Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Course Structure for M. Sc. II (Botany)

SYLLABUS (CBCS) FOR M. Sc. Botany II (w. e. f. June, 2020)

Academic Year 2020-2021

Sem	Paper Code	Title of Paper	No. of Credits
III	BOT5301	Angiosperms and Evolution	4
	BOT5302	Developmental Botany	4
	BOT5303	Computational Botany	4
	BOT5304 A BOT 5304 B BOT 5304 C BOT 5304 D	Advanced in Plant Physiology OR Advanced Mycology and Plant Pathology OR Bryology OR Angiosperm taxonomy	4
	BOT5305	Practical's Based on BOT 5301,5302 and 5303	4
	BOT5306.A BOT5306.B BOT5306.C BOT5306.D	Practical's based on special paper Advanced Plant Physiology OR Practical's based on special paper Advanced Mycology and Plant Pathology OR Practical's based on special paper Bryology OR Practical's based on special paper Angiosperm Taxonomy	4
	CC-23	Certificate Course – II	2
	SD-23	Skill Development – I	2
IV	BOT5401	Plant Pathology	4
	BOT5402	Industrial Botany	4
	BOT5403	Plant Biotechnology	4
	BOT5404 (A) BOT 5404 (B)	Advanced Plant Physiology OR Advances in Mycology and Plant Pathology OR	4

	BOT5404 (C) BOT5404(D)	Bryology OR Angiosperm taxonomy	
	BOT5405	Practical's Based on 5401, 5402 and 5403	4
	BOT5406	Research Projects, Review of Literature and Summer Training	4
	SD-24	Skill Development – II	2
		Total Credits	55

Class : M.Sc. II (Semester- III)
Paper Code : BOT 5301
Paper : I Title of Paper: Angiosperms and Evolution
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To create awareness and inculcate knowledge of morphological and taxonomical awareness of local flora.
2. To give idea of economic importance of angiosperms and evolution.

B) Learning Outcome:

1. Expert in angiosperms to conserve angiosperm diversity.

TOPICS / CONTENTS:

Credit I - Systematics and Classification of Angiosperms (15L)

1. Systematics: A key science, importance, relevance to conservation, taxonomic structure -taxonomic hierarchy, the species concept, categories and ranks, alpha and omega taxonomy, taxonomy as synthetic discipline. **5L**
2. International Code of Botanical Nomenclature: Salient features-principles, important rules and recommendations, provisions for the governance of the code, appendices **3L**

3. Systems of Angiosperm classification: Brief history of pre-Darwinian and post-Darwinian classification systems (any four), phenetic versus phylogenetic systems, cladestics in taxonomy, angiosperm phylogeny group (APG). **4L**
4. Recent Systems of Classifications: By Armen L.Takhtajan, Authur Cronquist, R. M. T. Dahlgren and Robert F. Thorne. **3L**

Credit II -Taxonomic Aspects of Angiosperms (15L)

1. Morphological variations, systematic position, interrelationship, phylogeny and economic importance of following families: Magnoliaceae, Lauraceae, Piperaceae, Aristolochiaceae, Nymphaeaceae, Moraceae, Urticaeae, Casuarinaceae, Alismataceae, Hydrocharitaceae, Najadaceae, and Aponogetonaceae, Bignoniaceae, Passifloraceae, Aracaceae, Eichhorniaceae, Typhaceae, Amaranthacaeae **10L**

2. Phytogeography: Phytogeographic regions of India, endemism, hotspots and hottest hotspots. Endemism in Western Ghats, plant explorations, invasions and introductions. **5L**

Credit III: Evolution = (15 Lectures)

1. Emergence of evolutionary thought: Steps and preview of evolution, Lamarkism, Darwinism- Concepts of variation, adaption, struggle for fitness and natural selection; Nerdarwinism, Spontaneity of mutations, The evolutionary synthesis, Fossils- Formation, Nature, Types, Geological time scale **3L**
2. Origin of cells and unicellular evolution: Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, Concepts of Opairn and Halden, Experiment of Miller (1953), The first cell, evolution of prokaryote, origin of eukaryotic cells, evolution of unicellular eukaryotes, anaerobic metabolism, photosynthesis and aerobic metabolism, RNA world theory **4L**
3. Molecular Evolution: Concepts of natural evolution, molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence

analysis, origin of new genes and proteins, gene duplication and divergence **4L**

4. The mechanism of evolution: Population genetics- populations gene pool, gene frequency, Hardy-Weinberg law, Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modification, isolation mechanism, speciation, allopatric and sympatricality, parapetric, convergent evolution, sexual selection, co-evolution **4L**

Credit IV : Modern techniques in angiosperm taxonomy 15 L

1.Anatomy in relation to taxonomy: Wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding the interrelationships, evolution of angiosperms and solving taxonomic problems. **3L**

2. **Palynotaxonomy**: Pollen morphology-Polarity, symmetry, NPC of pollen, exine stratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomic importance. **3L**

3.**Chemotaxonomy**, classes of compounds and their biological significance, stages in chemotaxonomic investigations. Techniques-Criteria for use of chemical in plant taxonomy; Proteins and taxonomy- seed proteins, techniques of protein electrophoresis, analysis of A. A. sequence and its significance in systematics. Serology and taxonomy-history, precipitation reaction, techniques, antigen, antisera, antibody, application of serological data in systematics. **6L**

4. **Ultrastructural Systematics**: SEM and TEM studies and plant systematics; SEM and plant surface structure, TEM and dilated cisterneae of endoplasmic reticulum and sieve element, plastids, applications of data in the classification of higher taxa. **3L**

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1. Blatter E and W.S Millard. 1929. Some Beautiful Indian Trees J.Bom. Nat Hist Soc.
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23. Stuessy T. F. 2002. Plant taxonomy. The systematic Evaluation of comparative data. Biseu Sigh Mahendra Pal Sign Pehra Duk.
24. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology,
25. Evolution, Ecology. S. Chand and Company, New Delhi.
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27. Cooper G.M and Hausman R.E. (2007) (4th Edn). The Cell molecular approach
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Class : M.Sc. II (Semester- III)
Paper Code : BOT 5302
Paper : II Title of Paper: Developmental Botany
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To study structure of plant development process.
2. To pertain knowledge of different embryological techniques.

B) Learning Outcome:

The main outcome of this course is to acquaint students with some anatomical techniques.

