DEPARTMENT OF BOTANY
OSMANIA UNIVERSITY

M.Sc. BOTANY (CBCS)

New Syllabus
(Effective from Academic Year 2022-2023)

Contents:

DEPARTMENT OF BOTANY, OSMANIA UNIVERSITY
M.Sc. BOTANY (CBCS)
New Syllabus - Course Structure
(Effective from Academic Year 2022-2023)

Semester – I				
S.No	**Subject code**	**Paper No. and Subject title**	**Credits**	**Total Marks**
	THEORY			
1.	MBOT.CC.T.1.101	**I: Phycology and Mycology**	**3**	**100**
2.	MBOT.CC.T.1.102	**II. Bryophyta and Pteridophyta**	**3**	**100**
3.	MBOT.CC.T.1.103	**III. Angiosperm Systematics**	**3**	**100**
4.	MBOT.CC.T.1.104	**IV. Plant Biochemistry**	**3**	**100**
	PRACTICALS			
5.	MBOT.CC. P.1.105	Practical Lab-I	**2**	50
6.	MBOT.C.P.1.106	Practical Lab-II	**2**	50
7.	MBOT.CC.P.1.107	Practical Lab-III	**2**	50
8.	MBOT.CC.P.1.108	Practical Lab-IV	**2**	50
		Total	**20**	**600**

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Semester – II				
S.No	**Subject code**	**Paper No. and Subject title**	**Credits**	**Total marks**
	THEORY			
1.	MBOT.CC.T.1.201	**I: Applied Phycology and Mycology**	**3**	**100**
2.	MBOT.CC.T.1.202	**II: Gymnosperms and Embryology of Angiosperms**	**3**	**100**
3.	MBOT.CC.T.1.203	**III. Plant Anatomy and Palynology**	**3**	**100**
4.	MBOT.CC.T.1.204	**IV. Plant Physiology**	**3**	**100**
	PRACTICALS			
5.	MBOT.CC.P.1.205	Practical Lab-I	**2**	**50**
6.	MBOT.CC.P.1.206	Practical Lab-II	**2**	**50**
7.	MBOT.CC.P.1.207	Practical Lab-III	**2**	**50**
8.	MBOT.CC.P.1.208	Practical Lab-IV	**2**	**50**
		Total	**20**	**600**

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Semester – III				
S.No	**Subject code**	**Oaper No. and Subject title**	**Credits**	**Total marks**
	THEORY			
1.	CORE 1 MBOT.CC.T.2.301	**I: Cell Biology, Genetics and Biostatistics**	**3**	**100** (Int.30, Ex.70)
2.	CORE 2 MBOT.CC. T.2.302	**II: Environmental Pollution and Protection**	**3**	**100** (Int.30, Ex.70)_
3.	Elective I MBOT.CC. T.2.303	**Elective I – (A/B/C/D/E/F)**	**3**	**100** (Int.30, Ex.70)
4.	Elective – II MBOT.CC. T.2.304	**Elective II - (A/B/C/D/E/F)**	**3**	**100** (Int.30, Ex.70)
	PRACTICALS			
5.	MBOT.CC.P.2.305	Core I- Practical lab I	**2**	**50**
6.	MBOT.CC .P.2.306	Core II - Practical lab II	**2**	**50**
7.	MBOT.CC.P.2.307	Elective I- Practical Lab (A/B/C/D/E/F)	**1**	**25**
8.	MBOT.CC.P.2.308	Electives II- Practical Lab (A/B/C/D/E/	**1**	**25**
	Seminar	**Seminar**	**2**	**50**
		Total	**20**	**600**

	Semester-III, Elective I (A/B/C/D/E/F)	Semester III, Elective II A/B/C/D/E/
A	Molecular Genetics	Plant Tissue Culture and Biotechnology
B	Carbon and Nitrogen assimilation and crop productivity	Phytohormones and Plant Development
C	Plant Pathogen Interactions and Plant diseases	Biofertilizers, Biopesticides and Mushroom Cultivation
D	Phytogeography and Plant Systematics	Plant Biodiversity and Conservation
E	Actuopalynology and Palynotaxonomy	Melissopalynology and Forensic Palynology
F	Medicinal Botany and Phytochemistry	Cultivation and Post-Harvest Technology of Medicinal and Aromatic Plants

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Semester – IV				
S.No	**Subject code**	**Paper No. and Subject title**	**Credits**	**Total marks**
	THEORY			
1.	CORE 1 MBOT.CC.T.2.401	**I: Recombinant DN A Technology**	**3**	**100** (Int.30, Ex.70)
2.	CORE 2 MBOT.CC.T.2.402	**II: Plant Ecology, Biodiversity and Conservation Biology**	**3**	**100** (Int.30, Ex.70)
3.	Elective III- MBOT.CC.T.2.403	**Elective III- (A/B/C/D/E/F)**	**3**	**100** (Int.30, Ex.70)
	PRACTICALS			
4.	MBOT.CC.P.2.405	Core I -Practical Lab I	**2**	**50**
5	MBOT.CC .P.2.406	Core II- practical Lab II	**2**	**50**
6	MBOT.CC.P.2.407	Elective III- Practical Lab (A/B/C/D/E/F)	**2**	**50**
7	**Project**	**Project**	**5**	**150**
		Total	**20**	**600**

Semester -IV	**Elective III** (A/B/C/D/E/F)
A	Horticulture and Plant Breeding
B	Stress Physiology
C	Molecular Plant Pathology and Disease Management
D	Seed Technology and Nursery Management
E	Aerobiology and Paleopalynology
F	Pharmacognosy of Medicinal Plants

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Course Structure for I and II Semester
New Syllabus (Effective from Academic Year 2022-2023)

Semester I					Semester II				
	Course	Hrs /Wk	Credits	Marks		Course	Hrs /Wk	Credits	Marks
1	**CORE 1** MBOT.CC.T.1.101	3	**3**	30+70	1	**CORE 1** MBOT.CC.T.1.201	3	**3**	30+70
2	**CORE 2** MBOT.CC.T.1.102	3	**3**	30+70	2	**CORE 2** MBOT.CC.T.1.202	3	**3**	30+70
3	**CORE 3** MBOT.CC.T.1.103	3	**3**	30+70	3	**CORE 3** MBOT.CC.T.1.203	3	**3**	30+70
4	**CORE 4** MBOT.CC.T.1.104	3	**3**	30+70	4	**CORE 4** MBOT.CC.T.1.204	3	**3**	30+70
5	**CORE 1** Practical MBOT.CC.P.1.105	4	**2**	50	5	**CORE 1** Practical MBOT.CC.P.1.205	4	**2**	50
6	**CORE 2** Practical MBOT.CC.P.1.106	4	**2**	50	6	**CORE 2** Practical MBOT.CC.P.1.206	4	**2**	50
7	**CORE 3** Practical MBOT.CC.P.1.107	4	**2**	50	7	**CORE 3** Practical MBOT.CC.P.1.207	4	**2**	50
8	**CORE 4** Practical MBOT.CC.P.1.108	4	**2**	50	8	**CORE 4** Practical MBOT.CC.P.1.208	4	**2**	50
9	Seminar	2	-	-	9	Seminar	2	-	-
Total			**20**	**600**	**Total**			**20**	**600**

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Course Structure for III and IV Semester
New Syllabus (Effective from Academic Year 2022-2023)

SEMESTER III					SEMESTER IV				
	Course	Hrs. /Wk.	Credits	Marks		Course	Hrs. /Wk.	Credits	Marks
1	CORE 1 MBOT.CC.T.2.301	3	3	30+70	1	CORE 1 MBOT.CC.T.2.401	3	3	30+70
2	CORE 2 MBOT.CC.T.2.302	3	3	30+70	2	CORE 2 MBOT.CC.T.2.402	3	3	30+70
3	ELECTIVE – I MBOT.CC.T.2.303	3	3	30+70	3	ELECTIVE –III MBOT.CC.T.2.403	3	3	30+70
4	ELECTIVE – II MBOT.CC.T.2.304	3	3	30+70	–	–	–	–	–
5	CORE 1 Practical MBOT.CC.P.2.305	4	2	50	4	CORE 1 Practical MBOT.CC.P.2.405	4	2	50
6	CORE 2 Practical MBOT.CC .P.2.306	4	2	50	5	CORE 2 Practical MBOT.CC.P.2.406	4	2	50
7	ELECTIVE-I Practical MBOT.CC.P.2.307	4	1	25	6	ELECTIVE-III Practical MBOT.CC.P.2.407	4	2	50
8	ELECTIVE-II Practical MBOT.CC.P.2.308	4	1	25	7	PROJECT MBOT.CC.P.2.408	4	5	150
9	SEMINAR	2	2	50	9	SEMINAR	2	-	-
Total			**20**	**600**	Total			**20**	**600**

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Course Structure
Semester – I

S.N.	Subject Code	Subject Title	Credits	Instruction Hrs/week	Duration of (hrs) Exam.	Evaluation		Total Marks
	THEORY					Internal	External	
1.	MBOT.CC.T.1.101	Phycology and Mycology	3	3	3	30	70	100
2.	MBOT.CC.T.1.102	Bryophyta and Pteridophyta	3	3	3	30	70	100
3.	MBOT.CC.T.1.103	Angiosperm Systematics	3	3	3	30	70	100
4.	MBOT.CC.T.1.104	Plant Biochemistry	3	3	3	30	70	100
	PRACTICALS							
5.	MBOT.CC.P.1.105	Practical Lab-I	2	4	3	-	50	50
6.	MBOT.CC.P.1.106	Practical Lab-II	2	4	3	-	50	50
7.	MBOT.CC.P.1.107	Practical Lab-III	2	4	3	-	50	50
8.	MBOT.CC.P.1.108	Practical Lab-IV	2	4	3	-	50	50
Total:			**20**	**28**		**600**		**600**

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M.Sc. BOTANY- I SEMESTER

MBOT.CC.T.1.101 (CORE) 3 Hrs/Week 3 Credits

PAPER – I: Phycology and Mycology

UNIT-I: Classification of Algae and Fungi

1. General characters and comparative study of important systems of Classification of Algae-Fritsch and Parker systems of classification
2. Criteria used in the primary classification of Algae: a) Pigments b) Reserve food materials c) Flagella
3. Algae on diverse habitats – Terrestrial, Freshwater, Marine, Reproduction in algae (vegetative, asexual and sexual)
4. General characters of true fungi and fungi like organisms, Classification of fungi (Alexopoulus and Mims 1996 and Hibbett *et.al* 2007)
5. Brief account of hyphal structure, mode of nutrition, types of reproduction in fungi (asexual, sexual and fruiting bodies). Heterokaryosis, Parasexual cycle and Sex Pheromones (hormones) in fungi.

UNIT – II: Algae

Morphology, life history and classification of the following groups of algae.

1. Cyanophyceae: *Microcystis*, *Lvngbya* and *Aulosira*
2. Chlorophyceae: *Eudorina*, *Pediastrum*, *Hydrodictyon*, *Pithophora*
3. Chlorophyceae: *Ulva, Stigeocolmum*, *Draparnaldiopsis*
4. Chlorophyceae: *Cosmarium*, *Closterium* and *Bryopsis*
5. Charophyceae: *Nitella*

UNIT – III: Fungi

Morphology life cycle (Hibbett et.al 2007) of the following types.

1. Microsporidia: General account
   Chytridiomycota: *Synchytrium*
2. Blastocladiomycota: *Allomyces*, *Pilobolus*
   Neocallimastigomycota: General account
3. Detailed account of Ascomycota - *Taphrina*, *Emericella*, *Neurospora, Gibberella, Glomerella, Morchella*

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4. Basidiomycota: *Melampsora, Phallus, Ustilago*
5. Oomycota: *Peronospora*, Fungi-like organisms - *Stemonitis*

MBOT.CC.P.1.105 Practicals (Labs) **4 Hrs/Week 2 Credits**

1. Identification of the genera mentioned in Cyanophyceae
2. Identification of the genera mentioned in Chlorophyceae.
3. Collection algal material in and around university college/campus (a minimum of 20)
4. Introduction to basic Mycological Techniques and Lab Safety
5. Methods of sterilization, media preparation and culturing of fungi
6. Identification of fungal cultures, slides and specimens - *Synchytrium, Allomyces, Glomus Emericella, Neurospora, Morchella, Fusarium, Colletotrichum*
7. Identification of fungal cultures, slides and specimens- *Melampsora, Phallus, Ustilago, Peronospora, and Stemonitis*
8. Study of Symptomology of fungal diseases
9. Identifying the fungal diseases by taking sections and slide preparation: Downy mildews, Tikka disease, *Melampsora* rust, Wheat rust and White rust.
10. Collection of fungal plant disease material (a minimum of 20)

REFERENCES

1. Fritsch, F.E. The structure and reproduction of algae volume 1 and 2
2. Robin South,G and Alan Whittick: Introduction to Phycology
3. Morris,I: An Introduction to Algae
4. Bold, H.C. and Wynne, M.D.: Introduction to the Algae structure and reproduction
5. H.D.Kumar: Introductory Phycology
6. John Webster and Roland W.S. Weber - Introduction to Fungi
7. Alexopoulos C.J., C.W. Mims and M. Blackwell – Introductory Mycology
8. Mehrotra R.S. and K.R. Aneja – An Introduction to Mycology
9. Smith, J.E. - The Filamentous Fungi
10. DS. Hibbett *et.al.*2007. A higher level Phylogenetic classification of fungi Mycol Res. 111(Pt 5): 509.47.

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MBOT.CC.T.1.102 (CORE) 3 Hrs/Week 3 Credits

PAPER-II: Bryophyta and Pteridophyta

UNIT – I: Bryophyta

1) General characters and classification system (proposed by G.M. Smith) of Bryophytes.

2) Distribution, structure and reproduction of the following groups.

a). Marchantiales : *Targionia*
b). Jungermaniales : *Pellia, Porella*
c). Anthocerotales : *Notothylas*
d). Sphagnales : *Sphagnam*
e). Polytrichales : *Polytrichum*

3) Structure and evolution of Gametophyte in Bryophytes

4) Structure and evolution of Sporophyte in Bryophytes.

5) Economic importance of Bryophytes.

UNIT – II: Pteridophyta

1). General characters and classification system proposed by Sporne in Pteridophytes.

2) Distribution, structure and reproduction of the following groups.

a). Psilatales : *Psilotum*
b). Lycopodiales : *Phylloglossum*
c). Selaginellales : *Selaginella*
d). Isoetales : *Isoetes.*
e). Equisetales : *Equisetum.*
f). Filicales : *Adiantum, Salvinia, Azolla*

3) Telome theory and its applications

4) Stellar Evolution in Pteridophytes

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UNIT – III: Paleobotany

1). Paleobotany: Introduction, Fossils, fossilization and types of Plant fossils.

2). Fossil Bryophytes

3). Geological time scale, Carbon dating

4). Origin and evolution of early vascular Plants.

5). General characters of *Lepidodendrales*, *Calamitales* and *Sphenophyllales*.

MBOT.CC.P.1.106 Practicals (Labs) **4 Hrs/Week 2 Credits**

BRYOPHYTES:

I. Morphological and Structural Study using whole mount of

1) *Plagiochasma* 2). *Fimbriaria /Asterella* 3). *Targionia*

4). *Notothylas* 5). *Sphagnum* 6). *Polytrichum*.

PTERIDOPHYTES:

II. Morphology and Anatomy of vegetative and reproductive organs using cleared whole mount sections.

7) *Psilotum* 8) *Isoetes* 9) *Adiantum* 10). *Salvinia* 11) *Azolla*

12) Slides and Specimens of Bryophyta and Pteridophyta.

REFERENCE BOOKS

1. Smith, G.M. Cryptogomic Botany. Vol.II
2. Parihar, N.S.: Bryophyta
3. Parihar, N.S.1976: Biology and Morphology of Pteridophytes
4. Sporne, K.R. Pteridophyta
5. Rashid: Introduction to Pteridophyta
6. Cavers, F. Inter-relations of Bryophytes.

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MBOT.CC.T.1.103 (CORE) 3 Hrs/Week 3 Credits

PAPER – III: Angiosperm Systematics

UNIT – I: Taxonomy and Systematics

1. Taxonomy and Systematics: History, Definitions, Principles, Fundamental objectives and scope.
2. Taxonomic tools: Taxonomic keys - Dichotomous keys (Indented & bracketed keys); Herbarium (concept, development & functions, major herbaria in the world & India. Role of Botanical gardens and botanical museums.
3. Biosystematics: Definition, Categories and Deme terminology. Species concept - Taxonomic, Biological, Microspecies, Successional species.
4. Evolution of Angiosperms: Ancestral history, Origin, Dominance, Geographic distribution pattern and Endemism.
5. Synthetic approaches in systematics: Cytotaxonomy, Chemotaxonomy, Palynotaxonomy, Numerical taxonomy, Molecular taxonomy (DNA barcoding).

Unit-II: Plant Nomenclature & Classifications

1. Plant Nomenclature: Origin and development of code, International Code of Nomenclature (ICN) for Algae, Fungi and Plants. Type concept, Typification. Taxonomic rank; Effective and Valid publication; Rule of priority; Author citations, Rejection of names.
2. Brief account of Artificial (Linnaeus), Natural (Bentham & Hooker), Phylogenetic systems of classifications (Engler and Prantl).
3. An overview of classifications of the Phylogenetic systems: Hutchinson, Cronquist, Takhtajan, with emphasis on advantages and disadvantages.
4. Novel approaches in Plant Taxonomy: Cladistics – Definition and Methodology (Plesiomorphic and apomorphic characters, Homology and Analogy, Parallelism and Convergence).
5. Detailed account on an updated version of Angiosperm Phylogeny system of classification (APG system).

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Unit-III: Systematic study of the families (APG -IV)

Detailed systematic account and economical importance (includes: medicinal, horticultural, floricultural, Silvicultural) of the following families (16) in the following clades (in a *Sensu stricto*):

1. ANA grade (Basal Angiosperms): Nymphaeales - *Nymphaceae*; Magnoliids: *Magnoliaceae*; Piperales – *Piperaceae*.
2. Monocots: Poales – *Poaceae*; Dioscoreales –*Dioscoreaceae*;
3. Commelinids: Zingiberales – *Musaceae*, *Zingiberaceae*.
4. Eudicots: Ranunculales –*Menispermaceae*, *Ranunculaceae*; Proteales-*Nelumbonaceae*; Fabids: Fabales–*Fabaceae*,Rosales – *Rosaceae*.
5. Malvids:Myrtales–*Combretaceae*;Asterids: Ericales – *Ebenaceae*;Campanulids:Apiales-*Araliaceae*; Lamiids:Gentianales–*Loganiaceae*.

MBOT.CC.P.1.107 Practical(Labs) **4Hrs/week 2Credits**

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1. Identification of locally available plant families based on the floral parts (minimum of 10 families).
2. Construction of dichotomous keys – Indented and Bracketed keys for given plant material.
3. Identification of locally available (native/indigenous) plants up to species level by using Floras. (Minimum of 10 species)
4. Study and recording of intraspecific variations in the wild taxa available locally.
5. Study and identification of key characters in a group of species of a genus and construction of keys. (Locally available genera with minimum of 5 species).
6. Study of simple Nomenclatural problems.
7. Identification of genus and species by using Pollen morphology.
8. Hands on training on Herbarium techniques & Botanical Museum (collection, pressing, poisoning, drying, mounting and deposition) (Students required to submit at least fifty herbarium specimens of the local flora (native/indigenous) along with field note book).
9. Hands on training on GPS and GIS applications in plant identification and species mapping.

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10. Practice of plant identification by using e-resources (virtual herbaria, e-floras, plant data bases, App-Plantnet, Google images etc.).
11. Botanical excursions or local field visits for taxonomic studies. (Arboretums, Botanical gardens, Herbal gardens/nurseries, urban forest parks, national parks, wild life sanctuaries, tiger reserves, sacred groves etc.).

