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# **BENGALURU CITY UNIVERSITY**

## **SYLLABUS FOR M.Sc Plant Science (III & IV Semester)**

**CHOICE BASED CREDIT SYSTEM  
(SEMESTER SCHEME)**

**2020-2021**

**PROCEEDINGS OF THE MEETING OF THE BOARD OF STUDIES IN PLANT  
SCIENCE (PG) BENGALURU CENTRAL UNIVERSITY, BENGALURU.**

**Date:** 20-08-2020

**Agenda:**

1. To finalize the syllabus of Choice Based Credit System for III & IV Semester, M.Sc., Plant Science for approval.

**MEMBERS APPROVED THE SYLLABUS:**

1	Prof. L. RAJANNA	Chairman
2	Prof. Ch. RAMESH	External Member
3	Prof. G. R. JANARDHANA	External Member
4	Prof. S. MANIAN	External Member
5	Prof. RAJU. K. CHALANNAVAR	External Member
6	Prof. JAYARAM REDDY	Member
7	Dr. ROSHINI RAO	Member
8	Prof. RAJKUMAR H GARAMPALLI	External Member(Co-opt)

**MEMBERS NOT RESPONDED:**

1	Prof. M. B. SHIVANNA	External Member
2	Dr. M. SEENAPPA	Co-opted Member

**MINUTES OF THE MEETING**

Chairman sent emails to the respected members of the board for the approval of III and IV Semester M.Sc., Plant Science syllabus on 13.08.2020.

- a) The draft scheme of the study, Examination and Syllabus of Choice Based Credit System for III & IV semester M.Sc., in Plant Science was scrutinized, discussed and approved after changes suggested by the members.
- b) The Chairman BoS was authorized to make necessary modifications wherever it is required.

**SEMESTER III**

Paper Code	Title of the Paper	Theory (Hrs/Week)	Practical (Hrs/Week)	Total No. of Hrs/ Semester	Duration of examination (Hrs)	Max. Marks examination	Internal Assessment	Total Marks	Credits
HCT- 301	PLANT PHYSIOLOGY	4	-	52	3	70	30*	100	4
HCT- 302	TAXONOMY OF ANGIOSPERMS	4	-	52	3	70	30*	100	4
HCT- 303	PLANT ANATOMY AND PALYNOLOGY	4	-	52	3	70	30*	100	4
OET- 304	OPEN ELECTIVE ETHANOBOTANY	4	-	52	3	70	30*	100	4
HCP- 305	PRACTICAL – I	-	4	52	4	70	30**	100	4
		-	4	52					
HCP- 306	PRACTICAL – II	-	4	52	4	70	30**	100	4
		-	4	52					

**Total marks = 700, Total Credits = 24**

\* 15 marks for Test + 05 marks for assignment + 05 marks for Seminar + 05 marks for Attendance,

\*\* 10 marks for Record + 10 marks for Submission + 10 mark for test



**SEMESTER IV**

Paper Code	Title of the Paper	Theory (Hrs/Week)	Practical (Hrs/Week)	Total No. of Hrs/ Semester	Duration of examination (Hrs)	Max. Marks examination	Internal Assessment	Total Marks	Credits
HCT- 401	ECONOMIC BOTANY AND PHYTOCHEMISTRY	4	-	52	3	70	30*	100	4
HCT- 402	PLANT CELL, TISSUE AND ORGAN CULTURE	4	-	52	3	70	30*	100	4
HCT- 403	BIOTECHNOLOGY	4	-	52	3	70	30*	100	4
HCT- 404	ELECTIVE	4	-	52	3	70	30*	100	4
HCP- 405	PRACTICAL – I Of Paper : HCT – 401, 402 and 403	-	4	52	4	70	30**	100	4
HCP -406	PRACTICAL – II Of Paper HCT - 404	-	4	52	4	70	30**	100	4

**Total marks = 700, Total Credits = 24**

\* 15 marks for Test + 05 marks for assignment + 05 marks for Seminar + 05 marks for Attendance,

\*\* 05 marks for Record + 05 marks for Submission + 05 mark for test (7.5 marks for each paper HCT: 401 & 402 of Practical – I & 7.5 marks for each paper of HCT: 403 & 404 of Practical – II).

**NOTE:** Any one from the elective has to be chosen by the student

**Elective –** a) Systematics of Angiosperms

b) Plant Biodiversity and Conservation

In lieu of project work, practical exams are conducted for 100 marks.

**OR**

If project is mandatory then practical exams should be conducted for 50 marks.



## SEMESTER III

### HCT-301: PLANT PHYSIOLOGY

		52 hrs
<b>UNIT I:</b>	<b>Cell Structure:</b> Ultra structure of Plasma membrane, Mitochondria, Endoplasmic reticulum, Chloroplast, Golgi bodies, Ribosomes, Glyoxysomes, Peroxisomes, Cytoskeleton. <b>Water relations and Mineral Nutrition:</b> Water potential, its role in water movement from soil through plant into the air. Importance of nutrients, deficiency disorders and treatments. Passive and Active transport, Membrane transport proteins and Ion transport in roots.	13 hrs
<b>UNIT II:</b>	<b>Plant Growth regulators:</b> Types, physiological effects and mechanism of action of hormones and their applications in Agriculture and Horticulture. Physiology and biochemistry of flowering and senescence. <b>Seed physiology:</b> Seed dormancy- significance, types, methods of breaking dormancy, physiology and biochemistry of seed germination.	13hrs
<b>UNIT III:</b>	<b>Photosynthesis:</b> General concepts of photosynthesis, Photosynthetic pigments and LHCs and Photosystems, Photooxidation of Water, mechanism of electron & proton transport, Photophosphorylation. A brief description of C <sub>3</sub> , C <sub>4</sub> and CAM plants, photorespiration. <b>Respiration:</b> General aspects, Glycolysis, TCA Cycle, Electron transport and ATP synthesis and alternate Oxidase system. Pentose Phosphate pathway and its significance.	13 hrs
<b>UNIT IV:</b>	<b>Nitrogen and Lipid Metabolism:</b> Mechanism of Biological Nitrogen Fixation, Nitrogenase- Properties and mechanism of action. Structure and functions of Lipids, Synthesis and Degradation of fatty acids, Glyoxylate pathway and Gluconeogenesis <b>Stress Physiology:</b> Plant responses and adaptations to abiotic stresses (Freezing stress, heat stress, salinity stress, water deficit and oxygen Deficiency), Osmotic adjustments and its role in tolerance to drought and salinity.	13hrs

