# Shiksha Mandal's
# Bajaj College of Science, Wardha

**Proposed Syllabus for M.Sc. semester-III Program**

**(Academic Session 2024-25)**

## Syllabus
# DISCIPLINE SPECIFIC CORE (DSC), DISCIPLINE SPECIFIC ELECTIVES (DSE), AND OTHER COURSES

**MSc- Semester III course in Botany**

**Syllabus under Autonomy**
**As per National Education Policy (NEP) 2020**

## M.Sc. BOTANY SEMESTER -III

| S. N. | Course Category | Name of Course | Course Code |
|---|---|---|---|
| 1 | DSC – 9 | Angiosperm Taxonomy | PBO631T |
| 2 | DSC – 10 | Plant Ecology | PBO632T |
| 3 | DSC – 11 | Plant Development and Reproduction | PBO633T |
| 4 | DSC – 12 | **Practical** on Angiosperm Taxonomy, Plant Ecology, Plant Development and Reproduction | PBO634P |
| 5 | DSE – 3 | Mycology and Plant Pathology – I<br>**OR**<br>Molecular Biology and Plant Biotechnology - I<br>**OR**<br>Equivalent MOOC course | PBO635T |
| 6 | DSE – 3 | **Practical** on<br>Mycology and Plant Pathology – I<br>**OR**<br>Molecular Biology and Plant Biotechnology - I | PBO635P |
| 7 | RP | Research Project | PBO638P |

| S N | Course Category | Name of Course | Course Code | Teaching Scheme (Hrs.) | | | Total Credits |
|---|---|---|---|---|---|---|---|
| | | | | TH | TU | PR | |
| 1 | DSC – 09 | Angiosperm Taxonomy | PBO631T | 4 | - | - | 4 |
| 2 | DSC – 10 | Plant Ecology | PBO632T | 4 | - | - | 4 |
| 3 | DSC – 11 | Plant Development and Reproduction | PBO633T | 4 | - | - | 4 |
| 4 | DSC – 12 | Practical on Angiosperm Taxonomy, Plant Ecology, Plant Development and Reproduction | PBO634P | - | - | 2 | 2 |
| | DSE – 3 | Mycology and Plant Pathology – I<br>**OR**<br>Molecular Biology and Plant Biotechnology - I<br>**OR**<br>Equivalent MOOC course | PBO635T | 2 | - | - | 2 |
| 6 | DSE – 3 | Practical on Mycology and Plant Pathology – I<br>**OR**<br>Molecular Biology and Plant Biotechnology - I | PBO635P | - | - | 2 | 2 |
| 4 | RP | Research Project/ Dissertation (Core) | PBO638P | - | - | 4 | 4 |
| **Total** | | | | **14** | - | **8** | **22** |

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| **Master of Science (Botany)** | **Semester III - DSC – 09** |
| **Course Code** | **PBO631T** |
| **Course Name** | **Angiosperm Taxonomy** |
| **Course Credit** | **04** |
| **Course Working hours** | **60 hrs.** |
| **Course Structure** | **Theory and Practicals** |

Course objectives: This course aims to prepare the students to the advanced concepts and principles of taxonomy, phylogeny and evolution of angiosperm, important families of flowering plants, their classification and their current status as per angiosperm phylogeny.

Course Learning Outcomes:
CO1: Students will be able to understand salient features of various plant families, evolutionary inference of various morphological characters.
CO2: Students will describe outline of recent classification system and their significance and limitations.
CO3: Students will understand biodiversity assessment and importance of local plant diversity.

**Course Content**:

| **Module I:** | **Basal Angiosperms** |
|---|---|

**1.1 Concept of Evolution and Phylogeny-** Terms, Euanthial and pseduoanthial theory, herbaceous origin hypothesis, monophyletic and polyphyletic origin, origin of monocots
**1.2 Bentham and Hooker's vs. Angiosperm Phylogeny Groups (APG) system of classification-** distinguishing characters, similarities and differences.
**1.3 Outline of APG I to IV (2016)-** key features of APG-I (first) and APG -IV (2016), limitations of APG classification
**1.4 Details (vegetative characters, floral features, and affinities) on following clades (selected representative families of groups): Basal groups: ANA Grade** (Amborellales - Amborellaceae, Nymphaeales - Nymphaeaceae, Austrobaileyales – Illiciaceae)