REFERENCES:

Books:

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- Bhattacharyya, B. and Johri, B.M. (1998). Flowering Plants. Taxonomy and Phylogeny. Springer Verlag &Narosa Publishing House, New Delhi.
- Chattarjee, D. (1962). Phytogeographical Regions of India.
- Cox, C. B., Healey, I. N. & Moore, P. D. (1976). Biogeography. An Ecological and Evolutionary Approach. 2nd Edition. Blackwell Scientific Publications.
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- Dahlgren, R.M.T. 1985. The Families Of The Monocotyledons: Structure, Evolution, And Taxonomy. Springer Verlag. Berlin-Germany.
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- Hooker, J.D. ([1872-] 1875 -1897). Flora of British India. Reeve & Co. Ltd., London.Vol. 1 - 7.
- Hutchinson, J. (1973). The Families of Flowering Plants. Third edition. Oxford University Press. London.
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- Lawrence, H.M. George (1969). Taxonomy of Vascular plants. Second edition. Oxford and IBH Publishing CO. Calcutta.
- McNeill, J. et al. (Eds.) 2012. International Code of Nomenclature for Algae, Fungi and Plants (Melbourne Code). Regnum Vegetabile 154, Koeltz Scientific Books.
- Naik, V.N. 1988. Taxonomy of Angiosperms. Tata Mcgraw-hill Pub. New York.
- Naqshi, A.R. 1993. An introduction to Botanical Nomenclature. Scientific Publishers, Jodhpur.
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- Sharma, O.P. (2013). Plant Taxonomy. Second edition. MC GRAW HILL INDIA.
- Shivarajan, V.V. and Robson, N.K. (1991). Introduction to the Principles of Plant Taxonomy. Second Edition. Cambridge University Press.
- Sivarajan, V.V. 1991. Introduction to the Principles of Plant Taxonomy. Oxford & IBH
- Takhtajan , A, and Jeffrey,C. (1981). Flowering Plants. Origin and Dispersal.Bishen Singh Mahendra Pal Singh, 1981;
- Takhtajan A. (1997). *Diversity and classification of flowering plants*. New York: Columbia University Press.
- Takhtajan, A. (1997). Diversity and classification of flowering plants. Columbia University Press. New York.
- Thorne, F. Robert. (1992). An Updated Phylogenetic Classification of the Flowering Plants. A Journal of Systematics and Floristic Botany. Vol. 13 (2) 365 – 389.
- Turland N.J. et al. (eds.). 2018. International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code). Regnum Vegetabile
- Glashütten: Koeltz Botanical Books.

Online Resources - Plant data bases links:

- POWO: https://powo.science.kew.orgThe Plant List: http://www.theplantlist.org
- BHL: https://www.biodiversitylibrary.orgTropicos: https://www.tropicos.org/home
- IPNI: https://www.ipni.orgefloras: http://www.efloras.org/index.aspx
- https://sites.google.com/site/efloraofindia/

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Hyderabad-500 007

M.Sc. BOTANY- I SEMESTER

MBOT.CC.T.1.102 (CORE) 3 Hrs/Week 3 Credits

PAPER – IV : Plant Biochemistry

UNIT-I: Bioenergetics and Enzymatics

1. **Concepts of thermodynamics:** Thermodynamic Systems and Potentials; Internal Energy, Helmholtz free energy, Enthalpy, Gibb's Free Energy, Entropy, Disorder; Laws of Thermodynamics in Biological Systems.
2. **Energy Flow:** Electromagnetic radiation, energy content of light, harvesting the Sunlight, biochemical energy, energy conservation, unlocking the energy, storage in Photo assimilates and circulation of energy, endergonic and exergonic reactions.
3. **Bioenergetics:** Energy coupled reactions in Photophosphorylation and glycolysis; Energy currency-ATP synthesis and reactions energy rich compounds, biological energy transducers.
4. **Enzymes:** Structure and classification, Co-factors, isozymes, activation, inhibition and covalent modification; role of covalent modification in enzymatic activity; zymogens.
5. **Principles of catalysis:** Mechanism of enzyme action, regulation of enzyme action, enzyme kinetics, Michaelis - Menten kinetics; pH and temperature optima of enzymes.

UNIT-II: Biomolecules - Metabolites-I

1. **Carbohydrates:** Basic concepts of Carbohydrates, Structure, Classification, and functions of carbohydrates a) monosaccharides b) oligosaccharides c) polysaccharides, storage polysaccharides, structural polysaccharides, glycoproteins.
2. **Lipids:** Basic concepts of Lipids, Classification of lipids - simple lipids, compound lipids, sterols, polyunsaturated fatty acids, lipoproteins.
3. **Lipid Metabolism:** Biosynthesis of fatty acids, oxidation of fats, α-oxidation, β-oxidation, glyoxylate cycle, gluconeogenesis.
4. **Amino acids:** General properties, Classification, and characteristics a) non-protein amino acids b) peptide bonds c) Biosynthesis of amino acids with reference to GS and GOGAT.

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5. **Proteins:** General introduction, biological functions of Proteins a) Structure and Classification of proteins and Ramachandran plot

UNIT-III: Biomolecules - Metabolites -II

1. General introduction to plant secondary metabolites, chemical classification, distribution, and functions
2. Extraction techniques for secondary metabolites: Maceration, Percolation, Soxhlet extraction, Distillation, Microwave assisted extraction, and Super critical fluid extraction.

Properties, chemical classification, applications and study of the following phytochemicals:

3. **Alkaloids:** *Withania somnifera*, *Rauwolfia serpentina*, *Papaver somniferum*
4. **Glycosides:** Cardiac glycosides in *Digitalis purpurea*, Saponin glycosides in *Glycyrrhiza glabra* and *Dioscorea deltoidea*, Anthraquinone glycosides in *Cassia angustifolia*
5. **Terpenes & Terpenoids:** *Artemisia annua*, *Taxus brevifolia*, *Mentha piperita*, *Eugenia caryophyllus*, and *Foeniculum vulgare*

MBOT.CC.P.1.108 Practicals (Labs) **4 Hrs/Week 2 Credits**

1. Preparation of Buffers, pH measurements
2. Measurement of luminous intensity of the light
3. Determination of amylase activity
4. Estimation of reducing sugars in fruits
5. Estimation of fructose
6. TLC demonstration for separation of amino acids
7. Quantitative Estimation of protein
8. Determination of iodine number
9. Extraction and estimation of total alkaloid content
10. Estimation of total phenolic content
11. Preliminary phytochemical tests for Flavonoids
12. Preliminary phytochemical tests for Phenols

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REFERENCES:

1. Plant Physiology, biochemistry and molecular biology. David, T: Dennis and Davis Turnip.Longman. Scientific and technical U.K. 1990.
2. Plant Biochemistry Voet, D and Voet J.G. International
3. Outlines of biochemistry. 5th edition Con E.E. and Stump P.K. 1995. Willey
4. Principles of biochemistry, Lehnenger, A.L. 1982 CBS Publication
5. Biochemistry, Strayer W.H. 1976. Foreman Company.
6. Introduction to Plant Physiology. Willium G. Hopkins and Norman P. A. Huner
7. Plant Physiology. Lincoln Taiz and Eduardo Zeiger. International Edition
8. Plant Biochemistry. P.M. Dey and J.B. Harborne
9. Plant Biochemistry. Hans-Walter Heldt
10. Physicochemical and Environmental Plant Physiology. Park S. Nobel

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M.Sc. BOTANY- II SEMESTER

Paper-I - Applied Phycology and Mycology.

MBOT.CC.T.1.201 **(CORE)** **3 Hrs/week 3 Credits**

PAPER – I:

UNIT-I: Microbial diversity

1. General account of Archaebacteria and Eubacteria; Ultra structure of bacterial cell, biochemistry of cell wall, nutritional and growth factors of bacteria
2. Characteristics and ultrastructure of viruses Classification (ICTV) of viruses; Symptomatology and Transmission of plant viruses; Importance of the viruses.
3. General characters of Mollicutes, transmission and diseases caused by Spiroplasmas and Phytoplasmas.
4. Economic importance of Alge- algal Bio-fertilizers, Alge as food and feed. Role of algae in Industry (Alginic acid, Agar, Carrageenan)
5. Algal blooms, Toxic algae and Fossil Algae

UNIT – II: Algae

Morphology, life history and classification of the following groups of algae

1. Xanthophyceae- *Vaucheria, Botrydium*
2. Bacillariophyceae – *Cyclotella, Cymbella, Gomphonema.*
3. Euglenophyceae - *Euglena, Phacus*
4. Phaeophyceae - *Laminaria, Padina*
5. Rhodophyceae - *Porphyra, Gracillaria, Corallina.*

UNIT – III: Fungi

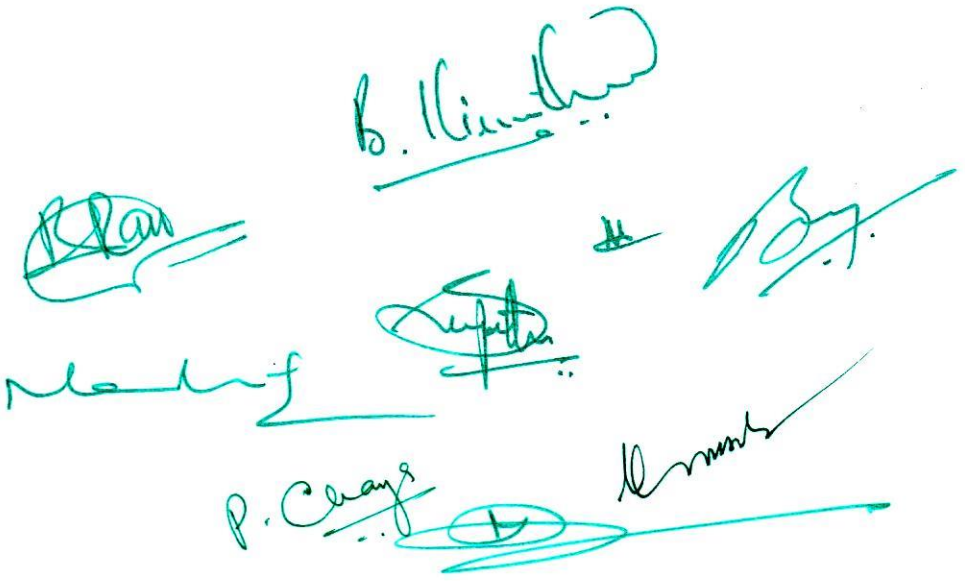
1. Fungi in Industry: Production of alcohol and organic acids.
2. Fungi in Medicine: Types of metabolites used in medicine and production of antibiotics.
3.. Fungi in Agriculture and Forestry:
   - **a)** Fungi as plant parasites (Wilts, Leafspots, Root rots, Smuts and Rusts).
   - **b)** Fungi as bio-fertilizers: Ecto and Endomycorrhizae.
   - **c)** Fungi as biopesticides: mycofungicides, weedicides, and insecticides.
4. Fungi as human and animal parasites (medical mycology)
5. Fungi as food: Mushrooms: Types of mushrooms, biology and growth of mushrooms, nutritional and medicinal value of edible mushrooms; Fungal protein (Saccharomycetes and *Fusarium*).

MBOT.CC.P.1.205 Practicals (Labs) 4 Hrs/ week 2 Credits

1. Identification of the genera mentioned in Xanthophycea, Bacillariophyceae, Euglenophyceae, Phaeophyceae and Rhodophyceae.
2. Identification of bloom forming algae.
3. Identification of Algal biofertilizers.
4. Identification of toxic algae.
5. Identification of fungal cultures, slides and specimens *of Rhizopus/Mucor, Aspergillus, Penicillium, Saccharomycetes, Fusarium, Alternaria, Cercospora, Pythium,* VAM fungi, *Trichoderma, Beauveria.*
6. Study of Mycorrhizal colonization in roots of *Parthenium* and *Tagetus.*
7. Study of Mushroom specimens
8. Staining of Gram + ve and Gram - ve Bacteria
9. Herbarium of diseased plants (fungal, bacterial, viral & mycoplasma diseases available locally – at least 2-3 specimens of each to be submitted).

Reference books

1. Fritsch, F.E. The structure and reproduction of algae volume I and II
2. Robin South,G and Alan Whittick: Introduction to Phycology
3. Morris,I: An Introduction to Algae
4. Bold, H.C. and Wynne, M.D.: Introduction to the Algae structure and reproduction
5. H.D.Kumar: Introductory Phycology.
6. Change. S.T. and P.G. Miles - Edible mushrooms and their cultivation
7. Mosses, B.V.A. - Mycorrhizae
8. Powel, C and D. J. Bagyaraj - V.A. Mycorhizae
9. Berry, R. - Industrial mycology (Vol. I)
10. Dubey, S.C. - Biotechnology.
11. Jeffrey C. Pommerville - Alcamo's Fundamentals of Microbiology
12. Arora D.R. and B. Arora - Text book of Microbiology



M.Sc. BOTANY- II SEMESTER

MBOT.CC.T.1.202 (CORE) 3 Hrs/week 3 Credits

PAPER – II: Gymnosperms and Embryology of Angiosperms

UNIT-I: Introduction and Classifications

1.1. Progymnosperms – Introduction, Classification (Beck, 1960), General characteristics and affinities of the following: i) Pityales ii) Aneurophytales iii) Protopityales.

1.2. Fossil gymnosperms - Introduction, General characteristics and affinities of the following: Pteridospermales, Pentoxylales, Bennettitales and Cordaitales.

1.3. Origin, evolution and distribution of extant gymnosperms.

1.4. Classifications – Morphological systems (Birbal Sahni, 1920), (Chamberlain, 1934), (Sporne, 1965). Phylogenetic system (Y Yang et al., 2022).

UNIT – II: Detailed Study of Extant Gymnosperms and Conservation

2.1. Study of morphology, anatomy and reproductive structures of the following: Cycadales – Cycas; Ginkgoales – Ginkgo; Araucariales – Araucaria; Pinales – Podocarpus; Gnetales – Gnetum.

2.2. Embryology of gymnosperms – Pollination mechanism; Formation of Endosperm; Structure, development of male and female gametophytes; Fertilization and post fertilization changes.

2.3. Conservation of gymnosperms – IUCN red listed threatened species. Indian endemics. Conservation priority areas in India: North East India, Eastern and Western Himalayas.

2.4. Economic importance of gymnosperms: As a source of gums, food, medicinal, ornamentals, resins and timber.

UNIT – III: Embryology of Angiosperms

3.1. Microsporangium – Structure of microsporangium, microsporogenesis, male gametophyte development and morphology.

3.2. Megasporangium: Structure and types of ovules, megasporogenesis, development of female gametophyte; structure and types of embryo sac.

3.3. Fertilization; self-incompatibility; barriers of fertilization; endosperm development and types; embryogeny; polyembryony; apomixis and parthenocarpy.

3.4. Recent advances and applications of embryology in Taxonomy, Agriculture and Horticulture.

MBOT.CC.P.1.206 Practicals (Labs) 4 Hrs/ week 2 Credits

1. Progymnosperms: i) Pityales ii) Aneurophytales iii) Protopityales. Specimens or Images to be displayed for study.
2. Fossil gymnosperms – Pteridospermales, Pentoxylales, Bennettitales and Cordaitales. Specimens or Images to be displayed for study.
3. Extant/living gymnosperms – Study of the vegetative, reproductive parts (pollen and seed cones) and anatomy (primary root, stem, leaf/leaflet) of the following: a) Cycas / Zamia, b) Araucaria/ Cupressus /Thuja c) Cedrus / Podocarpus/Pinus c) d) Ephedra/ Gnetum / Welwitschia.
4. Wood anatomy of Conifers: TS, TLS and RLS of the following woods - Araucaria Cupressus and Thuja.
5. Pollen (microspore) viability test by Evans blue method.
6. Embryology: Permanent slides of the following to be displayed for study.
   a) T.S. of anther b) Study of ovules c) Globular embryo
   d) Mature embryo) Polyembryony
7. Types of endosperm Permanent slides of the following to be displayed for study.
   a) Nuclear endosperm b) Cellular endosperm c) Helobial endosperm.
8. Field visits/Botanical excursions to the places of Gymnosperms in India: Eastern Ghats; Western Ghats; North East India; Eastern and Western Himalayas or Gymnosperms conservation institutions and gardens.

Reference books

1. Biswas Chhaya and B.M. Johri (1997). The Gymnosperms. Springer – Verlag Berlin Heidelberg GmbH.
2. B.M. Johri (1984). Embryology of Angiosperms.
3. Christenhusz et al. 2011. A new classification and linear sequence of extant gymnosperms. Phytotaxa 19:55 -70.
4. C.J. Chamberlain (2009). Gymnosperms. Structure &Evolution. CBS.
5. C.M. Govil. 2007.The gymnosperms Extinct and Extant. Krishna Prakashan Media (P) Ltd.
6. K.R. Sporne. (Print 2020).The Morphology of Gymnosperms. United Book Prints. New Delhi.
7. Panchanan (P) Maheshwari (1950). An Introduction to the Embryology of Angiosperms. New York. McGraw-Hill.
8. S.S. Bhojwani, S.P. Bhatnagar, P.K. Dantu (2015). The Embryology of Angiosperms, 6th Edition. Vikas Publishing House PVT LTD.2015.

9. S.S. Bhojwani and W.Y. Soh. (Editors). 2001. Current trends in the Embryology of angiosperms. Kluwer Academic Publishers. Dordrechat/Boston/London.
10. S.P. Bhatnagar and Alok Moitra (1996) (Reprint. 2004). Gymnosperms. New Age International (P) Limited, Publishers. New Delhi.
11. T. Pullaiah (2001).Text Book of Embryology of Angiosperms. Regency Publications.
12. Y Yang et al. (2022). Recent advances on phylogenomics of gymnosperms and a new classification.
13. *Online Resources of Gymnosperms:
14. The Gymnosperm Database - Conifers.org.
15. Conifers of the world - Conifers.org.
16. The Cycad page. The world List of Cycads. Cycadlist.org
17. The Ginkgo pages.
18. The IUCN red list of threatened species. iucnredlist.org

M.Sc. BOTANY- II SEMESTER

MBOT.CC.T.1.203 **(CORE)** **3 Hrs/week 3 Credits**

Paper: III Plant Anatomy and Palynology

UNIT –I: Anatomy and Epidermology

1. Introduction, importance and relationship of Plant Anatomy with Taxonomy
2. Characteristics and classification of Meristems. Vegetative shoot apex: Structure of shoot apex in Pteridophytes, Gymnosperms and Angiosperms. Theories to explain the organization of shoot apex: Mantle-Core Hypothesis, Tunica corpus theory and Anneau Initial & Meristem Diattente theory.
3. Root Apex: Structure of Root apex, quiescent centre concept. Theories to explain the organization of root apex: Apical cell theory, Histogen theory, Korper-Kappe theory.
4. Leaf: Structure with reference to C_3 and C_4 plants. Kranz Anatomy and its importance.
5. Epidermology: Structural composition of Epidermal cell complex, Stomatal complex, Trichome complex. Classification of Stomata and Trichomes.

UNIT –II: Xylotomy

1. Secondary growth with reference to Dicot stem. Structure and functions of vascular cambium.
2. Dicot wood anatomy: Morphology and arrangement of vessels, Tyloses. Distribution of the Axial Parenchyma, Ray Parenchyma and Wood Fibers.
3. Periderm: Origin of Phellogen, Phellum and Phelloderm and Lenticels.
4. Wood structure: Macro and Microscopical characteristics of wood, Wood maceration, Sapwood and Heartwood, Porus wood and Non-porus wood.
5. Salient features of the following woods.a) *Tectona grandis,* b) *Dalbergia sissoo* c) *Mangifera indica*
   d) *Vachellia nilotica.*

UNIT – III: Palynology

1. Palynology: Definition, Scope, Techniques (Acetolysis) and importance.
2. Morphology of pollen – Polarity, symmetry, size and shape, aperture pattern, NPC Classification, Exine stratification.
3. Aeropalynology –Introduction and types of allergic reactions in human beings. Applications of ELISA for diagnosis of pollen allergy in Clinical Palynology.
4. Melissopalynology– Introduction and Applications ofMelissopalynology in codification of honeys.
5. Forensic Palynology: Introduction and Applications of Forensic Palynology in solving the crime with some case studies.