### PRACTICALS

1. Determination of Water potential of the tissue by falling drops method.
2. Determination of Catalase activity by Permanganate Titration method
3. Determination of alpha-amylase activity in germinating grains.
4. Estimation of reducing sugars by 3,5-Dinitrosalicylic acid method
5. Estimation of Carbohydrates by Anthrone method
6. Estimation of total leg-haemoglobin in the nodules
7. Estimation of total chlorophyll content and **Chl a / Chl b** ratio
8. Estimation of Ascorbic acid content in fruits.
9. Determination of Isoelectric pH of Proteins.
10. Charts, physiology models and instruments.
11. Separation of amino acid and Phenolic mixture by TLC.
12. Effect of temperature on Water potential of potato tuber

## REFERENCE

1. Buchanan, B.B. Gruissem, W. and Jones, R.L. 2004. **Biochemistry and Molecular Biology of plants**
2. Conn, E.E. Stumpf. Bruenning, G. and Doi, R.H. 1987. **Outlines of Biochemistry**. John Wiley and Sons, New York.
3. Hall, D.O. and Rao, K.K. 1999. **Photosynthesis**. 6<sup>th</sup> edition, Published in association with the Institute of Biology, Cambridge University Press, Cambridge, U.K.
4. Hopkins, W.G. 1995. **Introduction to Plant Physiology**. John Wiley & Sons. Inc., New York, USA.
5. Moore, T.C. 1989. **Biochemistry and physiology of Plant Hormones**. 2<sup>nd</sup> edition. Springer – Verlag, New York, USA.
6. Stumpf, P.K. and Conn, E.E. (eds.) 1988. **The Biochemistry of Plants- A Comprehensive treatise**. Academic Press, New York.
7. Taiz, L. and Zeiger, E. 1998. **Plant Physiology**. 2<sup>nd</sup> edition. Sinauer Associates, Inc., Publishers, Massachusetts, USA.
8. Taiz, L. and Zeiger, E. 2003. **Plant Physiology**. 3<sup>rd</sup> edition. Panima Publishing Corporation, New Delhi/Bangalore.
9. Wilkins, M.B. 1989. **Advanced Plant Physiology**. Pitman publishing Ltd., London.. I.K. International PVT., New Delhi

## SEMESTER – III

### HCT-302: TAXONOMY OF ANGIOSPERMS

52 hrs

**UNIT I: Introduction:** Brief historical development – Ancient – Medieval and Modern. **13 hrs**  
**General account:** Aims, aspects and phases of development of Taxonomy. Role of Botanical Gardens, Herbarium and Botanical Survey of India. A comparative study of Bentham and Hooker, Hutchinson and Takhtajan systems of Classification with respect to principles, outlines and phylogenetic implications.

**UNIT II: Taxonomic Evidences:** Study of characters from Anatomy, Cytology **13 hrs**  
Embryology, Morphology, Molecular, Palynology and Phytochemistry in relation to Taxonomy.

**Species concept:** Principles employed in grouping, relationship and delimitation of species, genera, family, order and classes.

**UNIT III: Nomenclature:** Historical development – Principles of International Code of **13 hrs**  
Botanical Nomenclature, ICBN articles and recommendations. ICN - rules and recommendations

**Biosystematics** – Introduction, Principle and Methods. Numerical and experimental Taxonomy.  
Molecular systematic and Phylogenetic methods (a brief account on Angiosperm Phylogeny Group I, II and III).

**UNIT IV: Diagnostic and salient features of the following families:** **13 hrs**

**Magnoliidae** – Magnoliaceae and Aristolochiaceae

**Hamamelidae** – Casuarinaceae and Urticaceae

**Caryophyllidae** – Caryophyllaceae and Plumbaginaceae

**Dilleniidae** – Malvaceae and Ebenaceae

**Asteridae** – Gentianaceae and Asteraceae

**Alismatidae** – Alismataceae and Najadaceae

**Commelinidae** – Cyperaceae and Typhaceae

**Zingiberidae** – Zingiberaceae

**Liliidae** – Liliaceae and Orchidaceae.

### PRACTICALS

1. Description and derivation of a taxon to respective families of Bentham and Hooker's systems.
2. Preparation and uses of dichotomous and Polyclave keys
3. Use of various software packages for the online identification.
4. Study of significant characters viz., Pollinia, Thalloid angiosperms
5. Open carpel and bulbils.
6. Taxonomic uses of primary and secondary metabolites – micro and macro molecules
7. Mounting of a properly dried and pressed specimen of any wild plant on herbarium sheet. (The herbarium sheet shall be submitted with record book at the time of examination).
8. Field survey. (Note: Field trip of 2-3 days to a floristically rich area is compulsory)