| **Module II:** | **Core Angiosperms I** |
|---|---|

**2.1 Details (vegetative characters, floral features, and affinities) on** following clades (selected representative families of groups): Magnoliids - Magnoliaceae
**2.2 Monocots:** Commelinids (Poales - Poaceae/ Commelinales - Commelinaceae), Liliales - Liliaceae, Dioscoreales – Dioscoreaceae, Asparagales – Asparagaceae, Orchidaceae.
**2.3 Ceratophyllales** (Ceratophyllaceae)

| **Module III:** | **Core Angiosperms II** |
|---|---|

**3.1 Details on following clades (selected representative families of groups):**
Eudicots: Superrosids (Fabids - Fabaceae and Malvids - Malvaceae), Dilleniales (Dilleniaceae), Superasterids (Campanulids – Asteraceae; Lamiids – Lamiaceae, Solanaceae).
**3.2** taxonomic keys: types, guidelines of dichotomous keys and its importance in plant taxonomy

| **Module IV:** | **Botanical Nomenclature and Tools** |
|---|---|

**4.1 Botanical names:** Valid & invalid, legitimate & illegitimate, autonym, homonym, synonym, basionym, tautonym, ambiguous name, superfluous name, conserved name.
**4.2** Describing a new taxon with effective and valid publication in taxonomy, Citation of names of author(s) as per IPNI.
**4.3** Systematic Tools: Morphology, macro and micro-morphology, anatomy, embryology, palynology, cytology, phyto-chemistry.

**Practicals:**

**Practicals based on Angiosperm taxonomy:**

1. Description of specimens from representative, locally available families.
2. Description of various species of a genus, location of key characters and preparation of keys at generic level.
3. Location of key characters and use of keys at family level.
4. Field trips within and around the campus; compilation of field notes and preparation herbarium sheets of such plants, wild or cultivated as are abundant.
5. Training in using floras and herbaria for identification of specimens described in the class.
6. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

**Practicals based on taxonomy and phylogeny:**

7. Identification of key characters of various clades/ orders/ families/ genera and construction of dendrograms using these characters
8. Use of GBIF, IPNI, TROPICOS, and NCBI database for taxonomy.
9. Identification and retrieval of selected molecular markers and their utilization in molecular taxonomy
10. Construction of phylogenetic trees using various algorithms based on selected molecular markers
11. Comparison of morphology vs. molecular phylogenetic tree

**Suggested Readings**


Singh, G. (2012). Plant Systematics: Theory and Practice, 3rd edition. Oxford and IBH Pvt. Ltd. New Delhi

Simpson, Michael G., 1953-. Plant Systematics. 2nd ed. 1 online resource (754 pages) vols. Burlington, MA: Academic Press [an Imprint of Elsevier], 2010. http://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=802535.

Bhattacharya, B. ( 2005). A Textbook of Systematic Botany. Narosa Publishing House Pvt. Ltd, Delhi.

Cronquist, A. (1968). A Textbook of the Evolution and Classification of Flowering Plants. Thomos Nelson and Sons Ltd, Britain.

Daniel,M.(2009). Textbook of Taxonomy evolution at work. Narosa Publishing House Pvt. Ltd, Delhi.

Hartmann and Kester's. (2001). Plant Propagation Principal and Practices. Prentice Hall of India Private Limited, New Delhi.

Kochar,S.L. (2009). Economic Botany. Macmillan Publisher Pvt. Ltd. New Delhi, India.

Mascarenhas A.F. (1993). Test tube forests. Publications & Information Directorate (CSIR),New Delhi.

Mondal,A.K.(2014). A Textbook of Advance Plant Taxonomy. New Central Book Agency,Pvt,Ltd. Howrah.

Nair, R. (2010). Taxonomy Of Angiosperms. A.P.H. Publishing Corporation, New Delhi.

Nanda K.K. (1985). Vegetative propagation of plants. Kalyani Publishers,New Delhi

Pandey, S.N & Misra, S.P.(2014). Taxonomy of Angiosperms. Ane Book Pvt Ltd. New Delhi.

Pandey,B.P.(2015). A Textbook of Botany Angiosperms. Nirja Publishers & Printers Pvt:Ltd & S. Chand & Company Pvt: Ltd., Ramnagar, New Delhi.

Pradhan, A. ( 2013). Monocot Weeds. Salasar Imaging System, Delhi.

Randhawa & Mukhopadhyay. (2015). A Textbook Of Floriculture In India. Allied Publisher Private Limited, New Delhi.