MBOT.CC.P.1.207 Practicals (Labs) **4 Hrs/ week 2 Credits**

Practical Lab-III

1. Study of angiosperm leaf epidermis stomata, trichomes in the available taxa: *Crotalaria, Portulaca* or *Talinium, Tridax, Petunia* or *Datura, Tradescantia spathacea* or *Commelina, Cyperus* and Grass.
2. Estimation of stomatal frequency and stomatal index in the any available leaf material.
3. Maceration of wood and identification of various elements in *Magnolia champaca, Bombax ceiba, Tectona grandis, Terminalia arjuna* and *Azadirachta indica.*
4. Study of wood structure with the help of T.S., T.L.S., and R.L.S. in the following: a) *Tectona grandis* b) *Dalbergia sissoo* c) *Mangifera indica* d) *Vachellia nilotica.*
5. Histochemical tests for identification of the following: a) Cellulose b) Lignin c) Pectin d) Starch e)Suberin.
6. Study of shoot apex in suitable locally available materials to understand cyto-histologicalzonation (*Coleus* and *Kalanchoe*)
7. Study of the pollen grains of *Vachellia, Azadirachta, Cocos* and Grass.
8. Acetolysis technique.

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1. Fahn, A. Plant Anatomy (4th Ed.), 1990.
2. Easu, K. Anatomy of Seed Plants.
3. Easu, K. Plant Anatomy, 2nd Ed. Wiley N.Y. 1965.
4. Cutter, E.G. Plant Anatomy, Part I and II Edward Arnold; London, 1971 and 1978
5. Metcalf and Chalk. Anatomy of dicots (2nd Edition) (1983). Clarendon Press, Oxford.
6. Metcalf (1982-87) Anatomy of Dicots Vol. I to III
7. Meureth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Pub1. Inc., Menlo Park California.
8. Carliquist. S. (1988). Comparative wood anatomy, Springer – Berlag, Berlin.
9. Jeffrey, E.C. The Anatomy of woody plants.
10. Rao, K.R. & K.B.S. Juneja (1971) A Hand book for identification of fifty important Timbers of India.
11. Pearspm & Brown – Commercial Timbers
12. Lyndon R.F. 1990. Plant development – The cellular basis. Unnin. Hyman, London.
13. Steeves T.A. & Sussex 1. M, 1989, Pattersacin plant development 92nd Edition) Cambridge UNIT y
    Press, Cambridge.
14. P.K.K. Nair. Pollen Morphology of angiosperms.
15. P.K.K. Nair: Essentials of Palynology
16. Moor & Moor: Pollen analysis
17. R.B. Knox, Pollen allergy
18. M.R. Suxena : Palynology
19. A text book of Palynology: Kashinath Bhattacharya
20. Plant Anatomy: Pijush Rai

M.Sc. BOTANY- II SEMESTER

MBOT.CC.T.1.204 (CORE) 3 Hrs/week 3 Credits

Paper-IV: Plant Physiology

UNIT –I

1.1 Water relations:

a. Water potential
b. SPAC concept

1.2 Mineral nutrition: Mechanism of ion uptake

a. Electrochemical potential
b. Uptake of solutes and macromolecules from soil
c. Ion channels
d. ATPase carrier
e. Aquaporins

1.3 Assimilation of Nutrients:

a. Physiology and biochemistry of nitrogen fixation
b. Sulphate reduction and assimilation

UNIT –II

2.1 Photosynthesis:

a. Properties of light and absorption of light by photosynthetic pigments, Composition and characterization of photo systems I and II
b. Photophosphorylation
c. Path of carbon in C_3 and C_4 plants, differences between C_3 and C_4 plants
d. CAM pathway and its regulation
e. Photorespiration, biosynthesis of glycolate and regulation of photorespiration

2.2 Respiration:

a. Glycolysis, fermentation, tricarboxylic acid cycle, Regulation of TCA cycle.
b. electron transport and oxidative phosphorylation, Coupling oxidative phosphorylationto electron transport, chemiosmotic hypothesis.
c. Hexose monophosphate shunt and its significance, Cyanide – resistant respiration

UNIT –III

3.1 Hormonal control of growth and development

a. General role of auxins, Gibberellins, Cytokinins, Ethylene and Abscissic acid
b. Mechanism of hormonal regulation-hormone receptors, and secondary messengers
c. Amplification of kinases.
d. Structure and functions of Calmodulin

3.2 Physiology of flowering

a. Photoperiodism
b. Phytochrome – structure and function

3.3 Physiology and biochemistry of seed dormancy and germination:

a. Causes of dormancy and methods of breaking dormancy
b. Biochemical changes accompanying seed germination.

1. Determination of water potential by Shardolo's methods.
2. Determination of total and titrable acidity.
3. Separation of chloroplast pigments by solvent method
4. Determination of chlorophyll a, chlorophyll b and total chlorophylls in C_3 and C_4 plants.
5. Determination of Anthocyanin Pigments.
6. Estimation of I.A.A

References

1. Principles of Plant nutrition 4th Edition by Mengel K. and E.A. Kirby International Institute of Polesh Switzerland 1987.
2. Mineral nutrition of crop plants. H. Marshener academic Press 1986.
3. Plant Physiology by F.B. Salisbury and C.W. Ross. Wordsworth biology series.
4. Growth and differentiation in plants by Warering and Phillips, Pergamon press.
5. Plants Cell structure and metabolism. J.L. Hall, Flower and Roberts, ELBS, Longman.
6. Advanced Plant Physiology by M.B. Wilkinson, ELBS, Longman
7. Introduction to Plant Physiology by G.R. Noggle and G.J. Fritz, Printice Hall Press
8. Cell Biology by C.B. Powar, Himalaya Publishing
9. Plant Physiology by R.N. Devlin and F.H. Witham, CBS 1986
10. Introduction to plant physiology W.G. Hopkins and Norman P.A. Huner
11. Plant Physiology. Lincoln Taiz and Eduardo Zeiger

Minutes of the meeting of Board of Studies held in the Department of Botany, University college of Science, Osmania University.

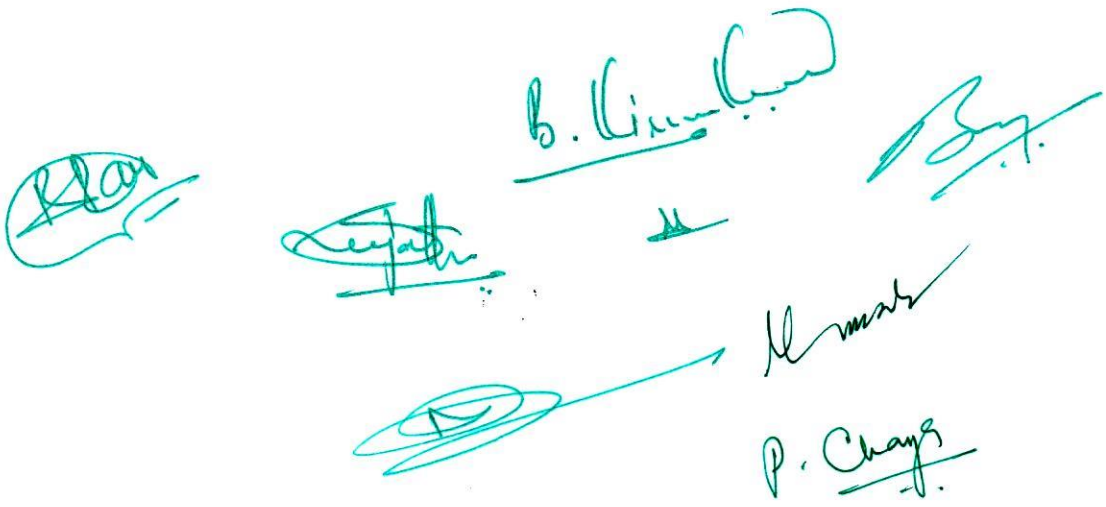
The Board of studies meeting for M.Sc. Botany has been held on 28.01.2023 in the Department of Botany, University college of Science, Osmania University.

The following members have attended the meeting:

1.	Prof. E. Sujatha	-	Chairperson, BOS in Botany Department of Botany, University College of Science, OU
2.	Prof. B. Ramadevi	-	Head, Department of Botany, University College of Science, OU
3.	Prof. P. Kamalakar	-	Department of Botany, University College of Science, OU
4.	Prof. A. Sabitha Rani	-	Department of Botany, University College of Science, OU
5.	Prof. K. Shailaja	-	Department of Botany, University College of Science, OU
6.	Prof. N. Lakshmi Bhavani	-	Department of Botany, University College of Science, Saifabad, OU
7.	Dr. A. Vijaya Bhaskar Reddy	-	Department of Botany, University College of Science, OU
8.	Dr. P. Chaya	-	Department of Botany, University College of Science, Saifabad
9.	Dr. M. Venkata Ramana	-	Department of Botany, University College of Science, Saifabad
10.	Dr. B. Kiran Kumar	-	Department of Botany, University College of Science, OU
11.	Dr. M. Vanaja	-	Senior Scientist, CRIDA, Hyderabad
12.	Dr. C. Sudhakar Reddy	-	Scientist-F, Forest and Ecology Division, National Remote Sensing Centre, Balanagar, Hyderabad

Minutes of the Meeting

1. The meeting was conducted to discuss the syllabus of M.Sc. Botany, II Semester as per the new credit system.
2. The syllabus of all four optional papers have been discussed by the BoS committee
3. It has been resolved to reduce the number of units to three and frame the syllabus as per the guidelines
4. The changes suggested by the members of BOS committee, senior faculty and Subject experts were incorporated in the syllabus, following UGC Guidelines.
5. It is resolved to approve the revised syllabus of all four Optional Papers of M. Sc. II Semester and to be implemented from the Academic year 2022-2023, present first year students.



M.Sc. Botany Syllabus (CBCS)

New Syllabus for Semester III & IV

With Effective from Academic Year 2022-2023

Dept. of Botany
Osmania University
Hyderabad

Board of studies meeting has been conducted on **17-06-2023 at 2:00 P.M.** in the, Department of Botany, University College of Science, OU. The following members are present in the meeting and approved the **M.Sc. Botany Course structure, III & IV Semester** syllabi with effect from the academic year **2022-2023.**

Internal members

1. Dr. B. Rama Devi, Professor and Head,
   Dept. Of Botany,UCS,OU

2. Dr. A. Sabitha Rani, Professor & Chairperson BOS,
   Dept. Of Botany, UCS, OU.

3. Dr. P. Kamalakar, Professor,
   Dept. Of Botany, UCS, OU.

4. Dr. E. Sujatha, Professor,
   Dept. Of Botany, UCS, OU.

5. Dr. K. Shailaja, Professor,
   Dept. Of Botany, UCS, OU.

6. Dr. N. Lakshmi Bhavani, Professor,
   Dept. Of Botany,UCS, Saifabad,Hyd.

7. Dr. A. Vijaya Bhasker Reddy, Asst. Professor,
   Dept. Of Botany, UCS, OU.

8. Dr. P. Chaya, Asst. Professor,
   Dept. Of Botany, UCS, Saifabad, Hyd.

9. Dr. M. Venkata Ramana, Asst. Professor,
   Dept. Of Botany, UCS, Saifabad, Hyd.

10. Dr. B. Kiran Kumar, Asst. Professor,
    Dept. Of Botany, UCS, OU, Hyd.

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17/6/23

17/06/23

17/6/23

17/6/23

P. Chaya 17.06.2023

17/06/2023

B. Kiran Kumar 17/6/23

External members.

11. Dr. M. Vanaja, Sr. Scientist,
    CRIDA, Hyderabad.

12. Dr. C. Sudhakar Reddy, Scientist –F,
    Forest and Ecology Division, NRSC, Balanagar, Hyd.

Special Invitee

1. Dr. S Nageswara Rao,Asst. Professor,
   Dept. Of Botany, UCS, OU

M.Sc. Botany, III Semester (CBCS)

Core I: Cell Biology, Genetics and Biostatistics (Theory)

MBOT.CC. T.2.301 **(CORE)** **3 Hrs/week 3 Credits**

Unit I. Cell biology

1.1. Principles Microscopy- Microscopy, Principles and application of Light microscopy, Fluorescent microscopy,Electron microscopy -(SEM, TEM)

1.2. DNA replication: Semi-conservative DNA replication, Enzymes involved in replication, DNA Polymerase enzyme in Eukaryotes and Prokaryotes. Split genes (Introns and Exons)

1.3. Regulation of Gene Expression - Prokaryotes (Lac Operon). Eukaryotic Gene expression and Regulation (Promoters, Transcription factors and Enhancers).

1.4. Cell cycle: Mitosis – overview of stages and importance. Meiosis – overview of Meiosis I & II stages and significance.

1.5. Cell cycle regulations: Role of Cyclins and Cyclin-dependent kinases in Progression of cell cycle, Maturation Promoting Complex (MPF), Apoptosis and Programmed Cell Death (PCD).

UNIT II. Genetics

2.1 Mendelian Inheritance: Mendel's experiments, Mendel's Laws of inheritance, Testcross and Backcross, Incomplete dominance, Codominance.

2.2. Gene Interactions: Dominant epistasis (12:3: 1), Recessive epistasis (9:3:4), Complementary genes (9:7), Duplicate genes (15:1).

2.3.Linkage: Linkage groups, Types of linkage, Coupling and Repulsion phase. Crossing over-Mechanism of Crossing over. Chromosome mapping in Eukaryotes (Two point and Three-point test cross)

2.4.Inherited Human diseases: Hemophilia, Sickle cell Anemia, Muscular Dystrophy (MD).

2.5.Extra Nuclear inheritance: Mitochondrial inheritance - Petite mutants in Yeast, Male sterility (Cytoplasmic, Genetic and Cytoplasmic -genetic male sterility).

UNIT III. Biostatistics

3.1.Biostatistics: Introduction- Variables (Random, Discrete and Continuous), Diagrammatic representation of Data (Line, Bar and Pie Diagrams), Graphical representation of Data (Frequency Curve, Polygon and Histograms).

3.2 Population Genetics: Hardy-Weinberg Law. Gene pool, Gene frequency and Genotype frequency

3.3. Measures of Central Tendency- Mean, Median, Mode. Measures of Dispersion-Variance, Standard Deviation (SD), Standard Error (SE), Coefficient of Variance.

3.4. Test of significance: Null hypothesis, Alternate hypothesis. Chi-square test, Student's "t" test.

3.5. Probability: Concept of Probability, Probability distribution (Binomial, Poisson and Normal).

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M.Sc. Botany III Semester (CBCS)

Core I: Cell Biology, Genetics and Biostatistics

(Practical)

MBOT.CC. P.2.305 **(CORE)** **4 Hrs./week** **2 Credits**

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1. Demonstration of Cytological Techniques. Fixation of Plant material and nuclear staining for the Mitosis and Meiosis studies.
2. Cytological Squash preparation of onion root tips to study the various stages of Mitosis.

Problems in Genetics:

3. Mendelian inheritance (Monohybrid, Dihybrid, Trihybrid)
4. Incomplete dominance &Codominance
5. Gene interactions
6. Chromosome mapping – Two-point test cross
7. Chromosome mapping – Three-point test cross

Problems in Biostatistics:

8. Measures Central Tendencies- Mean, Median, Mode
   Measures of Dispersion-
9. Variance,
10. Standard Deviation,
11. Standard Error
12. Coefficient of Variance.
13. Chi-square test
14. Student's "t" test
15. Maintenance of Practical Record.

Core -I: Cell Biology, Genetics and Biostatistics - Practical Model Paper

Time- 3hrs **50 Marks**

1.	Major Experiment (Mitosis Cell Division)	16 M
2.	Minor (2 problems in Genetics) 2x6	12 M
3.	Minor (2 Problems from Biostatistics) 2x6	12 M
4.	Record and Viva	10M

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2. Lodish, 8 th Ed. Cell and Molecular Biology.
3. E.D.P. De Robertis and E. M. F. De Robertis. 1987. Cell and Molecular biology8th Ed(Indian Ed
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15. K. K. De. 1992. Plant tissue culture.
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21. Turner, Mclennon, Bates and White. 1999. Instant notes in Molecular Biology.
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23. Purohit. S. S. 1999. Agricultural Biotechnology.
24. Stansfield. 1996. Theory & Problems in Genetics. Schaum's Series. McGraw & Hill.
25. Khan, I. A. and A. Khanum. 1994. Fundamentals of Biostatistics
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27. Balasubramainan. Ed. Concepts in Biotechnology.Universities Press.1996.
28. Deepak Bharihoke.2000. Fundamentals of Information technology

M.Sc. Botany, III Semester (CBCS)
Core II. Environmental Pollution and Protection
(Theory)

MBOT.CC.T.2.302 **(CORE)** **3 Hrs/week 3 Credits**

Unit I. Types of pollution

1.1. Kinds of pollution: Water pollution, Soil pollution, Air pollution and Noise pollution

1.2. Causes, Sources, Effects and control measures of various types of pollution

1.3. Pollutants: Major air pollutants primary and secondary. Pollutants -stationary and mobile sources

1.4. Acid rains - causes and effects on terrestrial and aquatic systems.

1.5. Human activities on Environment: Climate change, Greenhouse gases, Ozone layer depletion. Global warming

Unit II: Treatment of pollutants

1.1 Different forms of pollutants: Water, Soil, Air and Noise pollutants

1.2. Water quality parameters- BOD, COD, Hardness of water, criteria of water quality.

1.3 Primary treatment: Primary treatment (Industrial wastewater) - Segregation, equalization, neutralization, sedimentation, flotation and oil separation

1.4 Secondary treatment: Secondary treatment (Biological treatment)- Principles of biological treatment. Waste stabilization ponds, Aerated Lagoons-Activated sludge process, Trickling filter.

1.5. Sludge treatment and disposal: Preliminary operations, sludge digesters, sludge conditioning, dewatering methods, sludge drying bed. Vacuum filtration- filter process, centrifugation, sludge disposal methods.

UNIT III: Environmental Protection

1.1. Solid waste Management: Classification of solid wastes, types and sources. Major types of disposal methods.

1.2. Management of wastes: Municipal waste treatment, disposal and use in energy generation. Hazardous waste - types and disposal methods. Biomedical wastes- Types and disposal methods. Colour coding of biomedical waste.

1.3. Bioremediation: method - *In situ* and *Ex situ* bioremediation. Bioremediation of toxic metals.

1.4. Concept of Phytoremediation: Rhizo-filtration, Phytoextraction, Phytotransformation, Phyto-stimulation, Phyto-stabilization and Root zone technology

1.5 Conservation Practices: Role of an individual in the protection of pollution- direct and indirect role. Environmental (protection) Act-1986. Functions and powers of Central Pollution Control Board and State Pollution Control Board.