## REFERENCES

1. Chrispeels, M. J. and Sadava, D. 1977. **Plants, Food and People**. W.H. Freeman & Co., San Francisco.
2. Cronquist, A. 1981. **An integrated system of classification of flowering plants**. Columbia, University press, New York.
3. Cronquist, A. 1988. **The Evolution and Classification of Flowering Plants**. 2nd edition. New York Botanical Garden, New York.
4. Carlquist, S. 1961. **Comparative Plant Anatomy - a guide to taxonomic and evolutionary application of anatomical data in angiosperms**. Columbia Univ. Press. New York
5. Davis, P.H. and Heywood, V.H. 1973. **Principles of Angiosperm Taxonomy**. Robert E Kriegen Publ.Co., New York.
6. Erdtman, 1952. **Pollen Morphology & Plant Taxonomy**. Chronica Botanica, Waltham, Mass.
7. Heywood, V.H. and Moore, D.M. (eds.). 1984. **Current concepts in Plant Taxonomy**. Academic, Press, London.
8. Huber, H. 1977. **The treatment of Monocotyledons in an evolutionary system of classification**. Pl. Syst. Evol. suppl.
9. Hutchinson, J. 1973. **The Families of Flowering Plants arranged according to a new system based on their phylogeny**. Oxford University Press, Oxford.
10. **International Plant Names Index**. A list of Current Plant names from three source; the index kewensis (IK), the gray card index (GCI) and the Australian Plant names Index.
11. Lawrence, G. H. M. 1951. **Taxonomy of Vascular Plants**. Macmillan, New York.
12. Mc. Neill, J etal (eds) 2006. **International code of Botanical Nomenclature**. Regnum Vegetabile 146.
13. Michael. G. Simpson 2010. **Plant Systematics**. Academic Press, USA.
14. Mondal. A. K. 2005, **Advanced Plant Taxonomy**. New central Book Agency Pvt. Ltd., Kolkata.
15. Pimetel, D. and Hall, C.W. (eds.). 1989. **Food and Natural Resources**. Academic Press, London, New York.
16. Radford *et al* 1974. **Vascular Plant Systematics**. Harpen and Row New York.
17. Sambamurty, A.V. S. S 2005. **Taxonomy of Angiosperms**. IK International Pub., New Delhi.
18. Singh, G. 2010. **Plant Systematics**. An Integrated Approach 3 eds. Science Publishers Enfield. N.H.
19. Sneath and Sokal, R. R. 1973. **Numerical Taxonomy**. The Principles and Practice of Numerical Classification. WH Freeman, San Francisco.
20. Sreenath. K. P. 2009. **Angiosperms Classification Systems; An analytical approach**. Annadani Byrava Prakashana, Bangalore.
21. Turrill, W.B. (eds.) 1964. **Embryology in relation to Taxonomy**. Vistas in botany. Vol. IV Pregamon press, Oxford.
22. Wendy B. Zomlefer 2006. **Guide to Flowering Plant Families**. Overseas press, (India) Pvt. Ltd., New Delhi.
23. Young, D.A. and Siegler, D.S. (eds.) **Phytochemistry and Angiosperm**. Phytochemistry. Praeger Scientific, New York.

## SEMESTER-III

### HCT-303: PLANT ANATOMY AND PALYNOLOGY

52 hrs

#### PLANT ANATOMY

**UNIT I: Plant Cell Wall:** Structure and organization **13 hrs**

**Root anatomy:** Primary structure of root, variations in number of vascular Strands. Velamen, and Tricoblast.

**Leaf anatomy:** Dicot, Monocot and Variations, Venation pattern Stomatal types and distribution.

**Nodal anatomy:** Types of nodes and origin of bud traces.

**Internodal anatomy:** Herbaceous dicot, woody and monocot stem, medullary bundles, bicollateral bundles and internal phloem.

**Floral Anatomy:** Ontogeny and vascularization.

**UNIT II: Primary xylem:** Concepts of Protoxylem and metaxylem, vascular differentiation in shoot apex and leaf primordia. **13 hrs**

**Shoot apical meristem and Root apical meristem;** Theories and structural organisation, cyclic and acyclic changes in SAM.

**Diversity in structure of wood:** Heart and sapwood, Growth rings, Ring porous wood, Porous wood, diversity in axial parenchyma distribution and diversity in ray system.

**Anatomical Variations:** Ecological and anatomical adaptations in Hydrophytes, Xerophytes, Halophytes and Epiphytes.

**UNIT III: Phloem tissue:** Ultra structure and development of sieve tube element. **13 hrs**

**Vascular cambium:** Structure and activity, uniseriate / multiseriate nature, Fusiform ray initials and Cambium zone.

Variations in Vascular Cambium - Gnetum and Magnoliales

**Unusual Secondary Growth:** *Serjania clematidifolia* and *Passiflora sps*

#### PALYNOLOGY

**UNIT IV Introduction:** Scope and development, **13 hrs**

**Branches of Palynology:** Aerobiology, Forensic Palynology, Copra palynology, Paleopalynology and Palynostratigraphy.

**General account of pollen / Spore morphology:** Dicot, monocot, Gymnosperms and Pteridophytes, Chemical composition of pollen ornamentation, Palynological techniques.

