz. silibinin (active constituent of silymarin obtained from *Silybum marianum*), luteolin, rutin, hesperidin.

### Unit – IV Terpenoids

Definition, Distribution, Occurrence, Properties, Classification, Extraction( Qualitative and quantitative analysis) , Isolation and test of Alkaloids and Glycosides. Identification and structure Elucidation

Source plants, Uses and Chemistry of the following drugs : Terpenoids: monoterpenoids (volatile oils, iridoids), sesquiterpenoids, diterpenoids, triterpenoids (Limonoids, Quassinoids, Cucurbitacins, Brassinosteroids, Saponins and Cardiac glycosides) Carotenoids and polyterpenoids.

Volatile oils: Mentha, Lemongrass oil, cloveoil, Fennel, Citronella

Resin , Gum-Resin and Oleo resin: Cannabis, Capsicum, Balsam of tolu, Benzoin, Turmeric, Ginger, Asafoetida.

Medicinal plants as future source of new drugs: Approaches to discovery and development of natural products as potential new drugs. Isolation of active entity from medicinal plants.

Selection and optimization of lead compounds for further development with suitable examples of plant-derived drugs viz. Artemisinin from *Artemisia anua*, Arjungenin, Arjunolic Acid from *Terminalia arjuna*, Bacosides from *Bacopa monnieri*.

### Suggested Reference Book

1. Robinson, T. (1981). *The Organic Constituents of Higher Plants*. Cordus Press, Mass.
2. Stumpf, P.K. and Conn. E.E. (1980). *The Biochemistry of Plants*. Vol.1-14, Academic Press, London.
3. Wallis T. E.( 2005).Textbook of Pharmacognosy. 5<sup>th</sup> Edition. CBS publishers & Distributors Pvt. Ltd.
4. Daniel, M. (2005). *Medicinal Plants : Chemistry and Properties* Oxford & IBH Publishers, New Delhi.
5. Trease and Evans 2002. Pharmacognosy. W.B. Saunders. London.
6. Harborne, J.B. (1984) Phytochemical Methods, AP. London
7. Anonymous 2002. Quality control methods for medicinal plant materials. World Health Organisation, Geneva, A.I.T.B.S. Publishers & Distributors, Delhi.
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9. Chauhan MG and Pillai APG Microscopic profile of powdered drugs used in Indian Systems of Medicine- Volume 2- Leaf drugs. Published by Gujarat Ayurved University, Jamnagar.
10. Chauhan MG and Pillai APG Microscopic profile of powdered drugs used in Indian Systems of Medicine- Volume 3- Seeddrugs. Published by Gujarat Ayurved University, Jamnagar.
11. Kokate CK. Textbook of Pharmacognosy.
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