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M.Sc. Botany, III Semester (CBCS)
Core II. Environmental Pollution and Protection (Practical))

MBOT.CC. P.2.302 **(CORE)** **4 Hrs/week 2 Credits**

Major & Minor experiments:

1. Estimation Total hardness in water
2. Estimation of calcium in water
3. Estimation of Organic matter in water
4. Estimation of Biological oxygen demand in water
5. Estimation of Noise.
6. Qualitative estimation of solid waste
7. Qualitative estimation of coal
8. Qualitative estimation of fly ash
9. Qualitative estimation of Sugarcane bagasse
10. Qualitative estimation of cow dung
11. Qualitative estimation of wood

Study of following Spotters/ Photographs/Diagrams)

12. Identification of industrial waste
13. Identification of sewage waste
14. Identification of activated sludge
15. Analysis of different types of pollutants
16. Identification of Hazardous waste
17. Identification of Biomedical wastes
18. Colour coding of biomedical waste.
19. Phytoremediation
20. Record

Core II. **Core II. Environmental Pollution and Protection- Practical Model Paper**
Time- 3hrs **50 Marks**

1.	Major Experiment	14 M
2.	Minor Experiment (2X5)	10 M
3.	Spotters 4 (4x 4)	16 M
4.	Record and Viva	10 M

M.Sc. Botany, III Semester (CBCS)
Core II. Environmental Pollution and Protection (Practical))

MBOT.CC. P.2.302 **(CORE)** **4 Hrs/week 2 Credits**

Major & Minor experiments:

1. Estimation Total hardness in water
2. Estimation of calcium in water
3. Estimation of Organic matter in water
4. Estimation of Biological oxygen demand in water
5. Estimation of Noise.
6. Qualitative estimation of solid waste
7. Qualitative estimation of coal
8. Qualitative estimation of fly ash
9. Qualitative estimation of Sugarcane bagasse
10. Qualitative estimation of cow dung
11. Qualitative estimation of wood

Study of following Spotters/ Photographs/Diagrams)

12. Identification of industrial waste
13. Identification of sewage waste
14. Identification of activated sludge
15. Analysis of different types of pollutants
16. Identification of Hazardous waste
17. Identification of Biomedical wastes
18. Colour coding of biomedical waste.
19. Phytoremediation
20. Record

Core II. Core II. Environmental Pollution and Protection- Practical Model Paper

Time- 3hrs **50 Marks**

1.	Major Experiment	14 M
2.	Minor Experiment (2X5)	10 M
3.	Spotters 4 (4x 4)	16 M
4.	Record and Viva	10 M

REFERENCEs:

1. MN Rao, McGrace Hill 1993 – Air pollution
2. C.S.Rao- Environmental Engineering and technology
3. S.P. Misra and Pandey- Essential Environmental Studies
4. Y.Anjaneyulu- Introduction to Environmental Science.
5. P.D.Sharma- Ecology and Environment
6. P.C.Santra- E. MN Rao, McGrace Hill 1993 – Air pollution
7. .Waste water treatment-2nd edition. Narayana Rao and Amal K.Datta
8. Water treatment specification- Frank rose,Mcgrowl Hill 1985

M.Sc. Botany III Semester (CBCS)

Elective-I A. Molecular Genetics
(Theory)

MBOT.CC. T.2.303/A **(Elective)** **3 Hrs./week 1 Credit**

UNIT I. Classical Genetics

1.1 Concept of Gene: Classical and modern concept (cistron, muton and recon). Experiments to prove DNA (Griffith; Avery, McLeod and McCarty) and RNA as genetic material (Fraenkel and Singer).

1.2 Chemical Basis of Heredity: DNA double helical structure and its function. Forms of DNA- A, B and Z

1.3 Chemical Basis of Heredity: RNA structure and types and structure – mRNA, tRNA (clover leaf model), rRNA.

1.4 Chromosomes: Organization of DNA in chromosomes. Nucleosome concept. Euchromatin, Heterochromatin.

1.5 Morphology of chromosomes: Structure of chromosome. Telomeres and Telomerase. Chromosomal banding (G, C, Q & R banding.) Karyotype and Ideogram.

UNIT II. Genetic alterations

2.1. DNA Damage and Repair: Mechanism of DNA damage and repair (Base excision, Mismatch repair, Photoreactivation, SOS repair)

2.2. Cancer: Types of cancers. Brief account of Proto-oncogenes, oncogenes and tumor suppressor genes

2.3. Mutations: Types of mutations, Mutagens (physical and chemical). Gene mutations- Substitutions & Frameshifts, Transitions and Transversions

2.4. Chromosomal mutations: Numerical chromosomal aberrations (Aneuploidy. Euploidy, Polyploidy (Auto and Allopolyploids).

2.5. Chromosomal mutations: Structural chromosomal aberrations – Deletions Duplications, Inversions and Translocations. Brief account of transposable elements.

UNIT II.I Gene expression and regulation

3.1.: Transcription: Mechanism of transcription in Prokaryotic and Eukaryotes. RNA polymerases, Transcription factors, Promoters, Enhancers

3.2 . RNA processing: Post transcriptional modification of RNA in Eukaryotes- Splicing, Capping, Polyadenylation.

3.3. Translation: Salient features of Genetic code. Process of Translation- initiation, elongation, termination. Charging of tRNA. Aminoacyl tRNA synthetases.

3.4 Transcription Regulation. Mechanism of transcription regulation by noncoding RNA, RNA Editing, DNA methylation

3.5. Gene Regulation: Operon concept. Structure of Operon. Regulation of gene expression in Prokaryotes -Tryptophan operon (Trp) in *E. coli*.

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M.Sc. Botany III Semester (CBCS)
Elective-I A. Molecular Genetics
(Practical)

MBOT.CC.P.2.303/A **(Elective)** **4 Hrs./week 1 Credits**

Major & Minor

1. Estimation of DNA by DPA method
2. Estimation of RNA by Orcinol method
3. Construct the Karyogram of given karyotype
4. Study of C-Mitosis by Colchicine treatment
5. Giemsa banding of chromosome

Study of following Spotters/ Photographs/Diagrams)

6. DNA double helical structure
7. Different forms of DNA- A, B and Z
8. Euchromatin & Heterochromatin
9. Clover leaf model of tRNA
10. mRNA-structure
11. Transposable elements
12. rRNA- structure
13. Chemical and Physical mutagens
14. Splicing
15. Capping
16. Polyadenylation.
17. Record

Elective I. Molecular Genetics (Practical Model Paper)

Time- 3hrs **50 Marks**

1.	Major Experiment	14 M
2.	Minor Experiment (2X5)	10 M
3.	Spotters 4 (4x 4)	16 M
4.	Record and Viva	10 M

List of books recommended

1. A. K. Sharma and A. Sharma. 1990. Chromosome techniques. Butterworths.1990 Ed.
2. Edward. S. Lenhoff. 1990. Tools of Biology Mc Millan Company.
3. E.D.P. De Robertis and E. M. F. De Robertis. 1987. Cell and Molecularbiology. 8th Ed.. (Indian Edition is also available. Varghese Company).
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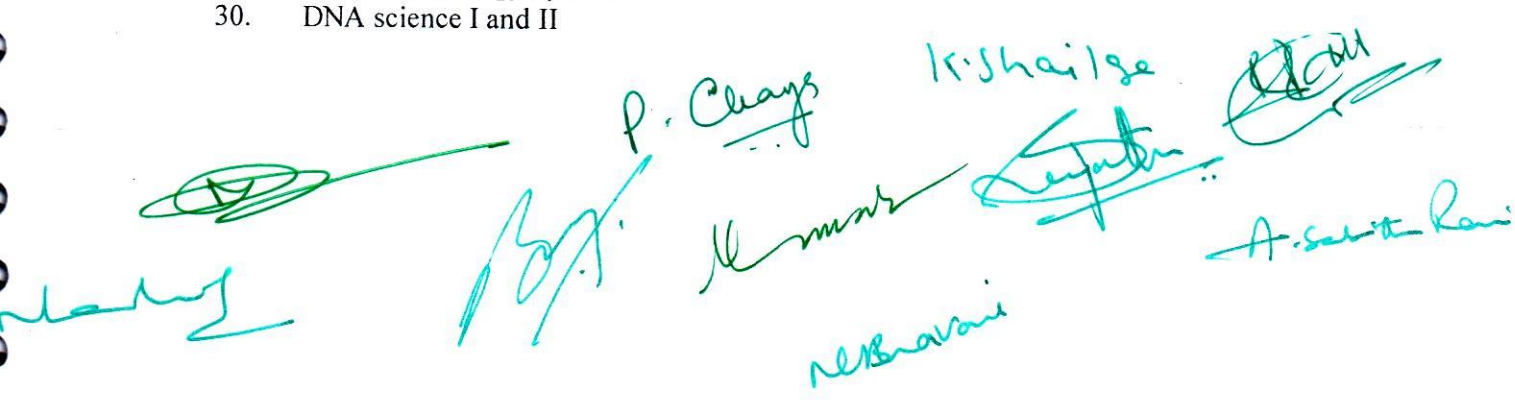
24. Ahluwalia. 1993Genetics.
25. Khan, I. A. and A. Khanum. 1994Fundamentals of Biostatistics
26. N. Mishra and K. K. Mishra. Naya Prakash. 1983. Introductory practical Biostatistics.
27. Cell and molecular biology by Lodish.
28. Cytogenetics by Swanson
29. Molecular biology by Robert F.Weaver.
30. DNA science I and II



M. Sc. Botany III Semester (CBCS)
Elective-IIA. Plant Tissue Culture and Biotechnology
(Theory)

MBOT.CC. T.2.304/ A **(Elective)** **3 Hrs./week 3 Credits**

UNIT -I: Establishment of Plant Tissue Culture

1.1. Tissue culture: Introduction, composition and preparation of culture media, sterilization procedures, culture techniques, Explants, nutrients and hormonal requirements.

1.2. Plant tissue culture: Concept of totipotency and cytodifferentiation, production and establishment of callus and suspension cultures. *In vitro* shoot regeneration and rooting.

1.3. Morphogenesis from cultures (Organogenesis, Caulogenisis, Rhizogenisis and Embryogenesis). Field transfer and acclimatization of regenerated plants.

1.4. Organ cultures: Production of pathogen free plants by culture of vegetative organs (shoot tips, root, leaf) and reproductive organs (anthers, ovule, embryo).

1.5. Somatic embryogenesis and production of synthetic seeds. Somaclonal variations and their applications

UNIT -II . Application of Plant Tissue Culture

2.1. Micropropagation: Various stages of micropropagation. Application of micropropagation in Horticulture and Forestry.
2.2. Protoplast culture: Isolation, culture and fusion of protoplasts. Somatic Hybridization (Hybrids and Cybrids)\
2.3. Anther culture, Production of haploids, significance of haploids.
2.4. *In vitro* production of secondary metabolites from medicinal plants. Hairy root cultures.
2.5. *In vitro* conservation and Cryopreservation of germplasm. Germplasm Banks (National & International).

UNIT -III: Transgenic plants

3.1. Transgenic plants: Definition, steps involved in transgenic plant production. Methods of gene transfer in plants (*Agrobacterium* mediated and Microprojectile bombardment method)
3.2. Transgenic plants resistance to Herbicides (Roundup Ready), enhanced quality traits (Flavor Savr Tomato) and improved nutritional benefits (Golden Rice),
3.3. Transgenic plants resistance to viral, bacterial and fungal diseases.
3.4. Transgenic plants resistance to Agriculture pests (Bt Brinjal and Bt Cotton).
3.5. Current status of transgenic plants in the world. Role of Transgenics in crop improvement.

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M. Sc. Botany III Semester (CBCS)
Elective-II A. Plant Tissue Culture and Biotechnology
(Practical)

MBOT.CC.P.2.304/ A **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor Experiments

1. Preparation of Tissue culture media
2. Surface sterilizing of explants from locally available plants
3. Inoculation of explants from locally available plants.
4. Induction of callusing, shoot regeneration and rooting.
5. Demonstration of synthetic seeds / encapsulation of embryos.
6. Multiple shoot induction

Study of the following spotters/ cultures/ Photo graphs

7. Callus, suspension cultures
8. dentification of various stages Micropropagation (Banana)
9. Isolation of Protoplasts, somatic hybridization (Hybrids & cybrids)
10. Organ culture (shoot tip, Anther culture)
11. Somatic embryogenesis
12. Hairy root culture
13. Methods of Gene transfer (Gene gun & A*grobactiurm* mediated)
14. Transgenic crops (Golden Rice, Flavor Savr tomato, Bt brinjal and Bt Cotton)
15. Maintenance of Practical Record.

Elective II. Plant Tissue Culture and Biotechnology- Practical Model Paper

Time- 3hrs **50 Marks**

1. Major Experiment	14 M
2. Minor Experiment	10 M
3. Spotters 4 (4x 4)	16 M
4. Record and Viva	10 M

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1. A. K. Sharma and A. Sharma. 1990. Chromosome techniques. Butterworths.1990 Ed.
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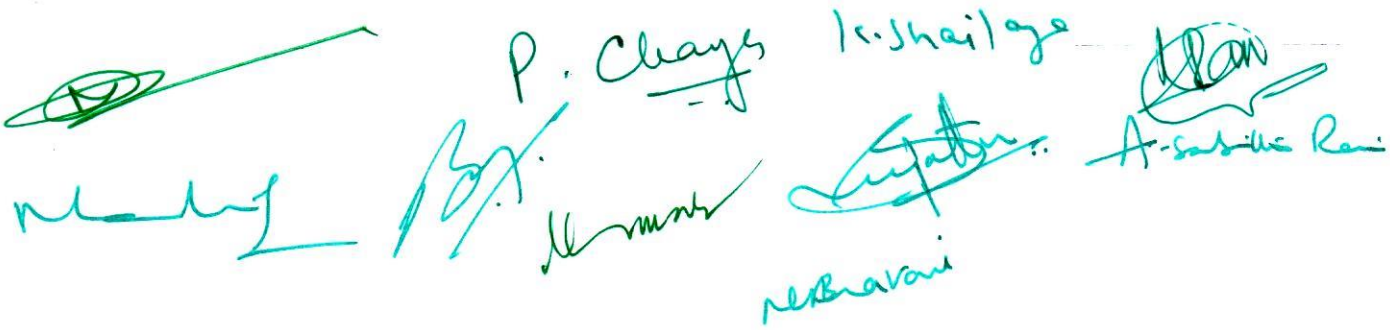

M.Sc. Botany III Semester (CBCS)
Elective-I B. Carbon , Nitrogen assimilation and Crop productivity
(Theory)

MBOT.EC.T.2.303 /B **3 Hrs./week 3 Credits**

UNIT-I: Carbon assimilation

1.1. RUBISCO-structure and function. Activation and catalysis of RUBISCO

1.2. Efficiency of C3, C4 and CAM pathways and productivity. Factors affecting photosynthesis

Starch metabolism and assimilate Partitioning:

1.3. Starch, sucrose metabolisms and assimilate partitioning

1.4. Source-sink relationship and influence on the yield

1.5. Manipulation of starch metabolism, Cyclodextrins and fructans

UNIT-II: Nitrogen Assimilation

Physiology and Biochemistry of Nitrogen fixation:

2.1 Nitrogen fixing organisms: Nitrogen fixing bacteria and Cyanobacteria, Actinorhizal and non-leguminous bacteria, Rhizosphere fixation in grasses

2.2. Physiology of Legume – Rhizobial symbiosis, Molecular communication and Nodulation

2.3. Molecular mechanisms of nitrogen fixation, Energetics of nitrogen fixation, Biotechnology of nitrogen fixation

2.4. nif genes in Rhizobium, Nod genes and Nod factors

2.5. Nitrogen dependent agricultural productivity - BNF and nitrogen fertilizers in agriculture; Fertilizer production and consumption scenario in India

UNIT-III: Crop Productivity

3.1. Photosynthesis and crop productivity, energy utilization efficiency by crops

3.2. Photo-inhibition, photo oxidation, excitation energy dissipation mechanisms

3.3. Photochemical and non-photochemical quenching of chlorophyll fluorescence

3.4. Photosynthesis and transpiration interaction, significance of WUE

3.5. Genes regulating potential traits of photosynthesis, biotechnological approaches for improving photosynthetic rate and productivity

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M.Sc. Botany III Semester (CBCS)

Elective-IB. Carbon, Nitrogen assimilation and Crop productivity (Practical)

MBOT.EC.T.2.303/B **4Hrs./week / 1Credit**

Major & Minor experiments.

1. Determination of leaf area

Estimation of Chlorophylls

2. Total chlorophyll
3. Chlorophyll-a,
4. Chlorophyll b
5. Ratio of chlorophyll-a & chlorophyll - b
6. Determination of stability index of chlorophyll pigments
7. Estimation of reducing sugars by dinitrosalicyclic acid reagent (DNS)
8. Estimation of protein content by Lowry's Bradford's method
9. Separation of Amino Acids by TLC

Study of following Spotters/ Photographs/Diagrams)

10. Study of Bacterioids.
11. Identification of Cyclodextrins
12. Identification of Fructans
13. Observation of various sources and sinks in the surrounding plants
14. Isolation and identification of *Rhizobium* from different plants
15. Maintenance of Practical Record.

Elective-I.B. Carbon, Nitrogen assimilation and Crop productivity

Practical Model Question Paper

Time- 3hrs **50 Marks**

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1. Major Experiment	16 M
2. Minor Experiment	12M
3. Spotters 4 (4x 3)	12 M
4. Record and Viva	10 M

REFERENCES

1. Plant Physiology: by F.B. Salisbury and Cleon W. Ross. 4th edition 1992.
2. Words worth publishing company. Belmont California
3. Photosynthesis and crop productivity in different ensvironments. J. Cooper, Cambridge
4. Plant Physiology, biochemistry and molecular biology. Ed. David. T. Dennis and David H.Turnip (1990). Longman scientific technical
5. Photosynthesis: A comprehensive treatise (1998) Ed. A.S. Raghavendra Cambridge University Press,
6. Introduction to Plant Physiology by W.G. Hopkins 2nd Ed. John Wiley, NY.
7. Photosynthesis-Physiological, Biochemical and Molecular aspects.????
8. Advances in Plant Physiology. Vol.2. A. Hemantarajan.
9. J.R. Gallow and A.E. Chaplin (1987) An introduction to Nitrogen fixation. Cassel Education Limited.
10. F.O' GARA; S. MNNIANA, J.J.DREEVON (eds.) (1988) Physiological limitations andGenetic improvement of symbiotic Nitrogen fixation. Kluwer Academic Pub.
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13. A.B. Prasad and A. Vaishampayan (1994) Biology and application of nitrogen fixingorganisms – Problems and prospects. Scientific Publications, Jodhpur, India.
14. P.S. Verma and N. Brisson (1987) Molecular Genetics of plant – Microbe interactions.
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16. N. S. Subba Rao (1998): Biofertilizers for agriculture and agroforesty: Oxford & IBH Publ.New Delhi.
17. K.V. B.R. Tilak: (1993): Bacterial fertilizers, ICAR Publication, New Delhi.
18. Plant Physiological Ecology. Hans Lambers, S. Stuart Champin III, Thijs L. Pons. Springer

M. Sc. Botany - III Semester (CBCS)
Elective-II B. Phytohormones and Plant Development
(Theory)

MBOT.CC.T.2.304/ B **(Elective)** **3 Hrs./week 3 Credits**

UNIT-I: Phytohormones and other Naturally occurring growth substances

Phytohormones: Biosynthesis, physiological role, and molecular mechanism of action of
1.1. Auxins, Gibberellins,
1.2. Cytokinins, Abscisic acid,
1.3. Ethylene
Naturally occurring growth substances other than principal compounds:
1.4. Polyamines, Methyl Jasmonates
1.5. Phenolics, Brassinosteroids

UNIT-II: Hormonal regulation and Senescence

Hormonal regulation of organ development:
2.1. Root development, Shoot development, and Leaf development
Effect of plant growth substances on flowering and fruiting:
2.2. Flower initiation and sex expression; Fruit set, development and ripening
Senescence:
2.3. Programmed cell death (PCD): Concept, types of PCD during vegetative and reproductive stages
2.4. Physiological and biochemical changes during senescence: loss of chlorophylls, nucleic acid metabolism, respiration and photosynthesis.
2.5. Hormonal control of senescence: cytokinins, Abscisic acid and ethylene

UNIT-III: Disease resistance and Agricultural applications of plant growth regulators
Physiological and molecular mechanisms of disease resistance in plants:
3.1. Hypersensitive reaction, Elicitors, Phytoalexins
3.2. Physiology of disease resistance, System acquired resistance (SAR)

Agricultural uses of plant growth regulators.

3.3. Rooting and plant propagation, Abscission, Flowering

3.4. Fruit set and development, Fruit ripening, Overcoming environmental stresses.

3.5. Plant growth Regulators and weed control: Auxin type herbicides 2,4-D phenoxy acetic acid, Pyridines

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M. Sc. Botany - III Semester (CBCS)
Elective-II B. Phytohormones and Plant Development
(Practical)

MBOT.CC.P.2.304/ B **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor Experiments:

1. Estimation of Indole Acetic Acid.
2. Estimation of Amylase enzyme
3. Radish cotyledonary bioassay for Cytokinins
4. Action of Abscisic acid on stomatal movement

Practical observation of growth parameters in plants by applying

5. Auxins
6. Gibberellins
7. Cytokinins
8. Abscisic acid

Studying and understanding the role of the following naturally occurring growth substances in plants

9. Polyamines
10. Methyl Jasmonates
11. Phenolics
12. Brassinosteroids
13. Visit to nearby nursery and enquiring the substances used by them as growth regulators
14. Observation and study of the symptoms of developmental and stress induced senescence in plants
15. Maintenance of Practical Record.