**Melitto palynology:** Role of bees in crop productivity, bee pollen in health care.

**Aerobiology:** General account and its applications, Methods used in atmospheric pollen monitoring.



## PRACTICALS

### PLANT ANATOMY

1. Study of epidermal appendages and Stomatal types.
2. Stomatal types.
3. Tracheary elements.
4. Root Anatomy.
5. Stem Anatomy
6. Leaf Anatomy.
7. Flower bud Anatomy.
8. Ecological Anatomy.
9. Double staining technique.
10. Maceration.

### PALYNOLOGY

1. Pollen morphology of common angiosperm taxa using permanent slides.
2. Study of pollen with particular reference to size, shape and colour
3. Study of pollen in unifloral and multifloral honey,
4. Volumetric and non – volumetric pollen traps.
5. Charts, palynology models and instruments

## REFERENCES

### PLANT ANATOMY

1. Abraham, F. 1982. **Plant anatomy** 3 editions, Pergaon Press, Oxford.
2. Carlquist, S. 1967. **Comparative Plant Anatomy**, Holt Reinert and Wi9nston, New York.
3. Chand, S. 2005. **Plant Anatomy**. S. Chand and Company Ltd., New Delhi.
4. Cutter, E. G. 1971. **Plant Anatomy – Part I & II**, Cell and Tissues. Edward Arnold, London.
5. Fahn, A. 1985. **Plant anatomy**, Pergaon Press, Headington Hill Hall, Oxford.
6. Katherine Easu, 1996. **Anatomy of Seed Plants**. First wiley Reprint, New Delhi.

### PALYNOLOGY

1. Agashe, S. N. 1997. **Aerobiology**. Orford and IBH Publishing Company, Pvt., Ltd., New Delhi.
2. Agashe, S. N. 2006. **Palynology and its Applications**. Oxford and IBH Publication Company, Pvt., Ltd., New Delh.
3. Agashe, S. N. and Eric Caulton. 2009. **Pollen and Spores. Applications with special Emphasis on Aerobiology and allergy**. Science Publisher New Hampshire USA Netherlands.
4. Erdtman, G. 1952. **Pollen morphology and Plant taxonomy of Angiosperms**. Almquist and Wiksell, Stockholm.
5. Nair, P. K. K. 1970. **Pollen Morphology of angiosperms; A historical and phylogenetic study**, Scholar publishing house, Lucknow.
6. Ogden, E. C. and Rayner, G. S. 1974 **Manual for sampling Airborne Pollen**. Hafner Press, Macmillan Publishing Co., Inc, New York.



### SEMESTER III

#### OET- 304: ETHNOBOTANY

<b>ETHNOBOTANY</b>	<b>52 hrs</b>
<b>UNIT I: Introduction of Botany:</b> Overall structures of the plants, its parts and various terminologies. Bacteria, Viruses, Fungi, Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.  <b>Ethnobotany:</b> History and importance of ethnobotany, ethnomedicobotany, ethnozooology, ethnoveterinary, ethnomusicology and ethnoagriculture and methods of studies. Tribals of Karnataka and their socio - cultural practices.	<b>13 hrs</b>
<b>UNIT II: Indigenous Phytotherapy:</b> Jaundice, skin, nervous disorders, respiratory and intestinal disorders and rejuvenation; scientific validation of folk claims.  <b>Traditional plants:</b> Cereals, pulses, vegetables, spices, and mushrooms. Edible fruits and seeds. Plants in folk songs and proverbs.	<b>13 hrs</b>
<b>UNIT III: Conservation and management:</b> Sacred groves, impact of modernization, a case study sholiga tribes of B. R hills and Khani tribals of Kerala.	<b>13 hrs</b>
<b>UNIT IV: Traditional systems:</b> Basic concepts and development of Ayurveda, Siddha, Unani and Tibetan systems of medicine.  A general account on the traditional uses of plants and animals with reference to Karnataka State tribals.	<b>13 hrs</b>

#### REFERENCE

1. Cotton, C.M. 1996. **Ethnobotany - Principles and Applications**, Century School Book by service Film setting Ltd.
2. Dahlgren. R. H., Clifford, T and P. F Yeo 1985. **The families of the monocotyledons; structure, Evolution and Taxonomy**. SpingerVerlag, NY.
3. Gary J, Martin, 2004. **Ethnobotany - A Methods Manual**, Chapman and Hall. UK.
4. Jain S. K. 1981. **Glimpses of Indian Ethnobotany**. Oxford and IBH, NewDelhi
5. Jain S.K.1987. **A manual of ethnobotany**. Scientific publisher Jodhpur.
6. Jain S.K and Mundgal , 1999. **Handbook of ethnobotany**. London.
7. Pursrglove, J.W. 1972. **Tropical Crops- Monocotyledons and Dicotyledons of ethnobotany, ethnomedicine, ethnoecology, ethnic communities**.
8. Rao, P. 1996. Sacred groves and conservation. WWF – India, Quartely 7 ; 4 -8
9. Trivedi, P. C. 2006. **Medicinal plants: Ethanobotanical Approach**, Agriobios, India.
10. Trivedi, P. C. 2002. **Enthnobotany**. Aavishkar publishers and Distributors, Jaipur.
11. Yoganarasimhan, S.N. **Medicinal Plants of India -Vol I- Karnataka**, Interline Publishing Pvt. Ltd.

### SEMSTER III

#### HCP – 305: PRACTICAL I

#### PLANT PHYSIOLOGY AND PALYNOLOGY (4 Credits)

#### PLANT PHYSIOLOGY (4 hr/week, 52hr)

1. Determination of Water potential of the tissue by falling drops method.
2. Determination of Catalase activity by Permanganate Titration method
3. Determination of alpha-amylase activity in germinating grains.
4. Estimation of reducing sugars by 3,5-Dinitrosalicylic acid method
5. Estimation of Carbohydrates by Anthrone method
6. Estimation of total leg-haemoglobin in the nodules
7. Estimation of total chlorophyll content and **Chl a / Chl b** ratio
8. Estimation of Ascorbic acid content in fruits.
9. Determination of Isoelectric pH of Proteins.