TOPICS/CONTENTS:

Credit I- Process of Plant Development (15L)

1. Plant development- concept, definitions and unique features. **1L**

2. Processes of development, cell growth, division and differentiation, competence, determination, commitment, specification, differentiation, redifferentiation and dedifferentiation. Polarity and symmetry, integration, organization of cells, tissues and tissue system to whole plant. Cell-cell interaction **6L**

3. Factors affecting for development- intrinsic and extrinsic **2L**

4. Vegetative development – structure and organization of seed embryo **1L**

5. Seed germination – Embryonal axis- meristems, establishment of seedling organ **1L**

6. Phenomenon of development, meristems as dynamic centers of cell regeneration, organ development, primordium to organ, juvenility – characteristics, transition to adult phase. Coordinated development **4L**

Credit II -Embryological Aspects of Development (15L)

1. Transition - vegetative to reproductive phase, morphological and histochemical changes in vegetative plant body **2L**

2. Gametophyte development, stamen and microsporogenesis, male gametophyte or male germ unit development, carpel and megasporogenesis, female gametophyte or female germ unit formation **4L**

3. Fertilization – Pollen tube growth and its path, its entry into embryo sac, gametic fusion, significance of double fertilization, abnormalities in fertilization **3L**

4. Embryo development - Development of embryo in dicots and monocot, unclassified or abnormal embryos, unorganized or reduced embryo **3L**

5. Polyembryony, apomictic phenomenon Polyembryony – concept and classification of polyembryony, special cases and causes of polyembryony, apomixis- concept, categories- agamospermy and vegetative reproduction apospory, parthenogenesis **3L**

Credit III -Physiology and Molecular Basis of Plant Development (15L)

1. Physiology of plant development – totipotency, light mediated development, hormonal control in development, light and hormonal signaling, cell lineages, cell fate mapping, positional informational techniques for studying development, specific gene expression . **6L**

2. Case study of organ culture, anther, pollen and protoplast culture and its role in understanding plant development **3L**

1. Molecular basis of plant development - Embryogenesis and seedling development, root, shoot and leaf development, gene expression during transition to flowering and flower development molecular genetics of gametophytes development, expression of cell incompatibility. **6L**

Credit IV - Economic Botany (15L)

Source, method of cultivation and economic uses of

1. Cereals- rice, wheat, maize, barley, oat

2**.** Millets – sorghum, pear millet, finger millet **2L**

3. Legumes and nuts- gram, pigeon pea, soybean, garden pea, black gram, moth bean, cowpea, peanut, almonds, green almonds, cashewnut, walnut **2L**

4. Vegetables- sweet potato, beet, carrot, radish, turnip, potato, brinjal, onion, garlic, cabbage, cauliflower, tomato, jack fruit, cucurbits, bitter gourd **1L**

5. Fruits- mango, citrus, grapes, banana, guava, papaya, anjeer, pineapple, date, apple, pear, plum, peach, strawberry **2L**

6. Plant fibres- cotton, flax, sun-hemp, coir **1L**

7. Wood and Cork – babul, mulberry, willow, deodar, pinewood, red sandalwood,teak, salwood, veneers, plywood cork **2L**

8. Rubber and its products **1L**

9. Fatty oils- linseed oil, safflower oil, soybean oil, sunflower oil, sarson oil, castor oil, peanut oil **1L**

10. Essential oils- camphor oil, eucalyptus oil, jasmine oil, lavender oil, clove oil, rose oil, turpentine oil **1L**

11. (a)Sugar industry and its byproducts **2L**

(b)Spices- *Asafoetida*, turmeric, ginger, cinnamon, saffron, cardamom, nutmeg

Tea and coffee industry

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2. Bhojwani and Bhatnagar. Embryology of Angiospems
3. K Essau. Plant Anatomy
4. Cutter. Plant Anatomy
5. S N Pandy. Plant Anatomy
6. S N Panday. Economic Botany
7. V Verma. Economic Botany
8. Bendre. Economic Botany
9. Hill. Economic Botany
10. Razdan. Plant Tissue Culture
11. Vasil. Plant Tissue Culture
12. P K Gupta. Elements of Biotechnology
13. Chawala. Introduction to Plant Biotechnology
14. C B Pawar. Cell Signaling
15. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
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Class : M.Sc. II (Semester- III)

Paper Code : BOT5303

Paper : III **Title of Paper: Computational Botany**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To inculcate knowledge of use of computer for biological data analysis.

2. To give idea of importance of different software's used in bioinformatics.

B) Learning Outcome:

1. Development of student's expertise in biostatistics, bioinformatics and biomathematics

TOPICS / CONTENTS:

Credit I- Basic Biostatistics (15 L)

1. Introduction to Statistics

Population, Sample, variable, Attributes-Concepts **9L**

Measures of central tendency – arithmetic mean, mode of median, mode,

Measures of dispersion range– variation ,combined S. D. BOX plot, standard deviation, coefficient of variance

Skewness and kurtosis

2. Correlation and regression **6L**

Bivariate correlation, positive correlation, negative correlation

Measures of correlation – Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's Rank correlation coefficient,

Regression – Equations of regression lines. Regression coefficient

Credit II- Experimental Statistics (15 L)

1. Design of experiments and analysis of variance **8L**

Sampling and sampling distributions – concept of sample and population.

Principles of design – randomization, replication, local control.

Guidelines for designing the experiments, size of plot, number of replications

Completely randomized design (CDR), Randomized block design (RBD), Latin Square Design (LSD)

Analysis of variance table (ANOVA), One way and Two way ANOVA

Tukey's test for pairwise comparison of treatments

Dunnet's test for comparison of treatment means with control

Duncan's multiple range test

Mann–Whitney U test

2. Testing of hypothesis **7L**

Hypothesis, statistical hypothesis, critical region, level of significance, p-value

T-test: t-test for mean, chi-square test: chi-square test for goodness of fit, F- test

NOTE – Emphasis be given on methodology and numerical problem solving rather than derivations and proofs.