Elective II B - Phytohormones and Plant Development Practical Model Paper

Time: 3 Hrs. **Max. Marks: 50**

1.Major question/experiment	16 M
2.Minor question/experiment	12 M
3.Spotters – A, B, C ,D (4X 3)	12 M
4. Record	5 M
5.Viva	5 M

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M. Sc. Botany III Semester (CBCS)

Elective-I C. Plant Pathogen Interactions and Plant diseases (Theory)

MBOT.CC.T.2.303 /C **(Elective)** **3 Hrs./week 3Credits**

UNIT- I : Plant Pathogen Interactions:

1.1. Introduction: Terminology, Disease concept. Pathogenicity. Koch's postulates; disease quantification, Disease rating scale.

1.2. Parasitism and Disease Development: Host range of pathogens, disease development, disease cycle, penetration (chemical and physical), colonization and dissemination of pathogens.

1.3. Host defense mechanisms: Structural defenses, Hypersensitivity, Physical barriers, Biochemical defense- Phenols and Phytoalexins.

1.4 Elicitors: Production and nature, fungal wall elicitors (carbohydrates and glycoprotein elicitors), microbial enzyme elicitors, mode ofaction.

1.5 Signal Transduction: Intracellular signals, short distance intercellular signals. Systemic signals molecules - Salicylic acid, Jasmonic acid.

UNIT- II: Pathogen Ingress and Plant Resistance

2.1 Genetics of pathogenesis: Genes involved in pathogenesis. Brief account on plant pathogenic genes in fungi. Physiological Specialization- origin of races, concept of biological forms.

2.2 Types of plant resistance to pathogens: non-host resistance (Vertical and Horizontal), Apparent resistance, Flor's concept (Gene-for-gene). Breeding for resistant varieties.

2.3 Plant defence responses: Generation of signals (Local and systemic responses). Fungal resistance genes in plants, defence genes and fungal avirulence genes.

2.4 Plant immunization: Systemically acquired resistance (SAR) Chemical inducers of plant resistance and Pathogenesis related proteins (PRPs).

2.5. Cloning resistance plants: Candidate genes for cloning fungal resistance genes (Chitinases, Glucanases). Ribosome Inactivating Proteins (RIPs).

UNIT III: Plant diseases:

Pathogen, disease symptoms, disease cycle and control measures of following diseases.

3.1 Fungal Diseases of Cereals: Bakanae disease of Rice, Karnal bunt of Wheat, Loose smut of Sorghum

3.2 Fungal diseases of Pulses: Pigeon pea Wilt, Chick pea Blight

3.3 Fungal Diseases of Fruit crops: Downy mildew of Grapes, Powdery mildew of grapes.

3.4 Fungal diseases of Vegetables: Leaf spot of Tomato, Chilly Die-back, Club root of Crucifers

3.5 Fungal diseases of Cash crops: Whip smut of Sugarcane, Cotton Wilt, Damping off of Tobacco.

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M. Sc. Botany III Semester (CBCS)

Elective-I C. Plant Pathogen Interactions and Plant diseases (Practical)

MBOT.CC. P.2.303/C (Elective) 4 Hrs./week 1 Credit

Major & Minor Experiments

1. Preparation of PDA media for culturing of fungi.
2. Isolation of fungi from the soil/ water/ Plant material and inoculation onto the PDA media.
3. Techniques of isolation of fungi: Dilution method/ soil plate method/Agar plate.
4. Calculation of spore count using Haemocytometer.
5. Micrometry and standardization of microscope.
6. Measurement of fungal spores and mycelium and Camera Lucida drawings
7. Diagnosis of plant diseases and proof of pathogenicity according to Koch's postulates.
8. Preparation of semi-permanent slides of the **diseased plant material studied in the theory.**

Study of following Spotters Spotters/ Photos/ Diagrams/ Structures)

9. Measurement of plant diseases- Disease scoring.
10. Plant disease diagnosis by studying symptoms in the field
11. Study of Chemical structure of Salicylic acid and Jasmonic acid
12. Study of Local and systemic responses
13. Study of Phenols and Phytoalexins
14. Study of Pathogenesis related proteins (PRP)
15. Maintenance of Record and Herbarium of diseased planta

Elective I: Plant Pathogen Interactions and Plant diseases
Practical Model Paper

Time- 3hrs 50 Marks

1.Major Experiment	14M
2. Minor Experiment (2X-5)	10 M
3.Spotters 4 (4x 4)	16 M
4. Record and Viva	10 M

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M Sc. Botany - III Semester (CBCS)

Elective-II C. - Biofertilizers, Biopesticides and Mushroom Cultivation (Theory)

MBOT.CC.T.2.304/ C **(Elective)** **3 Hrs./week 3 Credits**

UNIT- I . Biofertilizers:

1.1. Biofertilizers: Introduction, history, scope and importance of biofertilizers. Types of biofertilizer. Role of biofertilizers in sustainable agriculture.
1.2. Nitrogen Biofertilizers: Types, Symbiotic & Non-Symbiotic Nitrogen fixation. Nodule formation, Cyanobacterial Biofertilizers. Azolla in rice cultivation.
1.3 : Mycorrhizae: - Definition and Types (Ecto and Endo mycorrhizae) . VAM in detail- Isolation, colonization and multiplication. Role of mycorrhizae in Crop productivity and Forestry.
1.4. Phosphate biofertilizers: Phosphate solubilizing Fungi (PSF). Mechanism of phosphate solubilization and phosphate mobilization. Importance of PSF in Agriculture.
1.5. General aspects of Biofertilizers – Storage, shelf life and marketing. Factors influencing the efficacy of Biofertilizers. Current status of biofertilizer production in India

Unit II. Biopesticides:

2.1 Biopesticides: Introduction, importance, scope and potential of Biopesticides. Classification of biopesticides- Pathogen, botanical pesticides and biorationals.
2.2 Microbial Biopesticides: Diversity, scope and Types (Viruses, Bacteria, Fungi).
2.3 Entomogenous fungi, Nematophagous fungi, Mycoherbicides. Application of biopesticides in plant disease control.
2.4 Botanical pesticides: Definition and types of Botanicals and biorational pesticides. Role of plant-based products in Organic farming and eco-friendly agriculture
2.5 Biocontrol agents: Definition and types of biocontrol agents. Fungi as biocontrol agents- Isolation, Selection, mass production of *Trichoderma species* and development of formulations.
2.6 General aspects of biopesticides: Methods of application, storage and quality control measures of biopesticides. Advantages and disadvantage of biocontrol agents. Constraints & possible solutions in production and use of Biopesticides.

UNIT III- Mushroom Cultivation.

3.1.Introduction to mushrooms: History and Scope of mushroom cultivation. Edible and Poisonous Mushrooms. Common edible mushrooms- Button, Oyster and Paddy straw mushroom
3.2.Cultivation of mushrooms: Detailed methodology for commercial cultivation of Oyster and Paddy straw mushroom. Present status of Mushroom industry in India.
3.3. Principles of Mushroom cultivation: Sterilization of substrates. Spawn production - culture media preparation- production of pure culture and multiplication of spawn. Preservation of mushrooms -freezing, dry freezing, drying, canning.
3.4.Composting Technology: Mushroom bed preparation. Spawning, harvesting. Problems in cultivation of mushrooms - diseases, pests, moulds and their management strategies.
3.5. Health benefits of mushrooms: Nutritional, Medicinal Therapeutic value of mushrooms. Development of value-added products and entrepreneurship in mushroom cultivation.

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M Sc. Botany - III Semester (CBCS)
Elective-II C. - Biofertilizers, Biopesticides and Mushroom Cultivation (Practical)

MBOT.CC. P.2.304/ C **(Elective)** **4 Hrs./week** **11Credits**

Major & Minor experiments:

1. Isolation and identification of AM Fungi from the soil
2. Estimation of root colonization of VAM fungi
3. Cultivation of Oyster mushrooms- preparation of bed, spawning, harvesting
4. Cultivation of Paddy straw mushroom- preparation of bed, spawning, harvesting
5. Isolation, Identification and mass production of *Trichderma* specie
6. Spawn production –production of pure culture and multiplication of spawn
7. Preparation of Botanical pesticides from the locally available plants
8. Preservation of mushrooms -freezing/ dry freezing/ drying/canning.
9. Study of root nodule structure in legume
10. Cultivation and Azolla as biofertilizers.

Spotters (Cultures/ Photographs/ Diagram)

11. **Study of** Phosphate solubilizing Fungi (PSF).
12. Study of Entomogenous fungi, Nematophagous fungi, Mycoherbicides.
13. Study of bacterial biopesticides
14. Study of Cyanobacteria as a Biofertilizers
15. Maintenance of record

Elective II - Biofertilizers, Biopesticides and Mushroom cultivation
Practical Model Paper

Time- 3hrs **50 Marks**

5. Major Experiment	14 M
6. Minor Experiment (2x5)	10 M
7. Spotters 4 (4x 4)	16 M
8. Record and Viva	10 M

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M. Sc. Botany III Semester (CBCS)

Elective-I D. Phytogeography and Plant Systematics (Theory)

MBOT.CC. T.2.303/D **(Elective)** **3 Hrs./week 3 Credit**

Unit 1. Phytogeography and theories of plant distribution

1.1. Introduction, definition, divisions of Phytogeography and importance.
1.2. Plant distribution – Types and pattern of distribution - Continuous distribution,discontinuous distribution., types and theoretical explanation.
1.3. Plant migration and barriers of migration, vicarious and relict species – types andexamples.
1.4. Theories and principles of plant distribution. Continental drift; Age and Area theory andLand – Bridge theory.
1.5. Lowerence principles on plant distribution: Principles concerning environment, plantresponses, Migration & climaxes, perpetuation & evolution of floras and climaxes.

Unit 2. Vegetation types and Floristic studies

2.1.Major types of vegetation of world – Forests, Grasslands, Coastal, Tundra and Deserts.
2.2.Types of forest in the world –Boreal or taiga forests, Temperate forests, sub tropical and tropical forests. Forest types in India (Champion and Seth 1968).
2.3. Floristic regions of India. Floristic studies and Floristic wealth of Telangana state.
2.4.Taxonomic aids: Taxonomic keys, Floras, Manuals, Monographs, Revisions and e-Floras.
2.5.Applications of GPS and GIS in Plant Taxonomy: Mapping and monitoring of plant species, habitats, threat evaluation and hotspot analysis.

Unit 3. Synthetic and Novel approaches in plant Systematics

3.1.Chemotaxonomy: Role of secondary metabolites-alkaloids, phenolic compounds,terpenoids, amino acids and glycosylates in identification of plants.
3.2.Palynotaxonomy: Role of pollen morphology-Pollen units, size & shape, symmetry, polarity, aperture patterns and exine ornamentation in identification of plants.
3.3.Cytotaxonomy: Role of Chromosome number, Morphology and Chromosomal behaviorin identification of plants.
3.4.Molecular systematics –Definition, techniques, methods and approaches. DNA barcoding.
3.5.Cladistics: definition, development history, importance. Characters used: Plesiomorphic and Apomorphic, Homology and Analogy, Parallelism and Convergence.

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M. Sc. Botany III Semester (CBCS)
Elective-I D. Phytogeography and Plant Systematics
(Practical)

MBOT.CC.P.2.303/D **(Elective)** **4 Hrs./week 3 Credit**

Major & Minor questions from the following Practicals

1. Preparation of taxonomic keys to the Families/Genera/Species – Indented, Bracketedand Descriptive keys.
2. Identification of families, Genera and species by using Floras.
3. Study of vegetation and forest types found in the Telangana State from published Floras.
4. GPS mapping of some important tree species from your institution/nearby park/forest.
5. Study and analysis of endemism and endemic plants in Eastern Himalayan, North Eastern Western Ghats regions and Telangana State. (from published floras.)
6. Mapping of phytogeographical regions of the globe and India.
7. Solve the simple cladogram related problems (Data sheets will be provided to students)
8. Preparation of cladogram by using Mesqite software with any 10-15 characters (byusing Morphology, Anatomy, palynology or Molecular data).
9. Hands on training on Herbarium techniques and methodology (collection, processing, poisoning, drying, mounting, stitching, labelling and deposition).

Study of the following by Spotters/ observation/diagrams

10. Study of method of describing a new species as per ICN guidelines.
11. Methods of sample collections for molecular systematics or DNA barcoding.
12. Identify the species by using The DELTA format (DEscription Language for TAxonomy) computer software.
13. Study of some taxonomic instruments- Vasculum, Plant pressers, E-Herbarium sheet,GPS.
14. Visit to the plant molecular and phylogenetic lab to learn molecular methods and techniques.
15. Field visit to the any local biodiversity rich area.
16. Filed notebook and Record

Elective-I.D. Phytogeography and Plant Systematics - Practical Model

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Time: 3 Hrs.	**Max. Marks: 50**
I Major question/experiment	15 Marks
II Minor question/experiment (2x8)	16 Marks
III Spotters – A, B, C (3X 3)	9 Marks
IV Record & Field note book (3 +2)	5 Marks
V Viva	5 Marks

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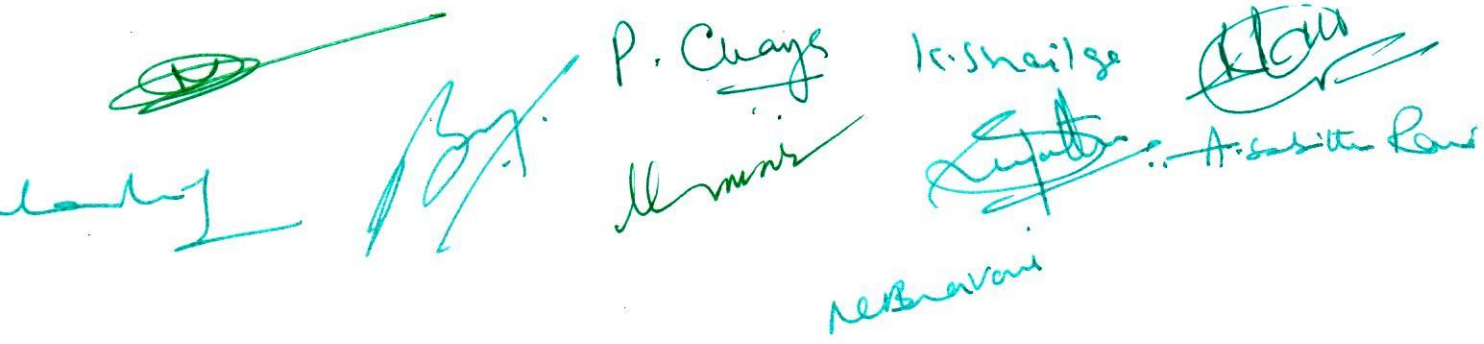

M Sc. Botany - III Semester (CBCS)
Elective-II D. Plant Biodiversity and Conservation
(Theory)

MBOT.CC. T.2.304/ D (Elective) **3 Hrs./week 3 Credits**

UNIT–I: Levels and Categories of Biodiversity

1.1. Biodiversity: Introduction, importance, objectives, structural and functional aspects.

1.2. Levels of Biodiversity: Genetic, Species and Ecosystem diversity.

1.3. Types of species for the maintenance of Biodiversity: Keystone species, Umbrella species, Flagship species, Indicator species, Priority species and Alien species.

1.4. IUCN red list Categories of species: Least concern, Threatened, Vulnerable, Endangered, and Extinct species.

1.5. Endemism: Definition, types of endemism, Characters of endemism, Theories of endemism, and endemic species of Telangana State.

UNIT–II: Hotspots, Value and Loss of Biodiversity

2.1. Biodiversity Hotspots: Definition and importance. Four major biodiversity hotspots of India: Eastern Himalayas, Indo-Burma region, Western Ghats and Sri Lanka, Sundaland.

2.2. Value of biodiversity: Consumptive, Productive, Social and Aesthetic value.

2.3. Loss of Biodiversity: Habitat loss, Pollution, over exploitation, ecosystem degradation and Invasive species.

2.4. Extinctions: Definition, types of extinctions: Extirpation, Co-extinction, Mass extinctions and planned extinctions.

2.5. Registering biodiversity: Red Data Book: History, objectives, colour codes and advantages of Red Data Book.

UNIT–III: Conservation of Biodiversity

3.1. Global approaches to biodiversity conservation. Species restoration, reintroduction and translocations. Benefits and risks of translocations.

3.2. Indian initiatives in Biodiversity conservation. Biodiversity act (2002), National biodiversity strategy and action plan (NBSAP 2002). Biodiversity Rules (2004).

3.3. National Legislations on conservation: Wildlife protection Act-1972; Forest Conservation Act- 1980; Biological diversity Act- 2002; Green Tribunal Act- 2009.

3.4. Organizations involved in conservation of Biodiversity: NBPGR, Botanical Survey of India (BSI), National Biodiversity Authority (NBA) and State Biodiversity Boards.

3.5. Conventions on Biological diversity: Conference of Parties (COP), Earth Summit (1992), Kyoto Protocol (1992), Nagoya protocol (2014).

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M Sc. Botany - III Semester (CBCS)

Elective-II D. Plant Biodiversity and Conservation(Practical)

MBOT.CC.P.2.304/ D (Elective) **4 Hrs./week 1 Credit**

Major questions from the following Practicals:

1. Interpretation of floristic diversity and species richness in the data provided.
2. Study of vegetation by Line transect / belt transect / quadrate methods.
3. Determination of frequency / Density / Abundance / Importance value index (IVI) of vegetation.
4. Determination of minimal quadrate size by the species area curve methods.
5. Measurement of Different Biodiversity Indices (Simpson's Diversity Index, Shannon's Diversity index).
6. Study of Singapore index on cities biodiversity (City Biodiversity Index or Singapore Index).

Minor questions from the following practicals:

7. Field visit to the any local biodiversity rich areas for assessment of species diversity.
8. Study of local wetlands and assessment of biodiversity.
9. Visit to the local protected areas and identifying the threats for the loss of biodiversity.
10. Study of environmental assessment and data interpretation for green audit of the campus for NAAC (Separate record must be submitted at the time of exam)
11. Study of Environmental Impact Assessment (EIA) at local construction sites in the urban and semi urban areas.
12. Study and assessment of exotic species diversity in the urban and semi urban regions.

Spotters from the following practicals:

13. Identification of economic potential species from the local flora (Wild edible Fruits, Medicinal plants, Timber etc.).
14. Identification and documentation of local genetic resources (landraces, wild crop relatives).
15. Identification of invasive weeds or alien species in the local flora
16. Field notebook and Record

Elective II. Plant Biodiversity and Conservation– Practical Model paper

Time: 3Hrs. **Max.Marks:50**

I	Major question/experiment	15 M
II	Minor question/experiment (2x8)	16 M
III	Spotters – A, B, C (3X 3)	9 M
IV	Record & Field note book (3 +2)	5 M
V	Viva	5 M

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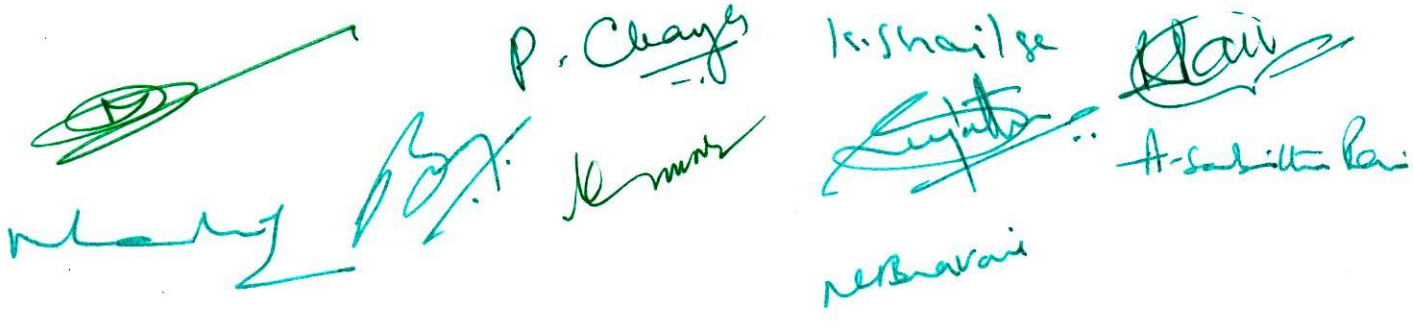

M. Sc. Botany III Semester (CBCS)
Elective-IE. Actuopalynology and Palynotaxonomy
(Theory)

MBOT.CC.T.2.303/ E **(Elective)** **3 Hrs./week 3 Credits**

Unit – I: Actuopalynology

1.1 Aspects, prospects and perspectives of palynology.

1.2 Spore morphology: Triletes, monoletes and aletes. Size, Shape and symmetry of spores; spore wall structure and sculpture.