Saxsena & Saxena.(2014). Textbook of Plant Taxonomy. Pragati Prakashan Educational Publishers, Meerut.

Sharma, O.P. (2009). Plant Taxonomy. McGraw-Hill Education (India) Private Limited,Tamilnadu, India.

Singh, Pande & Jain. (2011). A Textbook of Botany Angiosperms. Rastogi Publications, Meerut, India.


**Suggested URLs/Websites:**

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=4
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14

• http://www.surendranathcollege.org/new/upload/KOUSIK_GHOSH2020-04-05APG%20III%20Classification%20COMPILED.pdf
• http://francescofiume.altervista.org/taxa/APG.pdf
• http://www.mobot.org/MOBOT/Research/APweb/welcome.html

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| **Master of Science (Botany)** | **Semester III - DSC – 10** |
| **Course Code** | **PBO632T** |
| **Course Name** | **Plant Ecology** |
| **Course Credit** | **04** |
| **Course Working hours** | **60 hrs** |
| **Course Structure** | **Theory and Practicals** |

**Course objectives**: The main objective of the course is to introduce the students to the concepts and principles of community ecology, conservation and applications of these concepts to solve ecological challenges.

**Course Learning Outcomes**:

**CO1**: Students will be able to describe and compose concept of community, ecological niche andinterspecific interactions of plant as individuals and as community.
**CO2**: Students will perceive mechanisms of factors controlling primary production and litter fall decomposition. Students will prepare and assess ecological impact assessment and ecology of plant invasion.
**CO3**: Students will explain importance of botanical garden, seed banks in conservation of plants and understand structures of sanctuaries, biosphere reserves and other types of protected areas.
**CO4**: Students will be able to know the current status of biodiversity and its conservation
**CO5**: Students will aware regarding different agencies working in ecology conservation

**Course Content**:

| **Module I** | **Community Ecology** |
|---|---|

**1.1 Vegetation organization:** Concepts of community and continuum, analysis of communities (analytical and synthetic characters): interspecific associations, concept of ecological niche.
**1.2 Vegetation development:** Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristic and initial floristic composition; facilitation, tolerance and inhibition models).
**1.3 Community function**- Dynamics and succession, laboratory model, trends in succession, climaxconcept, General introduction to autecology.

| **Module II** | **Ecosystem ecology** |
|---|---|

**2.1 Ecosystem organization**: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); Nutrient budget in forest and aquatic ecosystem.
**2.2 Ecosystem stability:** Concept (resistance and resilience); Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration; Ecological management: Concepts; sustainable development; sustainability indicators.

| **Module III** | **Ecosystem Conservation** |
|---|---|

**3.1 Strategies for ecosystem conservation: *In-situ* :** Sanctuaries, National parks, Biosphere

reserves; Wetlands and Mangroves, Coral reefs . ***Ex-situ* :** Botanical gardens, Field gene bank, Seed Banks, *In-vitro* repositories, Cryobanks.

**3.2 Conservation efforts** : General account on activities of Botanical survey of India (BSI), National Bureau of Plant Genetics Resources (NBPGR), in conservation efforts. National Herbaria, Selection criteria for protection of habitats, Conservation indices, Indigenous and Community Conserved Areas (CCAs, ICCAs): key benefits and limitations of CCAs for conservation.

| **Module IV** | **Biodiversity** |
|---|---|

**4.1 IUCN**: General account, categories, distribution, Commissions, role in conservation and global pattern of biodiversity. Levels of Biodiversity and their importance

4.**2 Biological diversity concept and levels**, role of biodiversity in ecosystem functions and stability, Endemism, hotspots and hottest hotspots, invasions and introductions, Local plant diversities and its socioeconomic importance. Biodiversity act in India (2002).

**Practicals :**

1. A trip to the grass land/ forest/ water body to get acquainted with their plant species.
2. To study the distribution pattern of different plant species determined by Centered Quarter methods.
3. To determine minimum size and number of quadrats required to study grassland.
4. Qualitative parameters of distribution of plant species, Frequency, Density, Dominance, Abundance and IVI in woodland area.
5. To determine diversity indices (Shanon-Weiner, species richness, B-diversity) from given data.
6. To determine gross and net phytoplankton productivity by light and dark bottle method.
7. To estimate chlorophyll content in $SO_2$ fumigated and unfumigated leaves.
8. To study ecological adaptations of the given plants
9. To document the plants of botanical garden and identify their conservation status.
10. Field visit to field seed bank/ seed bank/ BSI/ NBPGR and prepare seed bank of any plant species.