Credit III - Bioinformatics **(15 L)**

Bioinformatics concept, Information resources NCBI (Functions), MGD **1L**

Types of databases (Primary, secondary, composite. flat file relational, hierarchial)**2L**

Sequences used in bioinformatics (genomic DNA, cDNA, organellar DNA, expressed sequence tags (EST). Gene Sequence Tags (GST) **3L**

Statistical analysis and evaluation of BLAST results. **3L**

b. Multiple sequence alignments (Dynamic programming, progressive methods, iterative methods) **3L**

c. Use of Bioinformatics tools in analysis **2L**

d. Protein structure prediction, motifs and domains, designing of primers. **1L**

Credit IV-Biomathematics (15L)

1. Types of measurement and their units **1L**
2. Making solutions – moles and molarity, stock solutions and dilutions **4L**
3. Ions and electrical potentials – Nerst and Goldman equations **1L**
4. Osmolarity and osmotic pressure measurements **1L**
5. Quantification of chemical reactions – equilibrium constant, reaction rates **1L**
6. pH measurements and preparation of buffers **2L**
7. Measuring concentrations using spectrophotometry **1L**
8. Measurement of enzyme activity **2L**
9. Specific activity of radioisotopes, making radioisotope solutions **1L**
10. Cell counting using serial dilutions, haemocytometry **1L**

References :

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3. Statistical methods in Agriculture and Experimental Biology – Mead, R. and Curnow, R.N. Chapman and Hall, 1983

4. Practical statistics and experimental design for plant and crop science – Clewer, A.G. and Scarisbrick, A.H. John Wiley, New York, 2001

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6. Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, New Delhi,2003

7. Bioinformatics and Molecular Evolution – Higgs PG and Attwood, TK

8. Fundamentals of Biostatistics By Irfan Ali Khan & Atiya Khanum, Ukaaz Publication, Hyderabad ISBN : 81-900441-0-9 : 2009.

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Class : M.Sc. II (Semester- III)

Paper Code : BOT 5304 (A)

Paper : IV **Title of Paper: Advanced Plant Physiology**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To train the students in physiological processes.
2. To make technosavy students.

B) Learning Outcome:

Enrich student knowledge with advanced plant physiology.

TOPICS/CONTENTS:

Credit- I Germination **(15L)**

Concept, seed viability and dormancy, methods of breaking seed dormancy, factors affecting on seed germination **7L**

Physiological changes takes place during seed germination, methods of application of fertilizers before seed sowing. **8L**

Credit- II : Plant Growth and Development **(15L)**

- **Growth**, phases, measurement of growth, nature of growth curve and formulae for growth curve, Metabolism and allocation of resource during vegetative and reproductive growth, RGR and NAR. Factors affecting growth. Shoot Root ratio, C/ N ratio. **4L**
- **Plant hormones** – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.
  (Auxins, GA, Cytokinins, ABA, Ethylene, Jasmonic acid, Brassinosteroides) **5L**
- Application of plant growth regulators in Agriculture. **1L**
- Physiology of flowering, circadian Rhythms, photoperiodism, vernalisation, **2L**
- Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. **3L**

Credit- III Senescence and Ageing (15L)

- **Senescence**: Concept, definition, patterns of cellular senescence –cell, tissue, organ, whole plant **7L**
- Physiological and chemical changes takes place during senescence (pigment, protein, photosynthesis, oxidative, nucleic acid), Effect of growth regulators on senescence. Control of plant senescence, PCD (Programmed Cell Death) in life cycle of plants. **8L**

Credit- IV: Biomolecules and Secondary metabolites (15L)

- Composition, structure and function of bimolecular (carbohydrates, lipids, proteins, nucleic acids and vitamins). **7L**
- Secondary metabolites - Biosynthesis of terpenes (IPP), Alkaloid (barberine) and Phenolics (Phenylpropanoid), flavonoides, Lignin. **8L**

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1. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular
2. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant
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Class : M.Sc. II (Semester- III)

Paper Code : BOT 5304 (B)

Paper : IV **Title of Paper: Advanced Mycology and Plant Pathology**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To study fungal habit and habitat diversity.
2. To pertain classification and taxonomy of fungi

B) Learning Outcome:

The main outcome of this course is to develop skilled mycologists and plant pathologist

Credit - I : Fungi as Organism **(15L)**

1. Fungi and their significance (1L)
2. Relationship of fungi with plants and animals (1L)
3. Milestones in mycological and pathological studies (2L)
4. Fungal cell- structure and composition (1L)
5. Physiology of fungal growth (2L)
6. Fungal ecology (1L)
7. Palaeomycology and Ethnomycology (2L)
8. Outline classification of fungi - (2L)
   E. A. Bessey System (1950)
   Alexopoulos System (1962),
   L. E. Hawkers System (1966),
   Alexopoulos and Mims System (1979),
   Webster and Weber System (2007)
9. Molecular method of fungal taxonomy (1L)
10. Fungi as model organism for genetical studies (2L)

Credit - II : Allied Fungi **(15L)**

(With respect to general characters, classification, structure, variation and importance)

1. **Myxomycota** - Acrasiomycetes, Protosteliomycetes, Dictyosteliomycetes, Myxomycetes. (6L)
2. **Plasmodiophoromycota** (2L)
3. **Straminipila** - Hyphochytridiomycota, Labyrinthulomycota and Oomycota (7L)

Credit - III : True Fungi **(15L)**

(With respect to general characters, classification, structural variation and pathological importance, if any)

1. **Chytridiomycota** - Chytridiomycetes (1L)
2. **Zygomycota** - Zygomycetes and Trichomycetes (2L)
3. **Ascomycota** - Archiascomycetes, Hemiascomycetes, Plectomycetes, Pyrenomycetes, Loculoascomycetes (6L)

4. **Basidiomycota** – Hymenomycetes - Agarics and Polypores, Homobasidiomycetes – Gasteromycetes, Heterobasidiomycetes – Auriculariales, Dacrymycetales, Tremellales
5. **Teliomycetes** – Rust and Smut fungi (6L)

Credit - IV : Anamorphic Fungi and Allied Aspects (15L)

1. **Deuteromycota**- Classification, structural variations and importance (4L)
2. **Fungal Association**- Lichens,mycorrhizae (3L)
3. **Fungal ecology**- Colonization strategies among fungi (2L)
4. **Ecological services of fungi**- bioremediation, biohydrometallurgy, microbiological sensors (2L)
5. **Fungi as Human pathogens**- Dermatomycosis (Tinea), intermediate and systemic mycosis, its symptoms, clinical aspects and control measures (4L)

References:

1. Ainsworth et al., 1973. The fungi VI –A, VI – B, Academic press.

2. John Webster and Weber, 2007. Introduction to Fungi, Cambridge.

3. Alexopolous C.J. Minms C.W. and Blackwell M., 1999. Introductory Mycology (4th Edition), Willey, New York.

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12. Vaidya J. G. 1995. Biology of the fungi. Satyajeet Prakashan, Pune.

13. Sharms O. P. 2011. Fungi and allied microbes. Mc Graw Hill Education Private Ltd., New Delhi.

Class : M.Sc. II (Semester- III)

Paper Code : BOT 5304 (C)

Paper : IV **Title of Paper: Bryology**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To understand deep knowledge of season, collection, life-cycle of plants.
2. To study reproductive structures and develop In-situ and Ex-situ conservation techniques.