1.3 Pollen morphology: Pollen units, Polarity, Size, Shape, Symmetry, Apertural pattern, Simple and compound apertures. Functions of apertures.

1.4 Pollen wall detailed structure: Sporoderm stratification: Faegri & Iverson and Ertdtman's views.

1.5 Sculpture of pollen wall and Chemical composition of pollen wall.

Unit – II Development of pollen and pollination

2.1 Microsporogenesis: T.S of anther, Meiosis and microspore mother cells, Development and ontogeny of pollen wall.

2.2 Pollen kitt, Ubisch bodies and their biological functions.

2.3 Pollen productivity and Pollen dispersal. Pollen viability, pollen preservation: cryopreservation and pollen banks.

2.4 Types of pollination: self and cross pollination. Artificial pollination and its applications.

2.5 Pollen germination: *in-vitro* and *in-vivo* germination. Factors affecting germination.

Unit – III Palynotaxonomy

3.1 Taxonomic significance of Palynology, Eurypalyny and Stenopalyny in Angiosperms, NPC system of apertural classification.

3.2 Pollen morphology of Gymnosperms: i) *Cycas*, ii) *Pinus* iii) *Cedrus*, iv) *Taxus*, v) *Gnetum*,

3.3 Pollen morphology of the following Angiosperm families: i) Malvaceae ii). Myrtaceae iii). Rutaceae iv). Asteraceae v). Arecaceae.

3.4 Palynological description and identification of the dicot pollen genera: i). *Tridax* ii). *Acacia* iii). *Vernonia* vii). *Azadirachta* v) *Terminalia*

3.5 Palynological description and identification of the monocot pollen genera: i) *Cocos*, ii) *Borassus*, iii) *Zea* iv) *Cyperus* v) *Allium*

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M. Sc. Botany III Semester (CBCS)
Elective-I E. Actuopalynology and Palynotaxonomy
(Practical)

MBOT.CC.P.2.303/ E **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor Experiments.

1. Wodehouse technique and preparation of temporary pollen slides.
2. Acetolysis technique and Preparation of Permanent pollen slides.
3. Assessment of pollen productivity by using haemocytometer
4. Determination of Pollen Viability by using Acetocarmine method.
5. Preparation of glycerin jelly

-Study of acetolysed pollen morphology of the following pollen types

6. *Hibiscus* pollen
7. *Gossypium* pollen
8. *Brassica* pollen
9. *Eucalyptus* pollen
10. *Psidium* pollen
11. *Sesamum* pollen
12. *Citrus* pollen
13. *Tridax* pollen
14. *Vernonia* pollen
15. *Boerhaavia* pollen
16. *Cocos* pollen
17. *Borassus* pollen
18. *Prosopis.* pollen m
19. Maintenance of Record

Elective-I.E.Actuopalynology and Palynotaxonomy- Practical Model Paper

Time: 3 Hrs. **Max. Marks: 50**

1.Major question/experiment	16 Mark
2.Minor question/experiment	8 Marks
3.Spotters – A, B, C ,D (4X 4)	16 Marks
4. Record	5 Mark
5.Viva	5 Marks

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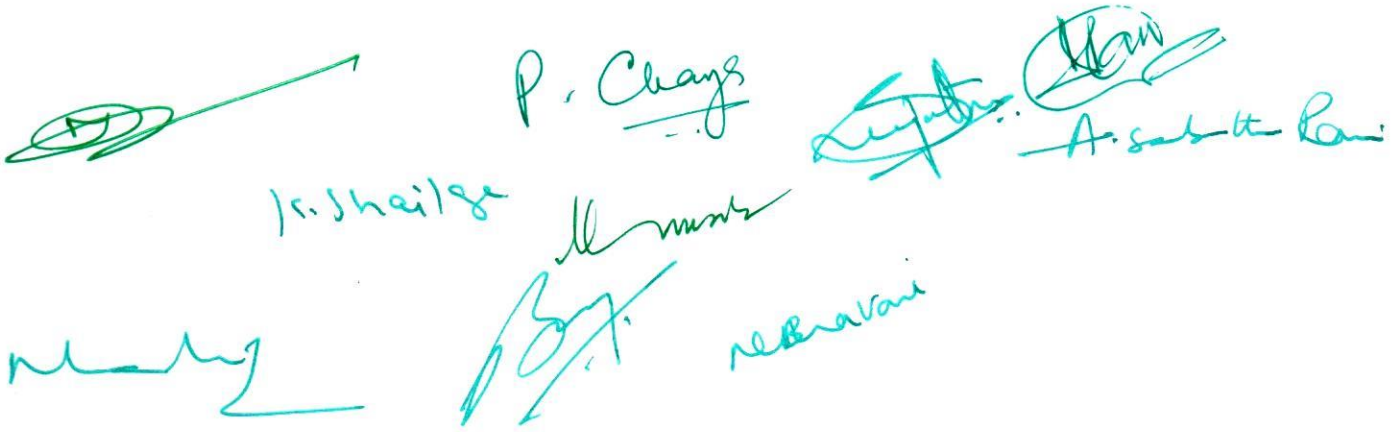

M Sc. Botany - III Semester (CBCS)
Elective-II E Melissopalynology and Forensic Palynology
(Theory)

MBOT.CC. T.2.304/ E (Elective) **3Hrs./week 3 Credits**

Unit-I : Melissopalynology

1.1 Melissopalynology and Bee Botany: importance and scope.
1.2 Honey bee colony, Forage pattern, behavior and honey producing potential of various honey bee species in India viz., indigenous *Apis dorsata, A. florea. A. cerana* and the recently introduced European honey bee *A. mellifera.*
1.3 Honey bee products – Honey, Bees wax, Pollen, Propolis, Royal jelly, Bee venom and their marketing.
1.4 Physical properties, Chemical composition and types of honey.
1.5 International methodology of qualitative and quantitative analysis of pollen of honeys. Estimation of absolute pollen count in Apiary honeys

Unit-II Applications of Melissopalynology and Bee-keeping

2.1 Application of Melissopalynology in codification of honeys: recognition of mixed honeys, adulteration of honeys, Geographical and Botanical source of honey, Unifloral and multifloral honeys.
2.2 Melissopalynological studies in India and Telangana State. Significant unifloral honeys of Telangana state.
2.3 Bee pasturage plants of Telangana State and their phenology. Nectar calendar: importance, methodology in preparation, Nectar calendars of Khammam and Medak districts.
2.4 Bee keeping- equipment and management; Strategies for enhanced honey production.
2.5 Role of Apiculture in rural development and social forestry.

Unit-III: Forensic Palynology

3.1 Forensic palynology: definition, scope, origin and development.
3.2 Methodology in forensic study: potential pollen/spore forensic sample collections: Collection of Pollen from Soil, Mud, Water, Animal Human and illicit drugs.
3.3 Laboratory techniques in forensic palynology: Acetolysis. Identification techniques: Light and Scanning electron microscope.
3.4 Forensic Palynology as an aid to Criminology case studies/evidences from sediments, cloths, hair and illegal drugs etc.
3.5 DNA barcoding method in forensic palynology and its applications.

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M. Sc. Botany - III Semester (CBCS)
Elective-II E Melissopalynology and Forensic Palynology
(Practical)

MBOT.CC.P.2.304/ E **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor Experiments:

1. Pollen analysis of unifloral honeys and quantification of pollen types
2. Pollen analysis of multifloral honeys and quantification of pollen types
3. Determination of moisture content of honey samples by using a Refractometer
4. Study of Honey Dew Elements and HDE/P ratio.
5. Determination of Absolute Pollen Count (APC) in apiary honeys.
6. Study of Granulation of honeys.
7. Study of Fermentation of honeys.
8. Study of pollen loads
9. Study of Nectar calendar (Khammam and Medak)

Study of the following spotters/ cultures/ Photo graphs/diagrams

10. Study of hive architecture of wild honey bees
11. Study of hive architecture of domesticated hive honey bees
12. Study of morphological features of some important unifloral pollen grains
13. Codification of honeys
14. Study of physical and chemical properties of honey.
15. Study of artificial wooden bee-box used in Bee-keeping.
16. Study of Bee-hive products and their importance.
17. Study of thixotrophic property of honeys.
18. Recovery of pollen/ spores from clothes, mud and hair.
19. Maintenance of Record

Elective-II E Melissopalynology and Forensic Palynology- Practical Model Paper
Time: 3 Hrs. **Max. Marks: 50**

I	Major question/experiment	16 M
II	Minor question/experiment	8 M
III.	Spotters – A, B, C ,D (4X 4)	16 M
V	Record & Field note book (3 +2)	5 M
VI	Viva	5M

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M. Sc. Botany III Semester (CBCS)
Elective-I F. Medicinal Botany and Phytochemistry
(Theory)

MBOT.CC. T.2.303/ F **(Elective)** **3 Hrs./week 3 Credits**

Unit-I: Traditional systems of medicine

1.1. Introduction: Origin, development and evolution of Medicinal Botany. Types of Indian traditional systems of medicines

1.2. Ayurveda system: origin, development, Principles, Diagnosis, treatment and plants used and preparation of drugs.

1.3. Siddha system: origin and development, fundamental concepts, diagnosis treatment and plants used and preparation of drugs.

1.4. Unani system: origin, development, fundamental principles, components, diagnosis, treatment and plants used and preparation of drugs.

1.5.] Homeopathy system: origin, development, fundamental principles, treatment and preparation of drugs.

Unit-II: Ethnobotany

2.1. Introduction: History, Definition, Objectives, Scope, Significance, and as inter-disciplinary science.

2.2. Methods and techniques: field data collection, documentation, Identification, Herbarium preparation, plant authentication.

2.3. Ethnomedicine: Plants used by ethnic groups as food, medicines, beverages, fodder, fibre, resins, oils, fragrances, natural dyes, natural sweeteners and other uses.

2.4. Use of plant Products: NWFP (Non-Wood Forest Produces), animal products, minerals, artefacts, and rituals, used by Tribal and Folk Communities of Telangana

2.5. Application of Ethnobotany: Role of ethnomedicine and its scope in drug discovery. Importance of ethnobotany in conservation and sustainable development.

UNIT – III: Phytochemistry

3.1. Phytochemicals: Definition. Classification of phytochemicals based on their chemical nature, general properties and their applications.

3.2. Biosynthesise of Secondary metabolites: Brief study of basic metabolic pathways and formation of different secondary metabolites through - Shikimic acid pathway, Acetate mevalonate pathway and Amino acid pathway.

3.3. Extraction of Phytochemicals: Methods of extraction (Maceration, percolation, soxhlation and others) Various types of separation techniques (distillation, crystallization, partition).

3.4. Photochemical Screening: Preliminary phytochemical screening using various chemical tests (Alkaloids, Saponins, Phenols, Tannins, Flavonoids , Glycosides)

3.5. Role of phytochemicals: Role of phytochemicals in the natural products drug discovery. Phytochemicals as a source of anticancer, antimicrobial, anti-inflammatory, Immuno-modulatory and anti-obesity medicine,

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M. Sc. Botany III Semester (CBCS)
Elective-I F. Medicinal Botany and Phytochemistry
(Practical)

MBOT.CC.P.2.303/ F **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor experiments:

1.Chemical tests for Alkaloids
2.Chemical tests for Tannins
3.Chemical tests for Flavonoids
4.Chemical tests for Saponins
5.Extraction of caffeine from tea powder.
6. Extraction and detection of sennosides from Senna leaves.
7.Extraction and detection of flavonoids from citrus peels.
8.Extraction and detection of tannins from Arjuna bark
9. Perform Thin Layer Chromatography (TLC) for the crude extract and observe the effect of polarity on the Rf (retention factor) value.

Study the following material/ spotter/ observations

10. Field visit and collection of ethno-botanical data from the local tribes.
11. Identification and collection of local medicinal plants (three) for phytochemical analysis.
12.Compare and assess the efficiency of extraction techniques (maceration, decoction, and Soxhlet) in the extraction of phytochemicals from given plant material.
13. Assessment of Medicinal Plant Quality through organoleptic evaluation and ash content
14.Purification of secondary metabolites through recrystallization technique
15.Prepare herbarium with local medicinal plants
16. Record

Elective-I F. Medicinal Botany and Phytochemistry- Practical Model Paper
Time: 3 Hrs. **Max. Marks: 50**

1.Major question/experiment	16 Mark
2.Minor question/experiment	12 Marks
3.Spotters – A, B, C ,D (4X 3)	12 Marks
4. Record	5 Mark
5.Viva	5 Marks

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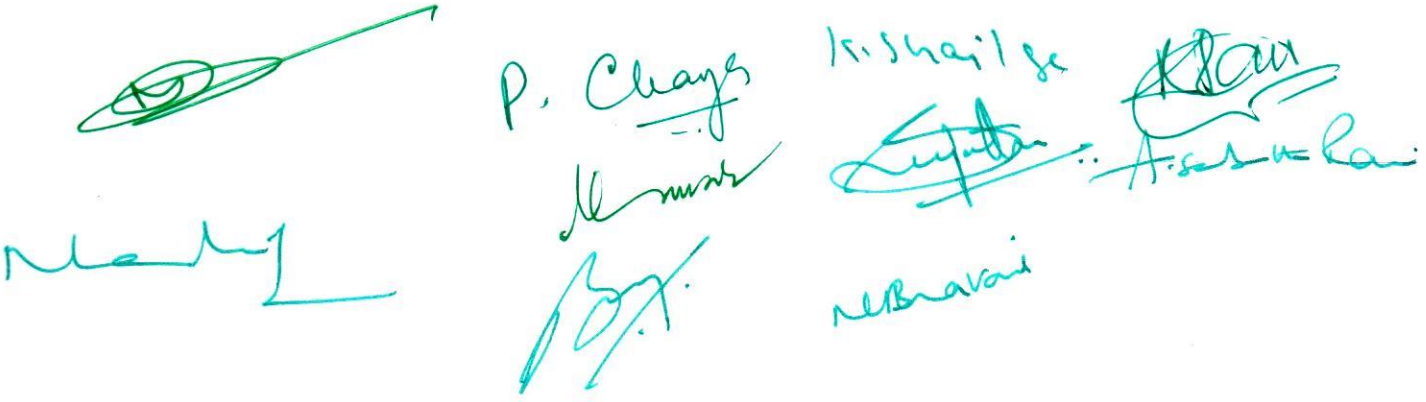

M. Sc. Botany - III Semester (CBCS)

Elective-II F. Cultivation and Post-Harvest Technology of Medicinal and Aromatic Plants (Theory)

MBOT.CC. T.2.304/ F **(Elective)** **3 Hrs./week 3 Credits**

UNIT – I: Cultivation practices

1.1 Methods of medicinal plant propagation: Seeds, Rhizomes, Stalks, Slips, Cuttings, micropropagation for endangered medicinal plants.

1.2 Active principles, uses, and cultivation practices for the following medicinal plants: a) *Andrographis paniculata* b) *Asparagus racemosus* c) *Coleus forskohlii,* d) *Rauvolfia serpentina* e) *Tinospora cordifolia* f) *Withania somnifera.*

1.3 Active principles, uses and cultivation practices for the following aromatic plants: *a) Acorus calamus b) Chrysopogon zizanioides c) Cymbopogon flexuosus b) Cymbopogon martinii c) Cymbopogon winterianus*

1.4 Advantages and Applications of *Azospirillum, Mycorrhiza* and *Rhizobium* as biofertilizers in the cultivation of medicinal plants.

1.5 Methods of organic farming of medicinal and aromatic plants, its significance.

Unit-II: Post-harvesting techniques

2.1.Harvesting: Time of harvesting, tools, methods, and post harvesting treatment.

2.2.Drying methods: Vacuum drying, osmotic drying and freeze drying, Drying tools, factors effecting drying.

2.3.Storage: Conditions, containers, duration, and post-storage treatment.

2.4.Processing techniques: Grinding, extraction, distillation, filtration and formulation.

2.5.Quality control: Identification, purity testing, microbial testing, heavy metal testing and residual solvent testing.

Unit III. Marketing and role of organizations

3.1. Demand and supply of medicinal plants, promotion of medicinal plant sector at national level and international level.

3.2. Export and import marketing value of medicinal and aromatic plants in India.

3.3. Role of National Medicinal Plant Board (NMPB), State Medicinal Plant Boards, other organizations CIMAP and NGOs.

3.4. Bio Trade and Access Benefit Sharing (ABS). Intellectual Property Rights (IPR) on medicinal and aromatic plants.

3.5. Guidelines and regulatory requirements for setting up Herbal drug industries in India

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M Sc. Botany - III Semester (CBCS)

Elective-II F. Cultivation and Post-Harvest Technology of Medicinal and Aromatic Plants (Practical)

MBOT.CC.P.2.304/ F **(Elective)** **4 Hrs./week 1Credit**

Major & Minor Experiment:

1. Extraction of essential oil from Eucalyptus leaves using steam distillation.
2. Extraction of essential oil from Clove buds using Clevenger's apparatus.
3. Extraction of essential oil from flower petals using Enfleurage method
4. Estimation of Heavy metal content in *Tinospora cordifolia* growing at various places using AAS
5. Preparation of Biofertilizers (using any one microbe)
6. Histochemical identification of the following chemical substances:
   a) Carbohydrates b) Amino acids d) Starch e) Tannins

Study of the following spotters / tissues/ observation/Report

7. Visit to the local areas and identification and data collection of potential medicinal plants for introduction in cultivation.
8. Visit to the local medicinal plant institutions (CIMAP, Medicinal plant board, State Biodiversity board) nurseries, gardens and local forest areas.
9. Learning various drying techniques of crude drugs.
10. Histological identification of tissue systems and deposits
    a). Epidermis, b) Parenchyma, c) Collenchyma, d) Phloem, e) Xylem, f) Crystals
11. Cultivation of any two Medicinal plants in an experimental plot and study of their phytoconstituents
12. Cultivation of any two aromatic plants in an experimental plot and study of their phytoconstituent
13. Market Research on Popular Medicinal Plants: Conduct a survey to identify popular medicinal plants in their region, gather information on demand, availability, and consumer challenges, and create a report on local demand and supply trends.
14. Prepare herbarium of medicinal and aromatic plants cultivated in the surrounding areas
15. Record

Elective-II F. Cultivation and Post-Harvest Technology of Medicinal and Aromatic Plants - Practical Practical Model Paper

Time: 3 Hrs. **Max. Marks: 50**

1.Major question/experiment	16 M
2.Minor question/experiment	12 M
3.Spotters – A, B, C ,D (4X 3)	12 M
4. Record	5 M
5.Viva	5 M

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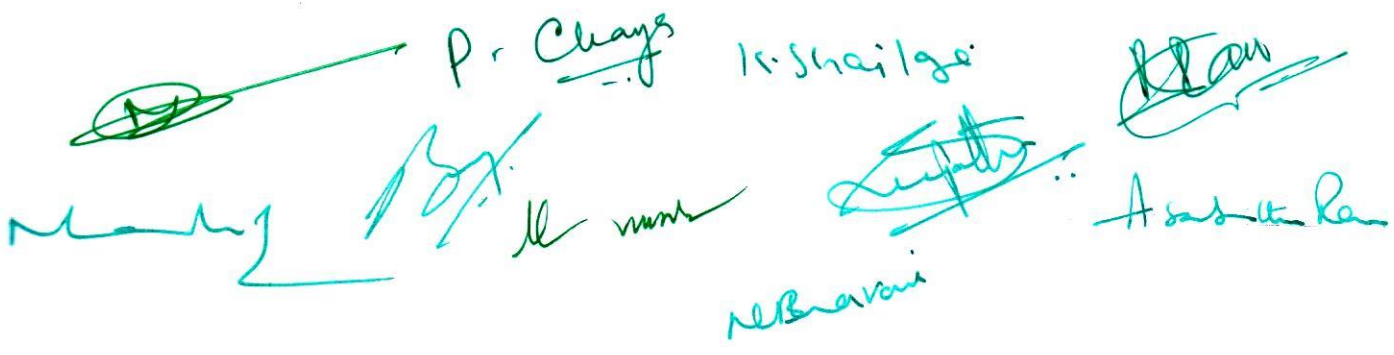

M.Sc. Botany, IV Semester (CBCS)

Core I: Recombinants DNA Technology

(Theory)

MBOT.CC.T.2.401 (CORE) **3 Hrs/week 3 Credits**

Unit-I: Gene cloning

1.1. Genetic engineering: Introduction, history and importance of gene cloning. Basic steps in gene cloning. Biosafety measures.