## Suggested Readings


1. Drummond J.M.F. (1990). Ecology and plant diversities. Agro Botanical Publishers (India),Bikaner
2. Leach William. (1963). Plant ecology. Methuen & Co. Ltd.,London.
3. Singh, J.S., Singh, S.P. & Gupta , S.R. (2014). Ecology, Environment Science & Conservation. S. Chand & Company pvt. Ltd. New Delhi.
4. Shukla, R.S. & Chandel, P.S. (2004).A textbook of Plant Ecology. S. Chand & Company pvt. Ltd. New Delhi.
5. Hussain Iqbal. (2008). Textbook of Plant Ecology. Oxford Book Company. Jaipur. Publishing House.Delhi.
6. Subrahmanyam,N.S. & Sambamurty, A. (2006). 2nd Edt. Ecology. Narosa Publishing House, Kolkata.
7. Bawa K.S. & Primack, R.B. (2004).Conservation Biology – A primer for South Asia. Meera Anna Oammen,Universities Pvt. Ltd.Hyderabad.
8. Joshi, P.C. & Joshi, N.P.(2005).A textbook of ecology & environment. Himalaya Publishing House, Mumbai.
9. Arora, M.P. (2004). Ecology. Himalaya Publishing House, Mumbai.


**Suggested URLs/Websites:**

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=4
https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2816487/
http://nopr.niscair.res.in/bitstream/123456789/8116/1/NPR%204%284%29%20306-314.pdf
http://admin.indiaenvironmentportal.org.in/reports-documents/protection-development-maintenance-and-research-biosphere-reserves-india

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| **Master of Science (Botany)** | **Semester III - DSC -11** |
| **Course Code** | **PBO633T** |
| **Course Name** | **Plant Development and Reproduction** |
| **Course Credit** | **4** |
| **Course Working Hours** | **60 hrs** |
| **Course structure** | **Theory and Practical** |

**Course objectives**: This course aims to prepare the students acquainted with a fundamental understanding of mechanisms associated with plant growth and development and differentiation of various plant organs. The course aims to distinguish anatomical and reproductive changes in flowering plants.

**Course Learning Outcomes**:

**CO1**: Students will be able to describe seedling growth and shoot development. Students will understand the differences between leaf and root development.

**CO2**: Students will compare and describe male and female gametophyte developments. Students willexplain the molecular mechanism of flower development.

**CO3**: Students will compare embryo development and illustrate embryogenesis, pistil, seeddevelopment and interpret changes associated with senescence.

**CO4**: Students will able to describe seed development and interpret changes associated with senescence.

**Course Content**:

| **Module I** | **Plant Development** |
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**1.1 Plant growth kinetics:** Types of plant growth: primary and secondary**,** Phase of growth, Growth Curve

**1.2 Seedling growth:** Tropisms; Photomorphogenesis of seedling; Hormonal control of seedling growth & control.

**1.3 Shoot Development:** Organization of shoot apical meristem (SAM); Cytological and molecularanalysis of SAM; regulation of cell fate in meristem; tissue differentiation in the shoot.

**1.4 Phytohormones:** Classification, chemical nature and their role in plant development

| **Module II** | **Organ Development and reproduction** |
|---|---|

**2.1 Leaf growth and differentiation:** Leaf Initiation, proximal-distal axis, adaxial-abaxial axis, Medio-lateral axis, Determination control of leaf form: leaf margin, Differentiation of epidermis (with special reference to stomata & trichomes) and mesophyll.

**2.2 Root Development:** Organization of root apical meristem (RAM); vascular tissue differentiation; lateral root hairs; root microbe interactions.

**2.3 Flower Development:** Physiology of flowering, florigen concept and photoperiodism, Genetics of floral organ differentiation; homeotic mutants in *Arabidopsis* and *Antirrhinum*.