B) Learning Outcome:

Students will get detail knowledge of bryophytes from different localities.

Credit –I :

1. History, Classification, distribution, habitat, morphology, Taxonomy, anatomy, phylogeny, inter-relationship, origin and evolution and comparative discussions of Gametophytes and sporophytes in living members of Hepaticopsida..... (15 L)

Credit –II :

2. History, Classification, distribution, habitat, morphology, taxonomy, anatomy, phylogeny, inter-relationship, origin and evolution and comparative discussions of gametophytes and sporophytesin living members of Anthoceropsida. ..... (15 L)

Credit –III :

3. History, Classification, distribution, habitat, morphology, Taxonomy, anatomy, phylogeny, inter-relationship, origin and evolution and comparative discussions of Gametophytes and sporophytesin living members of Bryopsida. ..... (15 L)

Credit –IV :

4. Modern taxonomy of bryophytes with reference to epidermal tissue system, palynology and cytology. ..... (15 L)

References:

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Smith, G.M. 1955. Cryptogamic Botany, Vol-IIBryophytes and Pteridophytes. Edi. 2, New York.

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Websites :

Hattori Botanical Laboratory
https://www.google.com/search?q=Hattori+Boanical&rlz=1C1CHWL_enIN909IN909&oq=Hattori+Boanical&aqs=chrome..69i57.13143j0j8&sourceid=chrome&ie=UTF-8

Australian Bryological Research Journal.
https://www.researchgate.net/publication/317644372_AUSTRALASIAN_BRYOLOGICAL_NEWSLETTER_Participants_at_the_Xth_Australasian_Bryophyte

Bulletin of Bryology
https://www.jstor.org/stable/1221137?seq=1

Indian Bryological Society
https://www.google.com/search?q=Indian+Bryological+Society&rlz=1C1CHWL_enIN909IN909&sxsrf=ALeKk023HYYE2mATYEdgv6xi8Yfevl1t-Q:1594468636630&ei=HKkJX7D_Jcvez7sPwOmYqAU&start=10&sa=N&ved=2ahUKEwiw_cPFksXqAhVL73MBHcA0BlUQ8tMDegQICxAt&biw=1366&bih=657

World Bryological Society
https://www.google.com/search?q=Indian+Bryological+Society&rlz=1C1CHWL_enIN909IN909&sxsrf=ALeKk023HYYE2mATYEdgv6xi8Yfevl1t-Q:1594468636630&ei=HKkJX7D_Jcvez7sPwOmYqAU&start=10&sa=N&ved=2ahUKEwiw_cPFksXqAhVL73MBHcA0BlUQ8tMDegQICxAt&biw=1366&bih=657

Class : M.Sc. II (Semester- III)

Paper Code : BOT 5304 (D)

Paper : IV **Title of Paper: Angiosperm Taxonomy**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To study Angiosperm diversity.
2. To pertain classification and taxonomy of Angiosperms

B) Learning Outcome:

The main outcome of this course is to develop skilled taxonomist.

Credit I **(15 lectures)**

Plant taxonomy: Importance of Angiosperm taxonomy and need for classification, definitions and concepts, hierarchical classification, general and special purpose classifications. Principles and practices in taxonomy.

Botanical Nomenclature: history, scientific names, International Code of Nomenclature for Algae, Bryophytes, Angiosperms (ICB): Salient features-Principles, Important Rules and Recommendations, Provisions for the governance of the Code, Appendices, typification catergories, Principle of priority, rank of taxa, effective and valid publication.

Taxonomy tools: Floras, monographs, revisions, Herbarium and botanical gardens, their role in teaching, research and conservation, important herbaria and botanical gardens. (Ex. Kew Botanical garden, AJCB Indian Botanic Garden, Kolkata and LBG, Shivaji Uni.Kolhapur)

Credit II: **(15 lectures)**

Systems of classification: Phenetic and Phylognetic systems. Critical account of the systems of classifications of a) Bentham and Hooker b) Takhtajan c) Engler and Prantl d) Cladestics in taxonomy, General account of Angiosperm phylogeny group (APG)

Taxonomic evidence and techniques used there in a) Morphology b) Micromorphology c) Cytology d)Biochemistry e) Palynology f)Anatomy g)Embryology h) DNA sequence

Modern trends of taxonomy: Morphology, cytotaxonomy, Chemotaxonomy, numerical taxonomy and molecular systematics.

Species concept: Concept of taxa, concept of species- Biological and alternative species concepts; concept of genus and family. Plant Speciation: Allopathic / Sympatric / Apomictic speciation, Isolating mechanisms

Credit III: **(15 lectures)**

Conservation biology: Biodiversity, its importance, assessment, Centers of diversity, loss and conservation, ethical principles of conservation biology, World organization for conservation of biodiversity, Ecological differentiation.

Species diversity: Species Richness, Species abundance. Red List categories of IUCN, means and ways for conservation. In situ and ex situ conservation strategies

Endemism: Concept of endemism, categories, biodiversity of India, mega-centers of endemism in India; Keystone and flagship species, endemic plants of India with special reference to Western Ghats and Maharashtra, sacred grooves and their importance.

Credit IV: **(15 lectures)**

Distinguishing features of the following families:

a) Dicotyledons: Ranunculaceae, Polygalaceae, Rutaceae, Burseraceae, Meliaceae, Rosaceae, Rhizophoraceae, Passifloraceae, Plumbaginaceae, Sapotaceae, Boraginaceae

b) Monocotyledons: Orchidaceae, Burmanniaceae, Araceae, Arecaceae, Cyperaceae.

References:

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- Synge, Hugh (ed.) 1980. **The biological aspects of Rare Plant Conservation**. John Wiley & Sons.
- Takhtajan, A. 1962. **Flowering plants- Origin and Dispersal**.
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- Gurucharan Singh, **Plant Systematics an Integrated Approach**, Fourth Edition, CRC press, Taylor and Francis Group.