#### PLANT PHYSIOLOGY AND PALYNOLOGY (4 hr/week, 52hr)

1. Charts, physiology models and instruments.
2. Separation of amino acid mixture by TLC.
3. Separation of Phenolic mixture by TLC.
4. Effect of temperature on Water potential of potato tuber
5. Pollen morphology of common angiosperm taxa using permanent slides.
6. Study of pollen with particular reference to size, shape and colour.
7. Study of pollen in unifloral and multifloral honey.
8. Volumetric and non – volumetric pollen traps.
9. Charts, palynology models and instruments.

## **HCP – 306: PRACTICAL II**

### **TAXONOMY OF ANGIOSPERMS AND PLANT ANATOMY (4 Credits)**

#### **TAXONOMY OF ANGIOSPERMS (4 hr/week, 52hr)**

1. Description and derivation of a taxon to respective families of Bentham and Hooker's systems.
2. Preparation and uses of dichotomous and Polyclave keys
3. Use of various software packages for the online identification.
4. Study of significant characters viz., Pollinia, Thalloid angiosperms
5. Study of significant characters viz., Open carpel and bulbils.
6. Taxonomic uses of primary and secondary metabolites – micro and macro molecules
7. Mounting of a properly dried and pressed specimen of any wild plant on herbarium sheet. (The herbarium sheet shall be submitted with record book at the time of examination).
8. Field survey. (Note: Field trip of 2-3 days to a floristically rich area is compulsory)

#### **PLANT ANATOMY (4 hr/week, 52hr)**

1. Study of epidermal appendages and Stomatal types.
2. Stomatal types.
3. Tracheary elements.
4. Root Anatomy.
5. Stem Anatomy
6. Leaf Anatomy.
7. Flower bud Anatomy.
8. Ecological Anatomy.
9. Double staining technique.
10. Maceration.



## SEMESTER IV

### HCT-401: ECONOMIC BOTANY AND PHYTOCHEMISTRY

#### ECONOMIC BOTANY

52 hrs

**UNIT I Introduction:** Plants in commerce and industry.

13 hrs

**General account:** Introduction, origin, distribution, botanical name, family, part used and methods of cultivation and uses - Rice, Wheat, maize; Beverages: Tea and Coffee, Oils and fats: classification, extraction methods; Sunflower, Safflower, Groundnut, Lin seed, Fibres: Cotton, Jute, Coconut & Agave Wood: features and properties of Teak, Mahogany and Vegetable sponges.

**UNIT II Family, useful parts and Chemical constituents:** Cardamom, 13 hrs

Cinnamom, Clove, Asafoetida, Ginger, Pepper, Coriander, Fennel, Henna, Indigofera, Butea, Arecanut, Beetle Leaf, Tobacco, Turmeric and Vanilla, Rubber- processing of rubber; Havea- gums and resins; gum Arabic, copals, turpentine. Sugars- sugarcane, preparations of sugar; stevia and beet sugar.

#### PHYTOCHEMISTRY

**UNIT III Extraction, Isolation and purification of herbal drugs:** General 13 hrs

methods of extraction, Isolation, Characterization and Identification of selected herbal drugs (Vincristine, Camptothecin and Curcumin).  
**Herbal drugs:** Roots, stem, wood, leaves, flowers, fruits and seed.

**UNIT IV Phytochemical screening:** Classification and structures of Alkaloids, 13 hrs  
phenols, saponins, terpenes, flavonoids, cyanogenic compounds, gums and mucilages.

**Biotechnology in herbal drugs:** Current trend in herbal medicine, types of DNA markers in plant genome analysis.

#### PRACTICALS

##### ECONOMIC BOTANY

1. Field Survey for collection of economically important plants of the region.
2. Study of locally available economic products of plant origin.

##### PHYTOCHEMISTRY

1. Qualitative phytochemical screening of
  - a) Phenolics
  - b) Tannins
  - c) Saponins

## REFERENCE

1. Bhushan Patwardhan, 2007. **Drug Discovery and Development**, New India Publishing Agency, New Delhi.
2. Biren Shah and Seth, A. K. 2010. **Text Book of Pharmacognosy and Phytochemistry**. Reed Elsevier India Pvt. Ltd., Haryana, India.
3. Kocchar, H. L. 1998. **Economic Botany of the tropics**, 2 Edn. Macmillan India Ltd.
4. Sharma, O.P. 1996. **Hill's Economic Botany** (Late Dr. AF Hill, Adopted by O. P Sharma)' Tata Mc Graw Hill Co. Ltd., New Delhi.
5. Rashtra Vardhana, 2009. **Economic Botany**, Super Book Publishers Pvt. Ltd., New Delhi.
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7. Pandey, S.N. and Chandha, A. 1999. **Economic Botany**, Vikas Publishing House Pvt. Ltd., New Delhi.
8. Raman, N. 2006. **Phytochemical Techniques**, New India Publishing Agency, New Delhi.
9. Wagner, H. and Bladt, S. **Plant Drug Analysis**, Pharma book Syndicate, Hyderabad, India.