**2.4 Pollination mechanisms** and vectors. Types of pollination, dispersal agencies.

| **Module III** | **Reproduction-I** |
|---|---|

**3.1 Male Gametophyte:** Structure of anther, microsporogenesis, tapetum; pollen development and gene expression; male sterility; sperm dimorphism; pollen germination; pollen tube growth and guidance.
**3.2 Female Gametophyte:** Ovule types; megasporogenesis; organization of embryo sac; types of embryosacs, the structure of polygonum embryo sac cells.
**3.3 Pollen-pistil interaction**, self-incompatibility and fertilization; Structure of the pistil; pollen-stigma interactions, double fertilization; *in vitro* fertilization. Structure of Seed

| **Module IV** | **Reproduction-II** |
|---|---|

**4.1 Seed Development and fruit growth**; Endosperm development; embryogenesis; ultrastructure and nuclear cytology; storage proteins of endosperm and embryo; Polyembryony; Apomixis; embryo.
**4.2 Fruit development-** Phases of fruit development
**4.3 Latent life**: Dormancy; Importance and types of dormancy; seed dormancy; overcoming seed dormancy; breaking of seed dormancy, and bud dormancy.
**4.4 Senescence and Programmed Cell Death (PCD):** Basic concepts; types of cell death, PCD in life cycle of plants; metabolic changes associated with senescence and its regulations; influence of hormonesand environmental factors on senescence.

**Practicals :**Any 16

1.Tissue systems, meristem, vascular and cork cambium.
2.Study of cytohistological zonation in the shoot apical meristem (SAM) in sections and double- stained permanent slides of a suitable plant such as Coleus, Kalanchoe, and Tobacco.
3.Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
4.Microscopic examination of sections of leaves such as Cleome, Nerium, Maize and Wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C3 and C4 leaf anatomy of plants.
5.Study of epidermal peels of leaves such as *Coccinia, Gaillardia, Tradescantia, Thunbergia*, etc. to study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.
6.Study of microsporogenesis and gametogenesis in sections of anthers.14. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, Crotalaria, Tradescantia, Brassica, Petunia, Solanum melongena, etc.)
7.Tests for pollen viability using stains and *in vitro* germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
8.Estimating percentage and average pollen tube length in vitro.
9.Field study of several types of flower with different pollination mechanisms (wind pollination, thrips

pollination, bee/butterfly pollination, bird pollination).

10.Study of nuclear and cellular endosperm through dissections and staining.

11.Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun (Syzygium cumini) etc. by dissections.

12.Study of seed dormancy and methods to break dormancy.

**Suggested Readings:**

1. Berg, L.(2009). A Textbook of Botany: Cengage Learning India Pvt Ltd.

2. Jacobs, W.P. ( 1979). Plant Hormones and Plant Development: Cambridge university, London.

3. Lack., A.J. & Evans, D.E. (2015). Plant Biology: Viva Book Private Ltd, New Delhi.

4. Leopolo., C.&Emam, K.(1975). Plant Growth and Development: Tata McGraw Hill Publishing Company,Delhi.

5. Maheshwari, P. (2012). The Embryology of Angiosperm: Tata McGraw Hill Publishing House, Private, Limited, Delhi.

6. Mishra, S. (2011). Plant Hormones: Discovery Publishing house Pvt Limited, New Delhi.

7. Regland, A. &Armugam, N.( 2014). Plant Function: Saras Publication, Nagarcoil.

8. Pandey&Chadha (2004). Plant Anatomy & Embryology: Vikas Publishing House Private, Ltd.Delhi.

9. Sharma., H.P. ( 2009). Plant Embryology: Narosa Publishing House Private Ltd.Delhi.

10. Vertpoorte R &Alfermann A.W. (2000) Metabolic engineering of Plant Secondary Metabolism. Kluwer AcademicPublisher, Dordrecht, The Netherlands.

11. Buchanan, B.B., Gruissem, W. and Jones, R. L. Biochemistry and Molecular Biology of Plants.

12. Taiz., L. &Zeiger, E. (2018).Fundamentals of Plant Physiology :Sinauer Associates Inc.

13. Haborne, J.B.. (1984). Phytochemical methods.Second Edition, Springer

14. Bhojwani and Bhatnagar. (2014). Embryology of Angiosperm.

**Suggested URLs/Websites:**

https://www.bionity.com/en/encyclopedia/The_ABC_Model_of_Flower_Development.html
https://authors.library.caltech.edu/36184/1/4095.full.pdf
https://www.cell.com/current-biology/pdf/S0960-9822(17)30343-3.pdf
https://www.narajolerajcollege.ac.in/document/sub_page/20210313_082628.pdf

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|---|---|
| **Master of Science (Botany)** | **Semester III - DSE -03** |
| **Course Code** | **PBO635T** |
| **Course Name** | **Mycology and Plant Pathology-I** |
| **Course Credit** | **2** |
| **Course Working Hours** | **30 hrs** |
| **Course structure** | **Theory and Practical** |

**Course objectives:** This course will provide and understanding of students in relation to basic concepts of Mycology and Mycotechniques., This course will aim to distinguish the role of fungi in dermatophytes and medical mycology.