Class : M.Sc. II (Semester- III)

Paper Code : BOT 5305

Paper : I, II, III Title of Paper: Practical's Based on BOT 5301, 5302, 5303

Credits : 4 No. of lectures: 60 (15 Practical's)

A) Learning Objectives:

1. To pertain taxonomical, embryological, computational techniques.
2. To provide the knowledge of different local families

B) Learning Outcome:

The learning outcome of this training useful to develop new methods in plant taxonomy and Embryology, Bioinformatics

TOPICS/CONTENTS:

Practical's based on BOT 5301 Angiosperm taxonomy (Any four)

1. Study of plant families (at least 5 locally available families- 3 of Dicotyledons and two of Monocotyledons. **4P**
2. Identification of genus and species of locally available wild plants (any four) **1P**
3. Preparation of vegetative and reproductive botanical keys of any six plants from different Families **1P**
4. Pollen preparations by Acetolysis method (Semi-permanent) and study of different pollen morphotypes. **1P**

Note:

1. Field trips of at least two days for collection and preparation of field notes and its submission.

Practicals based on BOT 5302 Developmental Botany (Any four)

1. Isolation of shoot apical meristems from seedling, young and mature vegetative plant and tracing the course of stomatal development and observations on stomatal types. **1P**
2. Histochemical analysis of secondary growth (primary to secondary axis) and comparison between vegetative SA and reproductively induced SA **1P**
3. Observations on **1P**

a. Microsporogenesis and development of male gametophyte (pollen)
b. Megasporogenesis and development of female gametophyte
c. Types of endosperm, dissection and isolation of endosperm **2P**

4. Observations on stages of embryo development, dissection and isolation of developing embryo (3 stages) and *in vitro* germination of spore/pollen **1P**

Practical's based on BOT 5303 Computational Botany (Any four)

1 t – test and F -test **1P**
2 Correlation and Regression **1P**
3 Chi-square test for goodness of fit and independent attributes. **1P**
4 Analysis of variance on the given data (ANOVA) **1P**
5 Tukey's test for pairwise comparison of treatments **1P**
6 Databases and database searching and DNA and protein sequence comparisons. **1P**
7 Multiple sequence alignments, progressive methods, CLUSTAL **1P**
8 Determining phylogenetic relationships using DNA and protein sequences **1P**

Class : M.Sc. (Semester- III)

Paper Code : BOT 5306 (A)

Paper : IV **Title of Paper: Practical's based on Advanced Plant Physiology**

Credits : 4 **No. of lectures: 60 (15 Practical's)**

A) Learning Objectives:

1. Create hands on training on physiological techniques
2. To give idea of experimental methodologies for crop physiology

B) Learning Outcome:

1. Students will acquire knowledge of plants physiology

Practical's based on BOT 5306.1 Advanced Plant Physiology

1. Testing of seed viability by TTC.	**1P**
2. Estimation of total alkaloids	**1P**
3. Effect of various PGRs on seed germination.	**2P**
4. Effect of various PGRs on seedling growth / enzymes.	**2P**
5. Isolation of starch.	**1P**
6. Extraction and isolation of caffeine from tea powder	**1P**
7. Comparative studies of accumulation of superoxide dismutase in normal and salt Stressed plants.	**2P**
8. Effect of weed extracts on seed germination	**2P**
9. Studies on changes in acidity and TSS during grape/ guava ripening	**1P**
10. Studies on changes in NR activity during leaf senescence	**1P**
11. Estimation of Total flavonoids.	**1P**

Note: Visit to advanced plant physiology laboratory and submission of report

Class : M.Sc. (Semester- III)

Paper Code : BOT 5306 (B)

Paper : III **Title of Paper: Practical's based on Advanced Mycology and Plant Pathology**

Credits : 4 **No. of lectures: 60 (15 Practical's)**

A) Learning Objectives:

1. To study the identification of fungi and preparation of their pure culture.
2. To identify soil, air and water borne fungal pathogens.

B) Learning Outcome:

Knowledge of the fungal pathogens should helpful to management of plant diseases.

Practicals based on BOT 5306 (A) Advanced Mycology

1. Preparation of culture medium for fungi-PDA medium, CDA medium, Sabourard's medium (2P)
2. Isolation of aquatic and soil fungi by baiting method (2P)
3. Isolation of fungi from rhizosphere and non-rhizosphere soil (2P)
4. Isolation of plant pathogenic fungi from root, stem and fruits (2P)
5. Study of seed borne fungi of any six crops (2P)
6. Study of fungal disease- (any one from each) rots, Downy mildew, wart, ergot, white rust, Anthracnose, rust, smut, leaf spot w.r.t. symptoms, causal organism and control measures (3P)
7. Study of fungi from the following groups – (10P)
   - Myxomycetes- any four
   - Chytridiomycetes- any two
   - Oomycetes- any four
   - Pyrenomycetes- any four
   - Loculoascomycetes- any two
   - Discomycetes- any four
   - Teliomycetes – any eight
   - Gasteromycetes- any four
   - Hymenomycetes- any six
   - Deuteromycetes- any six
8. Preparation of stains and mounting media for study of fungi (1P)

Note: 1. Compulsory visit to Western Ghats for collection and observation of fungi (at least for three days).
2. Visit to any one Mycology Institute / Laboratory.

Class : M.Sc. (Semester- III)

Paper Code : BOT 5306 (C)

Paper : III Title of Paper: Practical's based on Bryology

Credits : 4 No. of lectures: 60 (15 Practical's)

A) Learning Objectives:

1. To study the identification of Bryophytes

B) Learning Outcome:

1. Knowledge of the Bryophytes and their association.

Practical's based on BOT 5304 (C) Bryology

1. Study of any Six living genera of Hepaticae (thalloid) w.r.t. morphology, anatomy of gametophytes and sporophytes. ..... (03)
2. Study of any four living genera of leafy Jungermanniales (Hepaticae) w.r.t. morphology, anatomy of gametophytes and sporophytes. (02)
3. Study of any four living genera of Anthocerotales w.r.t. morphology, anatomy of gametophytes and sporophytes. (02)
4. Study of any Six living genera of Bryopsida w.r.t. morphology, anatomy of gametophytes and sporophytes. ..... (03)
1. Study of morphogenesis in any two genera of hepaticae/ anthocerotae/ musci cultured by in-vitro techniques of tissue culture as callus / organ/ free cell chloplast. .. … (2)
5. Study of mycorrhiza in gametophytes and sporophytes w.r.t. salt absorption and growth. …… .(1)

Class : M.Sc. (Semester- III)

Paper Code : BOT 5306 (D)

Paper : III Title of Paper: Practical's based on Angiosperm Taxonomy

Credits : 4 No. of lectures: 60 (15 Practical's)

A) Learning Objectives:

1. To study the angiosperm families
2. To identify and classify plant on the basis of characters

B) Learning Outcome:

1. Knowledge of the Angiosperm taxonomy

Practicals based on BOT 5306 (D) Angiosperm Taxonomy

1. Study of at least 20 locally available families of flowering plants (8P)
2. Identification of genus and species of locally available wild plants (2P)
3. Preparation of botanical keys by using Flora's (1P)
4. Knowledge of at least 20 plant species from each of the following categories: A)Medicinal Plants. B) Exotic weeds C) Endemic plants. (2P)
5. Field tours within and around Campus, compilation of field notes and preparation of herbarium by using photographs of such plants. (2P)

Note: Botanical excursion of about one week duration to any botanically rich location preferable outside the State.