1.2. Enzymes in gene cloning: Restriction endonucleases: type I, II, III, DNA ligases, alkaline Phosphatases. Reverse transcriptase.

1.3.Gene cloning vectors: Plasmids, (PBR322) Bacteriophages, Cosmids, Phagemids, YAC, BAC, Ti and Ri plasmids

1.4Gene Libraries: Construction of Genomic library and cDNA libraries, advantages and disadvantages.

1.5 Selection of Recombinants- Screening of recombinants by Marker genes, Reporter genes, Colony hybridization

Unit-II: Advances in rDNA technology

2.1: Genome Sequencing: DNA sequencing- Maxam-Gilbert and Sanger Method. Pyrosequencing. Next Generation Sequencing (NGS).

2.2. Molecular Markers: Definition, types and Applications. Restriction Fragment Length Polymorphism (RFLP), Random Amplified Polymorphic DNA (RAPD).

2.3. DNA Fingerprinting. Methodology and Applications in Forensic science, Medico legal aspects. RNAi technology

2.4. Gene therapy: Delivery techniques (Ex vivo & In vivo), Delivery vectors & application of gene therapy in inherited immunodeficiency syndromes. Genome editing (CRISPR-Cas9).

2.5. r-DNA technology: Application of recombinant DNA technology in Medicine, Industry and Agriculture.

Unit-III: Techniques in rDNA technology

3.1. Polymerase Chain Reaction (PCR) and RT-PCR: Principle, types, components, enzymes employed and applications of PCR

3.2. Gel electrophoresis: Principle and methodology- Agarose Gel Electrophoresis (AGE) and Polyacrylamide Gel Electrophoresis (PAGE)

3.3. Blotting Techniques – Northern, Southern and Western Blotting

3.4. Fluorescence Techniques: Fluorescence *In Situ* Hybridization (FISH) and Fluorescence-Activated Cell Sorting (FACS), Fluorochromes.

3.5. Autoradiography – Principle and applications. DNA Microarray and DNA chips.

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M.Sc. Botany, IV Semester (CBCS)

Core -I: Recombinants DNA Technology (Practical)

MBOT.CC.T.P.401 **(CORE)** **4Hrs/week 2 Credits**

Major & Minor:

1 .DNA estimation by DPA method.
2. RNA estimation by Orcinol method.
3. Gene sequencing problems
4. Restriction mapping problems
5. RFLP problems.
6. Polymerase Chain Reaction (PCR)
7. Agarose Gel Electrophoresis (AGE)
8. Polyacrylamide Gel Electrophoresis (PAGE
9. DNA extraction from banana / tomato

Study of following Spotters/ Photographs

10. Plasmids-Structure
11. Reporter genes- GUS (glucoronidase) assay, Luciferase,
12. Southern blotting technique
13. Northern blotting technique
14. Western blotting technique
15. Next Generation Sequencing (NGS).
16. DNA Microarray
17. Fluorescence *In Situ* Hybridization (FISH)
18. Fluorescence Activated Cell Sorting (FACS),
19. Autoradiography
20. Record

Elective II. Recombinants DNA Technology- Practical Model Paper

Time- 3hrs **50 Marks**

1.Major Experiment	14 M
2. Minor Experiment	10 M
3. Spotters 4 (4x 4)	16 M
4. Record and Viva	10 M

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M.Sc. Botany, IV Semester (CBCS)

Core II. Plant Ecology, Biodiversity and Conservation Biology (Theory)

MBOT.CC.T.2.402 **(CORE)** **3 Hrs/week 3 Credits**

Unit I .Ecology

1.1 Ecosystem Ecology: Ecosystem structure and function, energy dynamics, primary production, mineral cycling— (Carbon and Nitrogen)

1.2 Population Ecology: Characteristics of a population (Density, Natality, Mortality, Dispersion, Population size, Age structure, Life tables) population growth curves, life history strategies(r and k selection)

1.3 Species interactions: Types of interactions, Positive interactions- Mutualism, symbiosis, commensalism, protocooperation

1.4. Negative interactions- Exploitation, herbivory, carnivory, antibiosis and competition

1.5. Ecological Succession: Types (Hydrosere & Xerosere) and mechanisms, Changes involved in succession. concept of climax- Monoclimax and Polyclimax theories

Unit II: Biodiversity

2.1. Community Ecology: Characteristics of communities, Analytical, Quantitative--Frequency, density, abundance, cover and basal area and
2.2. Qualitative—Physiognomy, phenology, stratification, sociability, vitality and life forms, Raunchier concept, Ecotones.
2.3. Principles of biodiversity: Biodiversity: Definition, Concepts, Levels of Biodiversity-Species, Ecosystem and Genetic Diversities.
2.4. Measurements of Biodiversity-Species Richness, Species Evenness, Diversity Indices-Shannon and Simpson's Index
2.5. Global distribution of Biodiversity: Distribution patterns, Biodiversity at global, national and local levels. India as a Mega diversity nation.

UNIT III: Conservation Biology

1.1 Strategies for conservation: Conservation, IUCN Red List, Categories of Threatened Species, Criteria to differentiate Threatened Taxa.

1.2 *In situ* Conservation methods: Biosphere Reserves, Sanctuaries, National Parks, Sacred Grooves. Advantages and Disadvantages of *In Situ* Conservation.

1.3 Ex situ Conservation methods: Botanical Gardens, Gene Banks, Seed Banks, Field Gene Banks, *In vitro* Gene Banks. Advantages and Disadvantages of *Ex Situ* Conservation.

1.4 National Legislations: Policies relevant to Biodiversity- Biological Diversity Act-2002; State Biodiversity Boards, Biodiversity Management Committees, Peoples Biodiversity Registers; National Biodiversity Action Plan (NBAP); National Biodiversity Targets.

1.5 Conservation practices: Brief account on **organizations** involved in resource conservation IUCN, WWF,UNEP,UNESCO.

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M.Sc. Botany, IV Semester (CBCS)

Core II. Plant Ecology, Biodiversity and Conservation Biology (Practical)

MBOT.CC.P.2.402 **(CORE)** **3 Hrs/week 2 Credits**

Major & Minor experiments:

1. Determination of quantitative characters by random quadrat method -Abundance, Density, Frequency and Dominance.
2. Determination of Important Value Index(IVI) of plant species in selected area.
3. Calculation of Similarity and Dissimilarity Index
4. Estimation of Carbonates and Bicarbonates
5. Estimation of Chlorides and Dissolved Oxygen
6. Morphology and Anatomy of Hydrophytes and their adaptations.
7. Morphology and Anatomy of Xerophytes and their adaptations
8. Evaluation of life form classes of local flora.
9. Preparation of frequency diagram of plant community by Raunkiaer method
10. Preparation of biological spectrum
11. Determination of Simpson index of dominance of a plant community.
12. Determination of Shannon Weiner diversity for plant community.
13. IUCN threatened categories: Rare, Endangered and Vulnerable categories of plant species from Telangana.
14. Mapping of *in situ* plant conservation in India.
15. Ex situ conservation: Seeds of crop plants.
16. Maintenance of Practical records

Elective II. Recombinants DNA Technology- Practical Model Paper

Time- 3hrs **50 Marks**

1.Major Experiment	16 M
2. Minor Experiment	08 M
3. Spotters 4 (4x 4)	16 M
4. Record and Viva	10 M

REFERENCE:

1. E.P. Odum 1996 Fundamentals of ecology
2. E.J Koromondy .1996 Concept of Ecology
3. P.D Sharma . 1996 Ecology and environment
4. S.P. Misra .S.N. 2010 Pandey Essential Environmental studies
5. N.S Subrahmanyam and Sambamurty 2000 Ecology
6. Gaston,K. J and Spicer,J.I.2004. Biodiversity: An Introduction (2nd Ed.) Blackwell Publishing Company.
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8. 8) Heink, U and Kowarik,I. 2010 What criteria should be used to select biodiversity indicators . Biodiversity Conservation 19:3769-3797.
9. IUCN Red List of threatened species Version 2012.2.
10. Chauhan, S.S 2014. Status of Biodiversity in India. Issues and Challenges. Indian Journal of Plant Sciences 3(1) :35-42.

M Sc. Botany – IV Semester (CBCS)
Elective-III A. - Horticulture and Plant Breeding
(Theory)

MBOT.CC. T.2.403 / A **(Elective)** **3 Hrs./week 3 Credits**

Unit I. Horticulture

1.1. Horticulture: Introduction, scope, branches and importance of Horticulture. Classification of horticultural crops based on soil, climatic requirements and seasons of growth.

1.2. Propagation of Horticultural plants: Natural propagation by Seeds (Seed structure & Types and germination types), vegetative propagation by runners, stolon, suckers, offshoots and detachable structures (bulb, com, tuber, rhizome).

1.2. Artificial Vegetative Propagation: Layering- different types and advantages. Cutting different types and advantages.

1.4. Artificial Vegetative Propagation: Grafting –root stock & scion, different types and advantages of grafting.

1.5. Artificial Vegetative Propagation: Budding, different types and advantages of budding. Application of Plant growth regulators in Horticulture.

Unit II. Nutrient and Disease Management of Horticultural Plants

2.1. Nutrient management: Macro and Micro nutrients- functions and deficiency symptoms. Integrative Nutrient management (INP)

2.2. Water Management: Different methods of irrigation. Drip irrigation system. Conservation of Soil moisture- Mulching.

2.3. Management of Fertilizers: Biofertilizers and Chemical fertilizers – Types, advantages and disadvantages. Manure- Types and their role soil fertility management.

2.4. Management of Diseases: Method of management of diseases of Horticultural crops- Prevention, cultural practices, biological and chemical control. Agri-clinics.

2.5. Management of Pest: Methods of management of pest of Horticultural crops- Mechanical, Physical, biological, chemical and cultural practices. Integrated Pest Management (IPM).

Unit III. Plant Breeding

3.1. Plant breeding objectives: Traits of interest - high yield, improved quality, disease and pest resistance, early maturity and resistance to biotic and abiotic stresses.

3.2 Conventional method of crop improvement: Principles of plant breeding, selective selfing and crossing techniques.

3.3. Traditional breeding methods: Selection methods – Mass selection, Pure line, Pedigree, Clonal selection. Merits and demerits of each method. Back cross breeding,

3.4. Hybridization: Methodology of production of commercial hybrids. Development of inbreed cultivars, Inbreeding depression. Heterosis- theories of and importance of Heterosis.

3.5. Mutation breeding: Induced polyploidy and its role in plant breeding. Importance of haploid and dihaploids in plant breeding.

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M Sc. Botany - IV Semester (CBCS)
Elective-III A. - Horticulture and Plant Breeding
(Practical)

MBOT.CC. T.2.403 / A **(Elective)** **4 Hrs./week 1 Credit**

Major and Minor experiments:

1. Seed viability test by Tetrazolium test.
2. Estimation of moisture content in soil.
3. Determination of Soil pH
4. Study of types of manures.
   Demonstration of vegetative propagation from locally available plants through following methods
5. Stem cutting.
6. Layering-Tip layering, Simple layering, mound layering, and Air layering.
7. Grafting- Cleft grafting, Whip or tongue grafting, Bark grafting,
8. Budding- T- budding, Chip budding, Patch budding
9. Study of Seed germination- Epigeal and Hypogeal.
10. Study of methods to overcome seed dormancy- Mechanical scarification, Soaking the seeds in water, Acid, scarification

Study of the following spotters/ cultures/ Photo graphs/diagrams

10. Study of Hybridization (Intraspecific, Interspecific)
11. Study of selfing and crossing pollination techniques:
    A) Emasculation: B) Bagging C) Pollination and D) Tagging
12. Identification of Horticultural tools and implements and their uses
14. Study of Vegetative propagation through corms, bulbs, rhizomes.
    Study of containers, preparation.
16. Preparation of Record.

Elective - II- Horticulture and Plant Breeding- Practical Model Paper

Time- 3hrs **50 Marks**

9. Major Experiment	16 M
10. Minor 2 (2x6)	12 M
11. Spotters 4 (4X3)	12 M
12. Record and Viva	10 M

REFERENCES:

1. Plant propagation (Principles and practices) Hortman, Kester, Fred T Davies, Robert Genene
2. Floriculture in India – T.K. Bose
3. Principles of horticultural science – Janick
4. Beautiful shrubs – Prathibha P. Trivedi
5. Commercial flowers Vol. I & II- T.K. Bose,Yadav, P. Pal, P.Das, V.A. Parthasarathy.
6. Floriculture in India – Randhawa and Mukhopadhyaya Allied Publishers.
7. Biotechnology and its application in horticulture S.P. Ghosh- Narosa Publishers.
8. Agricultural dairy- published by Agriculture Department A.P.
9. Horticulture dairy- Horticulture Department A.P.
10. Field Crops research. By Poehlman.
11. Genetics by Sambamurthy.
12. Plant breeding by Allard.
13. Plant breeding by Randhawa
14. Plant Tissue Culture-Protocols in Plant Biotechnology by MC Gayathri& R.Kavyashree-Narosa Publ.

M. Sc. Botany – IV Semester (CBCS)

Elective-III B. Stress Physiology (Theory)

MBOT.CC.T.2.403 / B **(Elective)** **3 Hrs./week 3 Credits**

UNIT –I: Water stress

Drought

1.1. Membranes and water stress, Stomatal response to water stress. Role of ABA

1.2. Photosynthesis and water stress, Osmotic adjustment, Mechanism of drought tolerance

Flooding

1.3. Flooding injury, Metabolic damage

1.4. Hormonal imbalance, Soil toxins

1.5. Tolerance mechanisms

UNIT –II: Temperature and UV radiation

Low temperature stress

2.1. Chilling and freezing effects on growth, Physiological and molecular mechanism of low temperature tolerance, Effect of low temperature on plant productivity

Heat stress

2.2. Cellular responses to high temperature: enzyme activities, photosynthesis, ultra structural effects, Molecular responses to high temperature. Heat shock proteins.

2.3. High temperature tolerance mechanisms in plants

Ultra violet – B (UV-B radiation):

2.4. Plant response to UV radiation, Effect of UV-B on chemical composition

2.5. Effect of UV-B radiation on photosynthesis, UV-B defense and gene expression

UNIT –III: Metals, Allelochemicals and Salt stress

Metal stress

3.1. Metal toxicity and tolerance with special reference to i) Aluminum ii) Manganese iii) Iron iv) Zinc

3.2. Phytochelations, Differential plant tolerance to heavy metals

Allelochemicals

3.3. Chemical nature of allelochemicals, Mode of release of allelochemicals, Regulation of allelochemical production and release, Mode of action of allelochemicals on plant physiological processes

Salt stress

3.4. Effect of high salt concentration of plants – water stress, nutrient ion deficiency, ion toxicity; Regulation of salt content – Salt exclusion, salt elimination, salt succulency

3.5. Mechanism of salt resistance and tolerance

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M Sc. Botany – IV Semester (CBCS)

Elective-III B. Stress Physiology (Practical)

MBOT.CC.T.2.403 / B **(Elective)** **4 Hrs./week 1 Credit**

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1. Estimation of Proline
2. Extraction and estimation of total phenols
3. Estimation of peroxidase
4. Estimation of polyphenol oxidase
5. Estimation of ascorbic acid oxidase

Study of the following spotters/ observations/Photographs/ structures

6. Identification of the morphological symptoms of plants under drought stress
7. Identification of the morphological symptoms of plants under flodding stress
8. Observation of the external symptoms of plants under chilling stress
9. Observation of the external symptoms of plants under heat stress
10. Understanding the external symptoms of plants under salt stress
11. Study of the mode of release of allelochemicals
12. Identifying the symptoms of Aluminum toxicity in plants
13. Understanding the symptoms of Zinc toxicity in plants
14. Observation of iron toxicity in plants
15. Maintenance of Practical Record

Elective-III B. Stress Physiology - Practical Model Paper

Time- 3hrs	**50 Marks**
1.Major Experiment	16 M
2. Minor	1 2 M
3. Spotters 4 (4X3)	12 M
4. Record and Viva	10 M

REFERENCES:

1. Plant ecophysiology Ed. M.N.V. Prasad. John Wiley and Sons Inc. NY (1997)
2. Encyclopedia Plant Physiology. New Series. 12 ABCD Plant ZPhysiology Ecology 1983.Springer Verlag Berlin
3. Plant Physiology. L. Taiz and E. Zeiger. 1999. Sinava Associates Inc. Publishers Sunderland MA
4. Photosynthesis. A comprehensive treatise. 1998. Ed. A.S. Raghavendra. Cambridge Univ. Press
5. Plant Physiology. Frank B. Salisbury and Cleon W. Ross. 4th edition. 1992. Words worth Publication Co,. Belmont.California
6. Stress Physiology. D.P. Singh
7. Plant Physiological Ecology. Hans Lambers, F. Stuart Champin II, Thijs J, Pons
8. Advances in Plant Physiology. A Hemantarajan

M Sc. Botany – IV Semester (CBCS)
Elective-III C. Molecular Plant Pathology and Disease Management (Theory)

MBOT.CC.T.2.403 / C **(Elective)** **3 Hrs./week 3 Credits**

UNIT- I Molecular plant Pathology:

1.1. Molecular Plant Pathology: Genesis, importance and scope of molecular plant pathology. Basic and advanced Techniques in plant pathology- Electrophoresis- Principle, procedure and application.

1.2 Study of advanced techniques: Principle, Types, Methodology, and applications of ELISA, PCR (Polymerase Chain Reaction). Brief account of RT-PCR.

1.3 Diagnosis of variability in plant pathogens: Molecular variability of pathogens. Molecular markers-Definition & types. Detailed study of Principle, procedure and application of RFLP and RAPD.

1.4 Advances in Molecular biology: Fungal protoplasts isolation, culture and fusion. Brief account of Vegetative compatibility groupings (VCG).

1.5 Bioinformatics: Application of Information Technology in plant pathology - Data bases, computer simulation, \, prediction & expert system, disease forecasting. Role of GPS, GIS and Remote Sensing in plant pathology.

Unit III. Fungal Biotechnology:

1.1.Fermentation: Fermenters, Different types of fermenters. Fermentation- processes, growth kinetics and scaling up biomass production.

1.2.Yeast: Types of yeast- Baker's, food, feed yeasts. Application of yeast in food, baking, feed industry. Role of yeast in industrial production of alcohols., Single Cell Proteins.

1.3.Fungal enzymes: Study on production and application of Industrial fungal enzymes (amylases, cellulases and chitinases).

1.4. Fungi in Industry: General account of production and application of primary metabolites from fungi (vitamins and proteins).

1.5.Fungi in Industry: Over view of production and application of secondary metabolites (antibiotics,pigments and alkaloids).

UNIT- II: Plant Disease management:

1.1. Disease Development: Effect various factors on disease development (moisture, temperature, wind, soil, host-plant nutrition). Disease triangle. Concept of Epidemiology. Elements of epidemics.