**Course Learning Outcomes:**

**CO1:** Students will be able to describe different variety of fungal diversity in a different ecosystem as well as mycorrhizal diversity and Myco-techniques used in the field of Mycology.

**CO2:** This course consist of basic introduction to medical mycology and Students will be able to understand different types of dermatophytic fungi and gain the knowledge related to biodegradable fungi.

**CO3:** Students will describe and understand industrial and non-industrial fungal metabolites.

**CO4:** Students will be able to describe the role of fungi in food and understand the concept of pathogen control at biochemical and molecular level. Upon completion of this course student shall acquire the practical skill for the cultivation of fungi.

**Course Content:**

| **Module I** | **Mycology and Myco-techniques** |
|---|---|

**1.1 Mycology:** General characters, distribution; Fungal diversity in different ecosystems (Fresh water fungi, Marine fungi, Coprophilous fungi).

**1.2 Rhizosphere and Phyllosphere:** concept and importance; Effect of environment on fungal growth **Kinds of mycorrhizae:** Ectotrophic and endotrophic mycorrhizae, role of mycorrhizae in agriculture.

**1.3 Myco-Techniques:** Methods of Collection, Isolation and Preservation of fungal strains. Molecular techniques in the fungal identifications. Nanoparticle production through fungi

| **Module II** | **Medical mycology and Industrial mycology** |
|---|---|

**2.1 Medical Mycology:** Dermatophytic fungi- common dermatophytes and human diseases caused by *Tinea pedis, Tinea capitis, Tinea barbae, Tinea, corporis and Tinea manuum;* Fungi allergic to human beings and their treatments including Aspergillosis

**2.1 Industrial Fungal Metabolites:** i) Antibiotics -penicillin, Cephalosporin, Griseofulvin.

**2.2 Fungal Enzymes** -. Amylase, proteases, Lipases, Pectinases, Cellulase and xylanases. iii) Organic acids -Critic acid, Gluconic acid, lactic acid.

| **Module III** | **Non-Industrial and Environmental Mycology, Introduction to Plant Pathology** |
|---|---|

**2.3Fungi as welfare to human being and non-industrial fungi:** Fungi in food and feed processing: cheese, fermented milk, and other fermented foods.

**2.4 Environmental Mycology**: Role of fungi in biodeterioration (Wood and Leather) and biodegradation (Cloth, Wood, Heritage, Buildings and others)

**2.5 Introduction to plant pathology**: stages of disease development, Role of defense strategies in the form of enzymes, toxins, phytoalexin, PR proteins, and Elicitors in controlling fungal infection, Systemic acquired resistance, Induced resistance,

| **Practical** | **Practical based on theory paper- Mycology and Plant Pathology** |
|---|---|

1. Principles & working of tools, equipment's and sterilization techniques, other requirements in the Mycology & Plant Pathology laboratory.
2. Preparation of different cultural media for cultivation of Fungi and Bacteria by using Petri dish, Stab and slant for cultivation of fungi
3. Monitoring and analysis of Aero- mycoflora and measure the size of spores and hyphal fragments by using micrometry.
4. Isolation of Soil fungi by soil plate (Warcup, 1950) and serial dilution (Walksman) method.
5. Isolation and preservation of river water fungi.
6. Isolation & identification of Phyllo sphere and Rhizosphere mycoflora.
7. To isolate and identify fungi from infected fruit or vegetable.
8. Isolation and identification of Leaf litter fungi and Coprophilic fungi.
9. Study of wood rotting fungi *(Schizophyllum, Auricularia, Hexagonia*).
10. Isolation of external and internal seed borne mycoflora by blotter and dry seed Agar Plate method (Cereals,pulses, oil seeds, fruit seeds).
11. Estimation of sugars, proteins, amino acids, enzymes in fungal mycelium and culture filtrate.
12. Study of mycorrhiza (VAM)
13. Monographic study of locally available plant diseases caused by fungi,bacteria and viruses.
14. Preparation and presentation of herbarium of pathological specimens available in the region

**Suggested Readings**

1.Aneja, K.R. (2015). Experiments in Microbiology Plant Pathology and Biotechnology. New Age International Publisher, New Delhi.6th Edition.
2.Dubey and Maheshwari. (2016). Practical Microbiology. S. Chand and Company Private Limited, New Delhi.
3.Hait, G. (2016). A Textbook of Mycology. New Central Book Agency, Kolkata.
4.Nair, L.N. (2001). Topics in Mycology and Pathology. New Central Book Agency, Kolkata.
5.Sethi and Walia. (2011). A Textbook of Fungi & Their Allies. Macmillan publishers, New Delhi. India.