Class : M. Sc. II (Semester- IV)
Paper Code : BOT 5401
Paper : I **Title of Paper : Plant Pathology**
Credit : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To give knowledge of pathological processes occurs in plants.
2. To make aware about structure and disease development in plants.

B) Learning Outcome:

1. Development of expertise in disease development and disease management in plants

Credit I - Introduction to Plant Pathology (15L)

1. Plant Pathology- Milestones in plant pathology **1L**
2. Plant pathology and its objectives **1L**
3. Nature and concept of plant disease, classification of plant diseases **2L**
4. Causes of plant diseases, symptoms of plant diseases, disease cycle **2L**
5. Bacterial and mollicutes diseases of plants. **2L**
6. Viral diseases of plants Diseases caused by viruses. **2L**
4. Nematodal diseases of plants **2L**
5. Plant disease epidemiology and forecasting of plant disease epidemics. **2L**
6. Effect of plant diseases on human affairs **1L**

Credit II - Pathogenesis (15L)

1. Pathogenesis: Penetration, Infection and spread of diseases **4L**
2. Effect of pathogen on plant physiological functions **4L**
3. Enzymes and toxins in plant disease **4L**
4. Pathogenicity of biotrophic and necrotrophic pathogens **3L**

Credit III–Disease Development (15 L)

1. **Environmental factors and disease development**- Effect of temperature, humidity, soil pH, soil texture, light, CO2 and O2 levels, nutrients and disease development **4L**

2. **Genetics of plant pathogen interactions**- Genetics of host parasitic interactions, phyotoalexin and antigen hypothesis, vertical and horizontal resistance, physiological specialization, adaptation of fungi to different hosts **3L**

3. **Plant defense mechanism**- Morphological and biochemical defense, defense through induced synthesis of proteins and enzymes, detoxification of pathogen toxins and hypersensitivity of defense reactions, concept of phytoncides **3L**

4. **Molecular biology** of host pathogen interactions, pathogenesity genes, avirulance genes, host- R genes, effecter molecules, miRNA **3L**

5. Concept of post-harvest diseases of fruits, vegetables and seeds **2L**

Credit IV-Disease Management and Related Aspects (15 L)

1. Diagnostic methods for detecting pathogens **2L**
2. Breeding methods for improving resistance in plants **3L**
3. Control of disease using fungicides and other chemicals **2L**
4. Bio-control agents for controlling disease **2L**
5. Disease control using biological and chemical activators of resistance **2L**
6. Plant disease assessment **2L**
7. Biotechnology and its role in plant pathology **2L**

References:

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2. Plant Pathology by George N Agrios, fifth edition, Academic Press, London, 2005.
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4. Plant Pathogenesis and Resistance by Jeng-Sheng Huang, first edition, Springer, Netherlands, 2001.
5. Plant Pathology by R. S. Mehrotra and Ashok Agarwal, second edition, Tata McGraw Hill Education, 2003.
6. Biocontrol of Plant Diseases by P. C. Trivedi, first edition, Aavishkar Publishers and Distributors, 2007.
7. Concise Encyclopedia of Plant pathology by P. Vidhyasekaran, first edition, CRC Press, 2004.
8. Topics in Mycology and Pathology by L. N. Nair, first edition, New Central Book Agency Kolkata, 2007.
9. Fundamentals of plant pathology by A.K. Sinha, Kalyani Publishers
10. Disease of crops plants of India by Rangswami and Mahadevan, Prentice Hall Publication

Class : M. Sc. II (Semester- IV)

Paper Code : BOT5402

Paper : II Title of Paper : Industrial Botany

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To give knowledge about different technologies and use in industries.
2. To make aware about methods required industrial application of subject knowledge.

B) Learning Outcome:

1. Experts required in future for use of plant at commercial level.

Credit I- Algal and Bio-pesticide Technology (15L)

A. Algal Technology

1. Introduction to Algal Technology 2L

Resource potential of algae, commercial utility of algae- food and feed, pigments, pharmaceuticals and neutraceuticals, fine chemicals, fuel and biofertilizers, seaweeds extracts as biofertilizers, distribution of economically important algae in India

2. Algal Products 5L

SCP- *Spirulina* mass cultivation and its applications, biodiesel from algae, advantages over other sources of biodiesel, cultivation and extraction methods, liquid seaweed fertilizers – method of preparation and application

B. Biopesticide Technology 8L

Concept and significance of bio-pesticide; types of biopesticides and their applications,

1. Herbal- Azadiractine, rotenone and pyrethrins
2. Insect predators/parasites- Lady bird beetle, *Trichrograma*
3. Fungal- *Trichoderma,* its isolation, mass multiplication and applications
4. Bacterial- *Bacillus thurengenesis*
5. Viral- Nuclear Polyhydrosis Virus (NPV), Helicoverpa Nuclear Polyhydrosis Virus (HNPV)

Credit II - Biofuel Technology (15 L)

1. Environmental implications of fossil fuel, concept of biofuel, alternatives for fossil fuels– ethanol, vegetable oil, biodiesel **3L**

2. Bioethanol Technology **5L**

Sources for bioethanol production- sugar crops, starch crops, cellulosic feed stock bioethanol production- sugar-to-ethanol process, starch-to-ethanol process, cellulose-toethanol process, bio-ethanol form lignocelluloses, distillation to dehydration process, technology applications of bioethanol, spark ignition engines, compression ignitionengines, fuel cells, standardization of bioethanol

3. Lipid Derived Biofuels **3L**

Sources - oil seed crops, microalgae, animal fats, waste oils

Fuel productions- oil extractions, oil refining, transesterification, properties and use of lipid biofuels, economy of lipid biofuels

4. Bio-hydrogen- Application and future prospects **2L**

5. Methanogenesis from agro industrial residues **2L**

Credit III -Fermentation Technology **15L**

1. Introduction **5L**

History, fermentation process, fermenters- design and construction, basic functions, types of fermenters, operation, aseptic operation and use of computer in fermenters, maintenance, types of fermentation process, batch fermentation, fed-batch fermentation, continuous fermentation, scale up of fermentations, industrial processes- upstream and down-stream processes, strain improvement of microbes

2. Alcohol and Beverage Industry **2L**

Sources and methods of production of alcohol, beer and wine

3. Organic Acid Industry **1L**

Sources and methods of production of vinegar, and citric acid

4. Antibiotic Industry **2L**

Sources and methods of production of Penicillin, Cephalosporins, and Griseofulvins

5. Food Industry **5L**

SCP - advantages and disadvantages, production of yeast biomass, production of mycoproteins, traditional fungal foods (Shoyu, Miso, Sake, Tempeh), production of Button mushroom, (*Agaricus*) Paddy straw mushroom (*Volvariella*) and Dhingri mushroom (*Pleurotus*).