## SEMESTER IV

### HCT-402: PLANT CELL, TISSUE AND ORGAN CULTURE

52 hrs

- UNIT I History and applications of Plant Tissue Culture:** Concept and development of tissue culture, role of auxins and cytokinins, improvement of media and recent advances in plant tissue culture. **13 hrs**
- Requirement for Tissue Culture:** Basic laboratory organization, instruments and equipments, culture media.
- Aseptic Manipulation:** Composition of media, media preparation, selection of media, sterilization of culture vessels, instruments, media, explants and transfer to media.
- Concept of Cellular Totipotency:** Vascular and organogenic differentiation, dedifferentiation, redifferentiation, totipotency of epidermal and crown gall cells.
- UNIT II Clonal Propagation:** Technique, multiplication by axillary, apical and adventitious shoots, factors influencing shoot multiplication and rooting and acclimatization of plants transferred to soil. **13 hrs**
- Organ, tissue and cell culture:**
- Organ Culture:** Leaf, Root, Flower, Anther, Pollen, Ovary, Ovule and Embryo,
  - Tissue Culture:** Meristem, Nucellus and Endosperm.
  - Cell Culture:** General account of single cell culture.
- UNIT III Somatic Embryogenesis:** Types, embryo maturation and plantlet development, factors affecting somatic embryogenesis and practical applications of somatic embryogenesis. **13 hrs**
- In vitro Pollination and Fertilization:** Methodology, factors affecting seed setting after in vitro pollination and applications of in vitro pollination.
- Protoplast Culture:** Isolation of protoplast, methods, source, culture, media, regeneration and protoplast fusion, somatic hybrids, cybrid production and their practical application.
- Somaclonal and Gametoclonal Variations:** Source of materials, culture conditions, molecular basis of variation, isolation of variants, disease resistant, herbicide resistant and stress tolerant lines.
- UNIT IV Role of Tissue Culture in Germplasm conservation:** Need for in vitro conservation, modes of conservation, cryopreservation, low pressure and low oxygen storage, multiplication through callus cultures, artificial seed **13 hrs**
- Industrial application with particular reference to secondary metabolites:** Techniques of selecting cell lines for high yields of compounds of secondary metabolites, mass cultivation of plant cells, Bioreactors, Elicitor – induced accumulation of products, factors limiting large scale production of useful components, application of tissue culture for synthesis of useful compounds.



## PRACTICALS

1. In vitro morphogenetic studies on any one plant system (Seed culture, multiplication of shoots, rooting and hardening)
2. Isolation of explants, establishment, subculture and maintenance of callus.
3. Morphology of callus cells (callus smear preparation) and histological aspects (microtomy).
4. Preparation of synthetic seeds.

## REFERENCE

1. Bajaj, Y.P.S. (Ed.). **Biotechnology in agriculture and forestry**. Various volumes published time to time. Springer-Verlag, Berlin
2. Bhojwani, S.S. 1990. **Plant tissue culture: Applications and limitations**. Elsevier Publishers, Amsterdam.
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6. Gamborg, O.L. and Phillips, G.C. 1995. **Plant cell, tissue and organ culture, fundamental methods**. Springer International student edition. New Delhi.
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12. Street, H.E. 1977. **Plant tissue and cell culture**. Academic Press, Berkeley, University of California. USA.
13. Thorpe, T.A. (Ed.) 1995. **Embryogenesis in plants**. Kluwer Academic Publishers, Netherlands.
14. Vasil, I.K. (Ed.). **Cell culture and somatic cell genetics of plants, various volumes**. Academic Publishers, Orlando.

**SEMESTER IV**  
**HCT-403: BIOTECHNOLOGY**

**52 hrs**

- UNIT I** Introduction, scope and importance of Biotechnology, Biotechnology scenario in India. **13 hrs**
- Recombinant DNA - I:**
- Enzymes used in genetic engineering: Restriction Endonucleases, Ligases, Polymerases, Kinases and Phosphatases, DNA Methylases and Topoisomerases.
- Use of vectors in cloning: Plasmids, Phages, Cosmids, ssDNA vectors, BAC, YAC, MACs. Expression Vectors, Sequencing vectors, Vectors for cloning PCR products, Binary and Shuttle Vectors. Improved *Agrobacterium* based Vectors and Virus based vectors for plants.
- UNIT II** **Recombinant DNA - II: Methods of DNA delivery:** PEG mediated DNA uptake, electroporation, Biolistic transfer, Microinjection, organelle transformation, Mechanism of integration of foreign DNA into plant genomes. **13 hrs**
- Genomic and cDNA libraries:** Construction, size, full length cDNA cloning, RT-PCR, RACE.
- Nucleic acid hybridization- Southern and Northern blotting techniques.
- UNIT III** **Plant Biotechnology - I:** Transgenic plant technology. Insect resistant plants- Cry- genes of Bt., their proteins and target insects, cry genes expression in plants, insect resistance to cry proteins. Bt cotton and Bt brinjal issues in India. Virus resistant transgenic plants. Herbicide resistance and stress-and senescence-tolerant plants. Modification of seed protein quality. Suppression of indigenous genes by antisense (delaying ripening). Genetic modification of flower pigmentation. Terminator technology, production of vaccines by transgenic plants. Problems in gene transfer in plants. Ethics of genetically engineered crops. **13 hrs**
- UNIT IV** **Enzyme Biotechnology:** Isolation, purification, immobilization and uses of enzymes. **13 hrs**
- Production of amylases, proteases and lipases.
- Microbial Biotechnology:** Production of organic compounds by fermentation: ethanol, acetone and butanol.
- Production of antibiotics - Pencillin
- Production of Single Cell Proteins - *Spirulina* and *Chlorella*.
- Production of Biofertilizers - *Azotobacter* and *Rhizobium*
- Production of Bioinsecticides - *Bacillus thuringiensis* and NPV
- Safety, social, moral and ethical consideration, IPR



## PRACTICALS

1. Study of fermentation by wine production.
2. Isolation of DNA and restriction digestion.
3. Agarose gel electrophoresis of restriction fragments.
4. Isolation of amylase producing bacteria.