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| **Master of Science (Botany)** | **Semester III - DSE -03** |
| **Course Code** | **PBO635T** |
| **Course Name** | **Molecular Biology and Plant Biotechnology-I** |
| **Course Credit** | **2** |
| **Course Working Hours** | **30 hrs** |
| **Course structure** | **Theory and Practical** |

**Course objectives**: This course aims to prepare students with an understanding of principles and techniques of plant tissue culture, recombinant DNA technology concepts and applications and basicsof bioinformatics.

**Course Learning Outcomes**:

**CO1**: Students will be able to explain principles and techniques of plant tissue culture.

**CO2**: Students will elucidate principles, tools and techniques of gene cloning process.

**CO3**: Students will describe and compare various cloning vectors and understand their role in cloning process.

**CO4**: Students will understand basics of bioinformatics.

| **Module I** | **Plant tissue culture and rDNA technology** | **15 hrs** |
|---|---|---|

1.1 Basic concept of cellular differentiation (dedifferentiation, undifferentiation, and redifferentiation), totipotency, Application of plant cell and tissue culture

1.2 Micropropagation- Steps, factors affecting micropropagation, Direct and indirect organogenesis,

1.3 Somatic embryogenesis, factors affecting somatic embryogenesis, applications of SE, Synthetic seeds and preparation of synthetic seeds, Application of synthetic seeds

1.4 Tools of rDNA technology: DNA manipulation enzymes- nucleases, polymerases, ligases, kinases

1.5 Molecular probing- oligonucleotide probes, nucleic acid hybridization (Southern, Northern), Recombinant DNA libraries (gDNA and cDNA)

| **Module II** | **rDNA technology** |
|---|---|

2.1 Antibodies as probe for protein detection (Western blotting), Polymerase Chain reaction-working principle, technique and PCR modifications, Applications of PCR in plant molecular biology

2.2 Vectors for prokaryotes and eukaryotes, ligation process, plasmids, cosmids, bacteriophages, Insertion and replacement vectors.

2.3 Introduction of foreign DNA into host cell- Transformation, transfection, Methods for selection and screening of recombinant transformants

| **Module III** | **Bioinformatics** |
|---|---|

3.1 Sequence analysis- concept and tools, similarity searches: BLAST, FASTA, scoring matrices: PAM,

3.2 pairwise sequence analysis: Needleman and Wunch, pairwise and multiple sequence alignment (dotmatrix method), local and global sequence alignment

3.3 Phylogenetic trees: Concept, types of trees, algorithm types- UPGMA, NJ

| **Practical topics** | **Molecular Biology & PlantBiotechnology** |
|---|---|

**Group A**

1. To design PCR primers to isolate the given gene for cloning it in the given vector.
2. To isolate plant genomic DNA amplify the specific regions of nrDNA by PCR
3. To find the sequences of a given protein in the protein database

4. To work out the sequence from given autoradiogram and to identify it from GeneBank by BLAST method.
5. To download the DNA sequences and protein sequences from databases and generate pairwise and multiple sequence alignment.
6. To generate phylogenetic tree using given DNA and protein sequences.
7. To predict a protein from given sequence by using online tools from NCBI.

**Group B**

8.To demonstrate bacterial transformation and selection of transformed cells
9.To demonstrate organogenesis using appropriate explants.
10.To demonstrate somatic embryogenesis using appropriate explants and prepare artificial seeds.
11.To demonstrate preparation of synthetic seeds
12.To demonstrate the anther culture.
13.To initiate micropropagation protocol of suitable plant species.