Credit IV. Nutrition Garden and Entrepreneurship **2L**

1. **Need of Nutritional Garden**: Nutritional awareness, nutritional deficiencies and disorders, balanced diet and knowledge of indigenous vegetables and its nutrient content.

Production technique: **4L**

Design, layout and implementation, choice of crop species, seed source, cropping pattern, crop season, soil testing, package of practices - INM, IPM & IDM, propagation methods, present nutritional garden models in India.

2. **Quality seed production techniques** (indigenous): Genetic, agronomy and seed treatments **2L**

Harvest and post-harvest management: Seed storage, and maintenance of seed bank. seed viability and dormancy. **2L**

Yield and economics: Bio-fortification and bio priming, recipes (season wise). **2L**

3. Entrepreneur: Concept, characteristics of entrepreneur, types and functions of entrepreneur, difference between entrepreneur and a manager. Need, objectives, course

contents and curriculum, phases and evaluation of EDPs, Meaning of project and report, project identification, project selection, contents of project reports, preparation of project report. Commercial banks, other financial institutions- IDBI, IFSI Bank Need of institutional support, institutional support to small entrepreneurs- SIDCO, SSIB, NABARD **4L**

References-

1. Biofuel Technologies- Recent Developments, Gupta, Vijay Kumar, Tuohy, Maria G. (Eds) Springer publication
2. Biofuel technology Handbook, Dominik Rutz, Rainer Janseen, WIP Renewable Energies, Germany
3. Biopesticides for sustainable agriculture: prospects and constraints, Editor(s): Nutan Kaushik
4. Entrepreneur Developments, S. S. Khanka, S. Chand., 2005
5. A Text Book of Microbiology, Dube and Maheshwari
6. A Text Book of Biotechnology. R C Dube
7. Insecticide control act 1985 Gazette of India

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9. Dr. G. S. K. Swamy, Dr. J. Auxcilia. Fundamentals of Horticulture.
10. Production techniques of vegetables and flowets. TNAU Coimbtore.
11. Seed production of vegetable, tuber and spice crops. Agrimoon
12. A beginners mannual on nutrition garden. Info global social service society(IGSSS) Mar2019.
13. R L Villareal, S Shanmugsundaram, M L Chadha, AVRDC. Primer in Vegetable Gardening.
14. School Gardens for Nutrition and Health- AVRDC Publication.
15. Dr. A Vadivel and Dr. M Shivanna. Soil and Plant analysis with practicals.

Class : M. Sc. II (Semester- IV)

Paper Code : BOT5403

Paper : III Title of Paper : Plant Biotechnology

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To generate awareness on recent trends in biotechnology
2. To make expertise persons in tissue culture

B) Learning Outcome:

Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between biotechnology and human needs

CREDIT- I 15L

Plant Physiology and basic Techniques in Plant Tissue Culture

1. Plant Nutrition: Role of microelements and micronutrients in plant metabolism. Plant Hormones: Types & Mechanism of Action, Role of Plant Hormones in growth & development of Plants.
2. Micro propagation: Organogenesis, Somatic Embryogenesis, Synthetic seeds. 2. Shoot tip culture/ Auxiliary bud culture, Embryo Culture & Embryo Rescue.
3. Design & lab setup of Plant Tissue Culture laboratory, Tissue culture Media (Composition preparation) Initiation and Maintenance of callus & Suspension culture.
4. Acclimatization of Plants, Somaclonal Variations / *In-vitro* mutagenesis Selected successful examples of Plants of Diverse Origin using Tissue Culture technology, Rescue of endangered plants.

CREDIT - II 15L

Agricultural Biotechnology

1. Plant Transformation: Basics of Tumor formation, Hairy root, features of Ti & Ri Plasmid ,Mechanism of DNA transfer role of Virulence gene, Use of Ti & Ri as

vectors, Multiple gene transfers vector less or direct DNA transfer methods in plants, Applications of Plant Transformation for Productivity

2. Crop improvement – Advantages of biotechnological methods over conventional methods of crop improvement. a) Homozygous plant production through anther & pollen culture b) Endosperm culture & production of triploids d) Apomixis e) Induced Polyembryony and their applications in crop improvement
3. Use of bioreactors in plant production & Scale-up Marker assisted selection – introduction to markers (RFLP, AFLP, microsatellites, RAPD, QTL)

CREDIT -III **15L**

Applications of Plant Biotechnology

1. Commercial micro propagation, Metabolic engineering & Industrial products Plant secondary metabolites, control mechanisms & manipulation of Phenyl Propanol pathway, Shikimate pathway.
2. Industrial enzymes, Biodegradable plastics, Therapeutic proteins, lysozomal enzymes, Antibodies, edible vaccines, Purification strategies, oleosin partitioning technology
3. Integration of Genetic Engineering of Plants in Agriculture Diseases resistant, Biotic & Abiotic stress resistant, Enhancement of nutritional value of crop Plants & molecular farming

CREDIT- IV **15L**

Introduction to Nano-world, Nanoscience and Nanotechnology

1. Nanoparticles, nanowires, thin films and multilayers, Applications in various fields viz. Physical and Chemical, Materials, Life Sciences.

   Nanobiotechnology: Introduction, Biomolecules as nanostructures and their applications in nanotechnology viz. Biosensors, separation of cells and cell organelles, cancer therapy, gene therapy etc.
2. Synthesis of nanostructure:

   Physical methods –mechanical methods, methods based on evaporation, sputter deposition, chemical vapour deposition (CVD), electric arc deposition.

   Chemical methods: Synthesis of nanoparticles by colloidal route, microemulsion, sol-gel method, chemical precipitation, pyrolysis.

Biological methods: Synthesis using microorganism, synthesis using plant extracts, use of proteins and template like DNA.

References:

1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers, USA.