## REFERENCE

1. Bajaj, Y.P.S. (Ed.) 1978. **Biotechnology in agriculture and forestry**. Various volumes published time to time. Springer-Verlag, Berlin
2. Bernard. R glick and Jack J. Pasternak, 2000. **Molecular Principles and Applications**. 2<sup>nd</sup> edition, ASM Press, Washington: DC
3. Bhojwani, S.S. 1990. **Plant tissue culture: Applications and limitations**. Elsevier Publishers, Amsterdam.
4. Bhojwani, S.S., and Razdan, M.K. 1996. **Plant tissue culture: Theory and Practice**. Elsevier Publishers, Amsterdam.
5. Brown, T.A. 1994. **Gene cloning**. Chapman and Hall Pub. New York.
6. Christopher, H. 1995. **Gene cloning and manipulation**. Cambridge University press. Cambridge, U.K.
7. Dixon, R.A. and Gonzales, R.A. (Ed.) 1994. **Plant cell culture, a practical approach**. 2<sup>nd</sup> edition, Oxford University Press, Oxford.
8. Evans, D.A., Dharp, D.R., Ammirato, P.V. and Yamuda, Y. (Ed.). **Handbook of Plant cell culture series**. Vol. 1-6, Mc Graw Hill Publishing Company, New York.
9. Gamborg, O.L. and Phillips, G.C. 1995. **Plant cell, tissue and organ culture, fundamental methods**. Springer International student edition. New York.
10. George, E.F. 1993 / 1996. **Plant propagation by Tissue culture**. Part 1 & 2, Exegetics Ltd. Southampton, England.
11. Glick B.R. and Pasternak, J.J. 1994. **Molecular Biotechnology: Principles and Applications of recombinant DNA**. American society of microbiology. Washington DC.
12. Greene, J.J. and Rao, V.S. 1998. **Recombinant DNA – Principles and Methodologies**. Marcel Dekker, New York. 1998.
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15. Neelima Rajvadya and DilipKumar Markandey, 2004. **Applied Microbiology**. Vol. II & V, A P H Publishing Corporation, New Delhi Old, R.W., and Primrose, S.B. 5<sup>th</sup> edition, 1994. **Principles of gene manipulations**. Blackwell Science. London
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20. Street, H.E. 1977. **Plant tissue and cell culture.** Academic Press, Berkeley, University of California.
21. Thorpe, T.A. (Ed.) 1995. **Embryogenesis in plants.** Kluwer Academic Publishers, Netherlands.
22. Vasil, I.K. (Ed.). **Cell culture and somatic cell genetics of plants, various volumes.** Academic Publishers, Orlando.
23. Yeoman, M.M. 1985. **Practical Cell culture technology.** Blackwell Scientific Pub.

## SEMESTER IV

### ELECTIVE

#### HCT-404-a: SYSTEMATIC OF ANGIOSPERMS

52 hrs

- UNIT I:** **A critical study of principles, outline and Phylogeny:** Arthur Cronquist (1988), Armen Takhtajan (2009), RMT Dahlgren (1980), Robert F. Thorne (1968) System of Classifications. Angiosperm Phylogeny Group – III. **13 hrs**
- UNIT II:** **Taxonomy in the service of Man and Conservation:** Introduction, field inventurisation, collection, preparation, preservation, documentation and handling of Herbarium. Historical development, role of National and International Botanical Gardens and Herbaria. **13 hrs**
- UNIT III:** **Evolution and differentiation of species:** Abrupt and gradual speciation. Isolating mechanism – geographical, ecological, seasonal, temporal, mechanical and ethological. Hybridization, stabilization and taxonomic treatments. **13 hrs**
- UNIT IV:** **Biosystematics:** Aims and procedures of Investigation. A case study of Clausen *et al* and Turresson experiments. Numerical Taxonomy. **13 hrs**

**Molecular studies:** Analysis of proteins, nucleic acids and chloroplast DNA data.

**Database:** Species identification packages and distribution mapping.

### PRACTICALS

1. Identification and classification of plants up to species level
2. Herbarium preparation
3. Study of biological significances
4. Study of plant modifications of taxonomic significances
5. Preparation and study of biographical notes on selected Taxonomists, Geographer and Geneticists.
6. Preparation of Manual / Flora / Monographs.
7. Modern Method of Systematics (Electrophoresis and Immunological studies).
8. Field visit to Botanical Garden / Research Institutes / Museum / National Parks / Sanctuary / Biosphere reserve or abandoned Airport.

### REFERENCE

1. Armen Takhtajan 2009. **Flowering plants**. Springer Science + Business Media.
2. Arthur Cronquist, 1988. **The Evolution and classification of flowering plants**. Thomas Nelson & Sons, London.
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25. Walter, K. S. and Gillett, H. J. 1998. 1997 **IUCN Red list of Threatened Plants**. IUCN, the World Conservation Union, IUCN, Gland, Switzerland and Cambridge, UK.