**Suggested Readings**

Bacevanii, A.D. & Francis Ouellette, B.F. (2006). Bioinformatics – A practical guide to the analysis of genes and proteins. Wiley India Pvt. Ltd., New Delhi.
Ghosh, Z. & Mallick, B. (2008). Bioinformatics- Principle Applications. Oxford University Press. London.
Zesk. A.M. (2008). Introduction o Bioinformatics. Oxford University Press. London.
Tandon, P. Advances in Plant tissue culture in India. Pragati Prakashan, Meerut.Co. pvt. Ltd. New Delhi.
Kumar, B. & Gautam, S. (2014). Plant tissue culture. Sonali Publication, New Delhi.
Razdan, M.K. (2016). Introduction to Plant tissue culture. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.
Klug, W., Cummings, M., Spenger, C.A. & Palladino, M.A.(2016). Concepts of Genetics. Pearson Education Service Pvt. Ltd. Chennai.
Aneja, K.R. (2003). Experiments in Microbiology, Plant Pathology & Biotechnology. New Age International Publisher, New Delhi.
Krebs, J.E., Goldstein, E.S. & Kilpatrick, S.T. (2011) Lewin's Gene X.10th edt. Jones and Bartlett Publishers, Canada.
Rastogi, S. & Pahak, N. (2016). Genetic Engineering. 7th Edt. Oxford University Press. New Delhi Das, H.K. (2010).A text book of Biotechnology. 4th Edt. Wiley India Pvt. Ltd., New Delhi.
Kar, D. & Halder, S. (2011). Cell biology, Genetics & Molecular biology. New Central Book Agency (P)ltd. London.

**Suggested URLs/Websites:**

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=3
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=4

| | |
|---|---|
| **Master of Science (Botany)** | **Semester III - RP** |
| **Course Code** | **PBO638P** |
| **Course Name** | **Research Project in Botany** |
| **Course Credit** | **4** |
| **Course Working Hours** | **120 hrs** |
| **Course structure** | **Practical** |

**Course Structure Project based or research based**

**Course Description:**

The research project in Botany course provides MSc Botany students with a unique opportunity to immerse themselves in real-world research and data collection experiences. Over a period of eight to ten weeks, students will have the chance to conduct research project in various settings, locally to address specific research questions related to the field of botany. This course is designed to complement the theoretical knowledge acquired during present and past courses and enable students to gather primary and/or secondary data that cannot be accessed through desk research alone.

**Course Learning Objectives:**

CO1: To develop practical research skills in the field of botany.
CO2: To design and implement a research project relevant to botany.
CO4: To gain hands-on experience in data collection techniques specific to botany.
CO4: To analyze and interpret field-collected data to address research questions.

**Course Learning Outcomes:**

Upon successful completion of the research project in Botany course, students will be able to:
CO1: Design a research project with a clear research question related to botany.
CO2: Demonstrate proficiency in various data collection methods, including plant observation, specimen collection, and environmental data recording.
CO3: Conduct semi-structured interviews and surveys to gather relevant information for botanical research.
CO4: Analyze and interpret field data to draw meaningful conclusions and prepare comprehensive research project reports and presentations.
CO5: Collaborate effectively in research project teams and adapt to diverse cultural and environmental contexts during research project.

**Course Content:**

**The course will cover the following key topics and activities:**
**Week 1-2: Introduction to research project in Botany**
Overview of course objectives and expectations
Selection of research topics and formulation of research questions
Ethical considerations in research project
Preparing a research project plan and proposal (two-page)
**Week 3-4: Data Collection Techniques**
Plant identification and specimen collection
Environmental data collection (e.g., soil analysis, climate data)
Introduction to equipment and tools used in botany research project
**Week 5-6: Research in Local Settings**

Conducting research project in local locations (e.g., local parks, villages, agricultural farms, forests, and Industrial area, Experimental work, Plant collections)
Implementing structured surveys and interviews
Data recording and management

**Week 7-8: Literature search and primary work**

Planning and executing research project (subject to safety recommendations)
Engaging with diverse communities wherever necessary. Students will be advised on suitable locations and conditions for their research project projects.

**Week 9-10: Literature writing and primary work -part of thesis writing and presentation of project based on introduction, literature search, review writing and method preparation.**

**Assessment: Rough draft of project and presentation**

Suggested Readings:

•Tomović, G., Mitrović, V., & Stevanovic, B. (2002). Methods of field studies in botany. Genetika,34. https://doi.org/10.2298/GENSR0203085T
•Narayana P S , Varalakshmi D and Pullaiah T (2021) Research Methodology in Plant Science, Scientific Publishers, India.