1.2. Principles of Plant Disease Management; Cultural practice, Biological Methods, Physical Methods

1.3. Chemical Method of disease management: Classification of fungicides. Chemical nature, mode of action and methods of application of fungicides-Sulphur fungicides, Copper fungicides, Mercurial compounds.

1.4. Plant Quarantine: Quarantine- General principles., domestic and International. Exotic pathogens and pathogens introduced into India. Sanitary and phytosanitary (SPS) issues under WTO and TRIPS

1.5. Integrated Disease management (IPM) -Introduction, history, importance, concepts, principles and tools of IPM. Survey, surveillance and forecasting of Insect pest and diseases

P. Chaya

K. Shailaja

Neelavani

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M Sc. Botany – IV Semester (CBCS)

Elective-III C. Molecular Plant Pathology and Disease Management (Practical)

MBOT.CC.T.2.403 / C **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor experiments:

1 Estimation of DNA by DPA method
2 Estimation of RNA by Orcinol method.
3 Estimation of enzymes: Cellulases, Chitinases and Amylases from fungal cultures
4 Estimation of sugars, proteins and amino acids in fungal mycelium and culture filtrate
5 Estimation of organic acids in fungal culture filtrates.
6 Demonstration of electrophoresis technique
7 Demonstration of PCR technique.
8 Demonstration of Protoplast isolation from fungi

Spotters (Cultures/ Photographs/ Diagram)

9. Study of RFLP and RAPD
10. Study of Fermenters
11. Study of Yeast in Baking, Alcohol production
12. Study of disease Triangle.
13. Study of some cultural practices
14. Study of some chemical pesticides
15. Maintenance of Record

Elective III- Molecular Plant Pathology and Disease Management - Practical Model Paper

Time- 3hrs **50 Marks**

1. Major Experiment	1 5 M
2. Minor Experiment	9 M
3. Spotters 4 (4x 4)	16 M
4. Record and Viva	10 M

REFERENCES:

1) Agrios, G.N. 1999, Plant Pathology. Academic press.
2) Alexander, N. Glazer & Hiroshi Nikaido, 1995. Microbial Biotechnology, W.H. Freemanand Company.
3) Bau, A.N. & Giri, B.K. 1993. The essential of viruses, vectors and plant diseases. WileyEastern Limited.
4) Bernard R. Glick & Jack J. Pasternak. 1996, Molecular Biotechnology, Panima Publishing Company.
5) Bridge, P., Jeffriens, P. and Morse, D.R., 1998, Information technology, plant Pathologyand Biodiversity, CAB international Publications.
6) Bridge, P.D. 1995, Molecular Variability of Fungal Pathogens, CABI Publ.
7) Bridge, P.D., Arora, D.K., Reddy, C.A. & Elander, R.P. 1998. Applications of PCR in Mycology,
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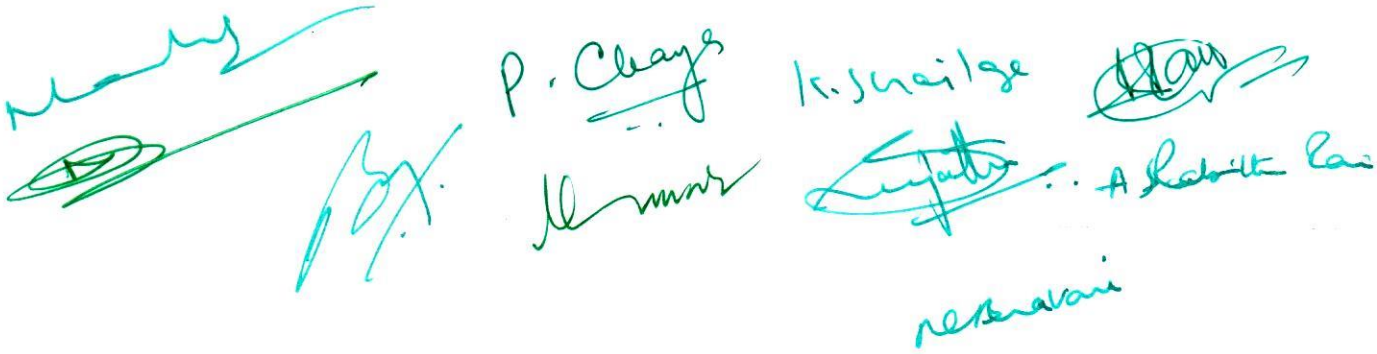
10) Dubey, R.C. 1995. A Text Book of Biotechnology, S. Chand & Company Ltd.
11) Greg J. Boland & Kuykendall, L.D. 1998. Plant Microbe Interactions and Biological Control.Marcel Dekker Inc.
12) Gurr, S.J. & Mc. Pherson, M.J. & Bowles, D.J. 1992. Molecular Plant Pathology, Vol. I & II Oxford
13) Horst w. Doelle, 1994, Microbia Process Development, World Scientific
14) Marshall, G. & Walters, D. 1994 Molecular Biology in Crop Protection, Chapman & Hall.
15) Mehrotra, R.S. 1991 Plant pathology, Tata Megrew – Hill Publishing Comp Ltd.
16) Natish, S. Chopra, V.L. & Ramachandran, S. 1994. Biotechnology in Agriculture Oxford andIBH Publishing Company.
17) Natish, S., Chopra, V.L. & Ramachandran, S. 1994 Biotechnology Agriculture Oxford andIBH Publishing Company.



M.Sc. Botany – IV Semester (CBCS)
Elective-III D.
Seed Technology and Nursery Management (Theory)

MBOT.CC. T.2.403 /D (Elective) **3 Hrs./week 3 Credits**

Unit 1. Seed morphology and methods

1.1 Introduction – Definition, Concept, Objectives, Role and Opportunities of seed technology.
1.2 Morphology of seed –Structure of seed, Seed coat anatomy, Seed dispersal.
1.3 Seed dormancy – Definition, Causes of seed dormancy, methods of breaking seed dormancy.
1.4 Methods of seed collection. Seed processing – Cleaning, Winnowing, Sieving, Drying and packing.
1.5 Methods of seed storage. Seed viability. Seed deterioration. Seed testing and Seed certification.

Unit 2. Gene banks and management

2.1 Gene banks Definition, types of gene banks - Seed gene bank, Cryo gene bank, Invitro gene bank, Field gene bank.

2.2 Gene banks management strategies and principles, access benefit sharing polices global level.

2.3 Global gene banks – Africa Rice, Biodiversity International, CIAT, CIMMYT.

2.4 Role of NBPGR and its regional stations in ex situ conservation of Indian plant genetic resources – crop plants, landraces, wild crop relatives, wild plants.

2.5 Role of Svalbard Global seed vault – Norway in long term seed storage and conservation of global plant genetic resources.

Unit 3.Seed germination methods and nursery management

3.1 Seed treatment –Organic seed treatments-Priming, Pelleting, Hot water treatment, Soaking, Scarification. Chemical seed treatment – Fungicide, insecticide, Sulfuric acid treatment.
3.2 Seed sowing - Stripe seeding, Point seeding, Broadcast seeding, Broad or line sowing, Dibbling, Transplanting, Planting.
3.3 Preparation of seed or nursery beds – Flat nursery beds, Raised nursery bed, Sunken nursery bed. Preparation of potting media – Soil, Compost, Sand, Sphagnum moss, Saw dust, Peat, Perlite, Vermiculite, Farmyard manure (FYM). Use growth regulators.
3.4 Transplanting techniques and methods. Factors influencing the survival rate of seedlings.
3.5 Seedling growth and management in Shade net/Net house, Polytunnel/Polyhouse and Glasshouse/Greenhouses.

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M.Sc. Botany – IV Semester (CBCS)

Elective-III D. Seed Technology and Nursery Management (Practical)

MBOT.CC.P.2.403 /D **(Elective)** **4 Hrs./week 1 Credit**

Questions from the following practicals:

1. Study of seed structure (Gymnosperm, Angiosperm seeds -Dicots, Monocots).
2. Study of seed coat anatomy of wild or crop plants locally available.
3. Tetrazolium test for seed viability and vigour in wild plants or cultivated crop seeds.
4. Study of natural methods of seed dormancy braking in hard seed coat seeds: Jitregi (*Dalbergia latifolia*), Nallamaddi (*Terminalia tomentosa*) Errachandhanam (*Pterocarpus santalinus*), Entada (*Entada rheedii*).
5. Study of seed dormancy breaking by using chemical (sulphuric acid) in hard seed coat species: Tellapoliki (*Givotia rottleriformis*), Srigandham (*Santalum album*).

Minor questions from the following practicals:

6. Study of seed germination percentage in rare tree species – Andugu (*Boswellia serrata*), Morri (*Buchanania lanzan*), Tapsi (*Kavalama urens*).
7. Methods of collection, processing and drying of seeds of local forest species.
8. Preparation of nursery beds, manure , filling of nursery bags, transplanting of seedlings.
9. Study of seed germination and nursery techniques in micro seeded plants - Ficus spp., Orchids.
10. Seed sowing and recording of germination and survival percentage of medicinal, vegetable and floricultural herbs (annuals).

Spotters from the following practicals:

11. Study of methods of application of growth regulators.
12. Methods of learning seed storage and preservation in gene banks.
13. Preparation of eco-friendly nursery bags and pots.
14. Methods of preparation of seed balls and scattering in the selected local forest area.
15. Visit to the local forest areas, gardens, nurseries, and horticultural institution and Visit to the gene banks - NBPGR Delhi and Hyderabad.
16. Field notebook and Record

Elective-III D. Seed Technology and Nursery Management **Practical Model Paper**
Time: 3 Hrs. **Max. Marks:50**

I	Major question/experiment	15 M
II	Minor question/experiment (2X8)	16 M
III	Spotters – A, B, C (3X 3)	9 M
IV	Record & Field note book (3 +2)	5 M
V	Viva	5 M

REFERENCES:

1. Rattan Lal Agrawal . 2018. Seed Technology.Oxford & IBH Publishing Co Pvt. Ltd.
2. Upadhyay, P.K. 2018. Principles of Seed Technology. Kalyani Publishers. New Delhi.
3. Phundan Singh. 2016. Objectives Seed Technology. Kalyani Publishers. New Delhi.
4. Rajeev Kumar. 2016. A Text Book of Seed Technology. Kalyani Publishers. New Delhi.
5. Boesewinkel, F.D. & F. Bouman. 1984. The Seed: Structure in Embryology of Angiosperms.
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7. Corner EJH (1976) The seeds of dicotyledons, 1 st edn, 2 vols. Cambridge University Press, Cambridge London New York Melbourne
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9. Donald L. Pluknett and Nigel J.H. Smith. 2016. Gene Banks and the world's. Food. Princeton University Press.
10. Sharma, R.R. 2013. Textbook of Plant Propagation and Nursery management. IBDC publisher.
11. Ellis, R.H. 1985.Handbook of seed Technology for Genebanks. Alliance Biodiversity & CIAT.
12. Ray. P.K. 2021. Essentials of Plant Nursery Management. Sibt Educational Books.
13. Kumar, V.2018. Practical Manual of Nursery Management. Agri Biovet Press.
14. Deepa H. Dwivedi and Navaldey Bharti. 2019. Handbook for skill development Nursery Management of Horticulture Crops. Satish Serial Publishing House.
15. Carlos Alberto Busso. 2013. From Seed germination to Young Plants. Nova Science Publishers.
16. Henry Kock.2008. Growing Trees from Seed. A practical guide to growing native trees, vines and shrubs.

M.Sc. Botany – IV Semester (CBCS)
Elective-III E.Aerobiology and Paleopalynology
(Theory)

MBOT.CC.T.2.403 /E (Elective) **3 Hrs./week 3 Credits**

Unit-I Aerobiology

1.1 Aerobiology- Definition, scope and importance in public health and plant diseases.
1.2 Air samplers: Rotorod sampler, Burkard volumetric sampler, Anderson sampler, Tilak air sampler, Lakhanpal and Nair sampler.
1.3 Bio aerosols: definition, Types of bio aerosols: epidermal shreds, pollen, fungal spores. Common allergic pollen and fungal spores of Hyderabad environment.
1.4 Meteorological impacts on aerosols and their distribution: wind, temperature, rainfall and humidity.
1.5 Pollen calendar: methods of preparation, importance. Hyderabad pollen calendar.

Unit-II: Pollen allergy, immunology and clinical aspects

2.1 Pollen expressed proteins that act as human allergens. Pollen morphology of some allergic pollen: *Partthenium, Holoptelea, Prosopis, Ageratum,* and *Cynodon.*
2.2 Symptoms of pollen allergy in human beings: Pollenosis, Rhinitis, Asthma, Conjunctivitis.
2.3 Mould spores provoking allergy- Systemic mycosis, Aspergillosis, Candidiasis and Zygomycosis/Mucomycosis (Black fungus).
2.4 Immune system and basic structure of immunoglobulins, Types of allergic (hypersensitivity) reactions, Mechanism of allergic reactions.
2.5 Diagnosis of pollen or spore allergy: Prick test, Intracutaneous test, ELISA and Treatment for pollen allergy.

Unit-III : Palaeopalynology:

3.1 Paleopalynology: definition, scope and importance. Geological Time Scale, Conditions for fossilization and Diverse types of palynomorphs, their preservation in various lithic entities.
3.2 Types of fossils: Impressions. Compressions, Petrifactions, casts and moulds.
3.3 Recovery and concentration of fossil spores and pollen by suitable maceration techniques and heavy liquid treatment.
3.4 Relevance of fossil pollen and spores in hydrocarbon exploration: TAI index.
3.5 Palynology of Tertiary deposits of southern India-Neogene of Cauvery basin-the stratigraphic, floristic and climatic significance of pollen floras.

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M.Sc. Botany – IV Semester (CBCS)
Elective-III E. Aerobiology and Paleopalynology
(Practical)

MBOT.CCP.2.403 /E **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor experiments:

1. Study of Aeroscopes: Volumetric - Rotorod and Tilak's air sampler
2. Study of Aeroscopes: Gravimetric - Lakhanpal & Nair
3. Qualitative and quantitative study of airborne pollen
4. Prick test for confirmation of pollen allergy
5. Study of Pollen calendar of Hyderabad
6. Study of phenology of common allergenic pollen types.

Spotters - Morphological study of some important allergenic pollen grains

7. *Parthenium*
8. *Holoptelea*
9. *Cynodon*
10. *Ageratum*
11. *Prosopis*

Spotters -Morphological study of some important allergenic fungal spores

12. *Alternaria*
13. *Aspergillus*
14. *Curvularia*
15. *Dreschlera*
16. *Nigrospora*
17. Maintenance of Record

Elective-III E. Aerobiology and Paleopalynology- Practical Model Paper
Time: 3 Hrs. **Max. Marks 50**

I	Major question/experiment	16 M
II	Minor question/experiment	8 M
III.	Spotters – A, B, C ,D (4X 4)	16 M
V	Record & Field note book (3 +2)	5 M
VI	Viva	5M

REFERENCES:

1. S.T.Tilak. 1989 Air borne pollen and fungal spores. Vaijayanti Prakasam, Aurangabad.
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M.Sc. Botany – IV Semester (CBCS)
Elective-III F.Pharmacognosy of Medicinal Plants
(Theory)

MBOT.CC.T.2.403 /F. (Elective) **3 Hrs./week 3 Credits**

UNIT – I: Pharmacognosy

1.1 Introduction: Scope and Importance of pharmacognosy, future prospects of pharmacognosy.
1.2 Classification of crude drugs: Morphological, taxonomical, chemical, pharmacological and alphabetical.
1.3 Raw drug repository: collection, preservation, storage
1.4 Substitutes and adulterants for crude drugs of commercial importance
1.5 Phyto-pharmaceuticals and herbal medicines. Challenges and opportunities in herbal drug development.

Unit-II: Phytochemical aspects of medicinal plants

Phytochemical profile, Identification tests, and Uses of

2.1 Root drugs: *Asparagus racemosus*, *Boerhavia diffusa, Rauvolfia serpentina, Withania somnifera.*
2.2 Leaf drugs: *Andrographis paniculata, Senna angustifolia, Centella asiatica, Datura stramionium*
2.3 Bark drugs: *Terminalia arjuna, Cinnamomum zeylanicum, Holarrhena pubescens, Cinchona officinalis*
2.4 Seed drugs: *Abrus precatorius, Piper longum,Psoralea corylifolia, Strychnos nux-vomica*
2.5 Flower drugs: *Crocus sativus, Hibiscus rosa-sinensis, Clitoria ternatea, woodfordia fruticosa*

Unit-III: Analytical pharmacognosy

3.1 Chromatographic techniques: Thin layer chromatography (TLC), High performance Thin Layer Chromatography (HPTLC), High performance liquid chromatography (HPLC), and Gas chromatography (GC).
3.2 Spectroscopic techniques: Principles of FT-IR, NMR, Mass spectrometry (MS).
3.3 Structure elucidation of the following compounds by spectroscopic techniques like UV, FT-IR, Mass, NMR (^{1}H, ^{13}C) a. Menthol, b. Kaempferol
3.4 Quality control: Standardization and quality assurance of medicinal plants, quality control parameters.
3.5 Safety and toxicity evaluation: Adverse effects of medicinal plants, herbal drug interactions, AYUSH guidelines for safety monitoring.

CHAIRPERSON
B.O.S. IN BOTANY
OSMANIA UNIVERSITY
HYDERABAD-500

M.Sc. Botany – IV Semester (CBCS)
Elective-III F. Pharmacognosy of Medicinal Plants
(Practical)

MBOT.CC.P.2.403 /F. **(Elective)** **4 Hrs./week 1 Credit**

Major & Minor experiments:

1. Perform identification tests for *Terminalia arjuna* bark for tannin
2. Estimation of total flavonoid content using UV-Visible spectrophotometer
3. Analysis of Sample using FT-IR: Identify and Report the Functional Groups Present in plant extract
4. Qualitative and Quantitative analysis of the following (in any two medicinal plants) using HPTLC a. Quercetin b. Rutin c. Kaempferol d. Gallic acid
5. Phytochemical profiling of *Cinnamomum zeylanicum* using GC-MS
6. Estimation of Reserpine content in the *Rauvolfia serpentina* root using HPLC
7. Powder analysis of the following a) Turmeric b) Cloves c) Senna d) Fennel e) *Cinnamon*
8. Determination of swelling index of Isabgol seeds (to identify adulteration)

Study of the following spotter/ Herbarium/ observation

9. Identification of locally available crude drugs based on morphological & anatomical characters (any two)
10. Determination of Haemolytic properties of saponin rich plants (any two)
11. Histochemical analysis of plant material for identification volatile oils and pigments
12. Histochemical analysis of starch grains obtained from various sources
13. Formulation and evaluation of herbal products of market value (gels/ creams/lotions/oils/powders)
14. Preparation of Herbarium of the medicinal plants mentioned in the theory.
15. Record

Elective – III F : Pharmacognosy of Medicinal Plants- Practical Model Paper

Time- 3hrs	**50 Marks**
1.Major Experiment	16 M
2. Minor	1 2 M
3. Spotters 4 (4X3)	12 M
4. Record and Viva	10 M

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2. Mohammed Ali .2019. Text book of Pharmacognosy. CBS Publishers &Distribution, New Delhi.

3. C.K.Kokate, Purohit and Ghokhale. 1996.Text book of Pharmacognosy. Nirali Prakassan.,

4. Dr.SH.Ansari. 2007. Essentials of Pharmacognosy. Birla publications, New Delhi.

5. Avinash Seth. Biren Shah. 2009.Text book of Pharmacognosy and Phytochemistry.

6. W.C. Evans. 2009. Trease and Evans Pharmacognosy. Belhaven Press. London.

7.T.C. Denson. 2012. AText book of Pharmacognosy. Kellock Robertson.

8. Sethi, P.D., HPTLC, Quantitative Analysis of Pharmaceutical Formulations, CBS Publishers, Delhi.

9 Wilfried, M.A. Niessen- Liquid Chromatography-Mass Spectrometry.

10. Hoffmann, Chromatography.

11.. Scott, Techniques and Practice of Chromatography.