## SEMESTER IV

### ELECTIVE

#### HCT-404-b: PLANT DIVERSITY AND CONSERVATION

	<b>52hrs</b>
<b>Unit-1:</b> Biodiversity; Definition, concept and scope; Global Biodiversity and mega diversity centers of the world; Endemism and hot Spots of biodiversity; Types of Biodiversity; Uses and importance of plant diversity; Agro biodiversity- origin and evolution of cultivated species, Vavilov's centres of biodiversity; Diversity in domesticated species; Feral plants.	<b>13 hrs</b>
<b>Unit-2:</b> Biodiversity Estimation: Conventional and molecular methods of estimation of biodiversity; Species richness, species evenness, species abundance; Ecosystem Diversity- Measuring ecosystem diversity, major ecosystem types of the world; Values and uses of biodiversity.	<b>13 hrs</b>
<b>Unit-3:</b> Values of Plant Diversity: Ethical and aesthetic values, uses of plants and microbes; Loss of Biodiversity- Loss of genetic diversity, loss of species diversity, loss of ecosystem diversity; Loss of agro-biodiversity, projected scenario for biodiversity loss; Invasive species.	<b>13 hrs</b>
<b>Unit-4:</b> Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation; Social approaches to conservation; Biodiversity awareness programmes; Organizations associated with biodiversity management- IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations.	<b>13 hrs</b>

#### PRACTICALS:

- 1) Study of local vegetation to record species diversity by quadrat / line-transect method.
- 2) Study of cultivated and feral plants.
- 3) Study of in-situ and ex-situ Conservation methods.
- 4) Study of major Agrobiodiversity crops.
- 5) Study of major forest products.
- 6) Study of minor forest products.
- 7-12) A visit to Botanic Gardens, Zoological Parks, Biosphere Reserves, National Parks and Sanctuaries, Sacred grooves

#### REFERENCES:

- 1) Heywood, H & Watson, R.J. 1995 **Global Biodiversity Assessment** Springer-verlag, Berlin.
- 2) Schulze, E.D. & Mooney, H (eds.) 1992 **Biodiversity and Ecosystem functions** John wiley, Chichester. 32.
- 3) Mooney, H.A. (eds). 1996 **Biodiversity and Ecosystem function, Scope**. Macmillan India Ltd. Madras.
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- 5) Ahmedullh, M. & Nayar, M.P. 1987 **Endemic plants of the Indian region** Vol. I. BSI Calcutta.
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## **SEMESTER IV**

### **HCP 405: PRACTICAL - I**

### **ECONOMIC BOTANY AND PHYTOCHEMISTRY; PLANT CELL, TISSUE AND ORGAN CULTURE & BIOTECHNOLOGY (4 Credits) (4 hr/week, 52hr)**

#### **ECONOMIC BOTANY**

1. Field Survey for collection of economically important plants of the region.
2. Study of locally available economic products of plant origin.

#### **PHYTOCHEMISTRY**

Qualitative phytochemical screening of

- a) Phenolics
- b) Tannins
- c) Saponins

#### **PLANT CELL, TISSUE AND ORGAN CULTURE**

1. In vitro morphogenetic studies on any one plant system (Seed culture, multiplication of shoots, rooting and hardening)
2. Isolation of explants, establishment, subculture and maintenance of callus.
3. Morphology of callus cells (callus smear preparation) and histological aspects (microtomy).
4. Preparation of synthetic seeds.

#### **BIOTECHNOLOGY**

1. Study of fermentation by wine production.
2. Isolation of DNA and restriction digestion.
3. Agarose gel electrophoresis of restriction fragments.
4. Isolation of amylase producing bacteria

## **HCP 406: PRACTICAL II**

### **ELECTIVE – a. SYSTEMATICS OF ANGIOSPERMS (4 credits - 4 hr/week, 52hr)**

1. Identification and classification of plants up to species level
2. Herbarium preparation
3. Study of biological significances
4. Study of plant modifications of taxonomic significances
5. Preparation and study of biographical notes on selected Taxonomists, Geographer and Geneticists.
6. Preparation of Manual / Flora / Monographs.
7. Modern Method of Systematics (Electrophoresis and Immunological studies).
8. Field visit to Botanical Garden / Research Institutes / Museum / National Parks / Sanctuary / Biosphere reserve or abandoned Airport.

**OR**

## **HCP 406: PRACTICAL II**

### **ELECTIVE – b. PLANT DIVERSITY AND CONSERVATION (4 credits - 4 hr/week, 52hr)**

1. Study of local vegetation to record species diversity by quadrat / line-transect method.
2. Study of cultivated and feral plants.
3. Study of in-situ and ex-situ Conservation methods.
4. Study of major Agrobiodiversity crops.
5. Study of major forest products.
6. Study of minor forest products.
- 7-12. A visit to Botanic Gardens, Zoological Parks, Biosphere Reserves, National Parks and Sanctuaries, Sacred grooves



ALTERNATIVE - A STUDY OF THE EFFECTS OF ANTI-EPILEPTIC DRUGS IN CHILDREN - 100 MARKS (20%)

1. Identification of the research problem to be studied
2. Identification of the research objectives
3. Study of the literature on the topic
4. Study of the theoretical framework of the study
5. Preparation and design of the research proposal (including theoretical framework, research objectives, research questions, etc.)
6. Preparation of a research proposal (including theoretical framework, research objectives, research questions, etc.)
7. Identification of the research methodology to be used
8. Identification of the research methodology to be used

100

ALTERNATIVE - A STUDY OF THE EFFECTS OF ANTI-EPILEPTIC DRUGS IN CHILDREN - 100 MARKS (20%)

1. Identification of the research problem to be studied
2. Identification of the research objectives
3. Study of the literature on the topic
4. Study of the theoretical framework of the study
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