2. Textbook of plant biotechnology, Chawala P.K.2002,Oxford&IBH,New Delhi.

3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture:Theory and Practice, Elsevier Pub.

4. Chrispeels, M. J. 2002.Plant Tissue Culture:Genetical Aspects. Jones and Bortlett Publishers, International.

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7. Agrobiotechnology and plant tissue culture, Bhojwani SS, Soh WY, Oxford & IBH Publ, India

8. Agricultural biotechnology, (2005), Kumar HD, Daya Publ House, India

9. Plant molecular breeding, (2009), Newbury HJ, John Wiley and Sons., USA.

10. Embryology of Angiosperms, (2009), S.S. Bhojwani and S.P. Bhatnagar, Vikas Publ House, India.

11. Ashwani Kumar, Shekhawat NS (2009) – Plant tissue culture and molecular markers: their role in improving crop productivity (IK International)

12.Biotechnology, 4th edition, (2010), H K Das, Wiley India Pvt. Limited, India

Class : M.Sc. (Semester- IV)

Paper Code : BOT 5404 (A)

Paper : IV **Title of Paper: Advanced Plant Physiology**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

3. To generate awareness physiological responses of plants towards different stress and phytoharmones
4. To train skilled students in basic process of plant physiology.

B) Learning Outcome:

To know and understand the experimental strategies and tools allowing widening and deepening the knowledge in plant physiology.

CREDIT- I Stress physiology **15L**

Water Stress: Membranes and water stress, Stomatal response to water stress, Photosynthesis and water stress, Osmotic adjustments, physiological mechanism of drought tolerance **2L**

Waterlogging stress: Waterlogging injury, Metabolic damage, Hormonal imbalance, Soil toxins Tolerance mechanisms **2L**

Low temperature: Chilling and freezing effects on germination, Physiological mechanism of low temperature tolerance, Effect of low temperature on plant productivity **2L**

Heat Stress :Cellular response on high temperature, enzyme activities, photosynthesis ultra structural effects. Functions of HSPs, role of membrane lipids in high temperance tolerance. **2L**

Metal stress: Metal toxicity and tolerance with special reference to Alluminium, manganese, Iron, Zinc, Role of phytochelatins (heavy, metal binding proteins). **1L**

Salt Stress:Mechanism of salt stress, Effects of salts on physiology of plants. **2L**

UV stress : Plant response to UV radiation in chemical composition of plants, Effect of UV radiations on photosynthesis **2L**

Oxidative stress: reactive oxygen species (ROS) – role of scavenging systems (SOD, catalase etc.). **2L**

Credit II Allellochemicals **15L**

- Major Allelochemicals nature in plants: Alkaloides, phenolics, terpenoides, glucosinolates, isothyosinates . **4L**
- Release and regulation of allellochemicals production and release **3L**
- Mode of action of allellochemicals on physiological process. **3L**
- Physiological and molecular mechanism of disease resistance in plants : Hypersensitive response, elicitors, phytoalexins, physiology of disease resistance, SAR(System Aquired Resistance) **4L**
- Applications of allellochemicals. **1L**

Credit III : Crop Physiology and Enzymology **15L**

- Physiological basis of yield of Jowar, Pea, Maize, Soyabean
  Role of crop physiology in agriculture, crop growth and productivity. **5L**
- Enzyme structure and properties, classification, Enzymes as biocatalysts, Importance of enzyme kinetics, factors affecting rates of enzyme mediated reaction, Michaelis-menton equation, substrate equation, Lineweaver- Burke plot, Haldane-Briggs relationship.**10L**

Credit IV Experimental Plant Physiology **15L**

- Preparation of solutions normal, molar, percent, ppm solutions.
- Methods of setting of physiological experiments.
- Physiological instruments-titrimetry, polorietry and their protocols.
- Post harvest physiology, ripening of fruits and its regulation, Metabolism of stored seeds and leafy vegetables.
- Biostatistics: Graphical and diagrammatical representation of data. Measures of central tendency, t-test, Chi-square test, ANOVA.

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7 Moore, T. C. 1989 biochemistry and physiology of plant hormones (2 nd edition), Springer Verlag, New York, USA

8 Salisbury, F. B and Ross, C. W. 1992 Plant Physiology (4 th edition), Wadsworth Publishing company California, USA

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11 Sergey Shabala, Plant stress physiology, 2nd edition, Boston, MA : CABI, 2017.

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13 Mohd Sayeed Akhtar, Salt Stress, Microbes, and Plant Interactions: Causes and Solution, 2019, Springer Verlag, Singapore, ISBN 9789811388002**.**

14 Biochemistry and Molecular Biology of Plants. 2002. Bob Buchanan, Wilhelm Gruissem, and Russell Jones. Wiley. ISBN-13: 978-0943088396. ISBN-10: 0943088399.

15 Plant Physiology and Development. 2014. 6th edition. Lincoln Taiz, Eduardo Zeiger, Ian Moller, and Angus Murphy. Sinauer Associates, Inc. ISBN-13: 978-0878938667. ISBN-10: 0878938664**.**

Class : M.Sc. (Semester- IV)

Paper Code : BOT 5404 (B)

Paper : IV **Title of Paper: Advanced Mycology and Plant Pathology**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

5. To know the primary and secondary metabolites of fungi.
6. To study industrial application of fungi.

B) Learning Outcome:

Students will get detail knowledge of fungi in relation to human welfare.

Credit - I

1. **Heterothallism, heterokaryosis and parasexual cycle (10L)**
   a) Homothallism
   b) Heterothallism (sexual incompatibility)
   c) Bipolar (unifactorial) heterothallism or two-factor heterothallism
   d) Multi-factor heterothallism
   e) Bipolar multiple – factor heterothallism
   f) Tetrapolar (multi-factor) heterothallism
   g) Octopolar (trifactorial) hetereothallism
   h) Heterogenic incompatibility (semi-incompatibility)
   i) Heterokaryosis
   j) Parasexual cycle

2. **Fungal hormone, physiological specialization and phylogeny (10L)**
   a) Fungal hormones
   b) Sirenin
   c) Antheridiol and oogonial
   d) Trisporic acid
   e) Yeast a-factor
   f) Physiological specialization
   g) Phylogeny of fungi
   h) Theories of algal ancestory
   i) Protozoans ancestory of fungi
   j) Sparrow's view with regard to the origin of lower fungi
   k) Biochemical support for evolutionary relationships
   l) Origin of zygomycetes
   m) Origin of ascomycetes
   n) Origin of basidiomycetes
   o) Recent concept on origin and phylogeny of fungi

Credit - II

3. **Role of fungi as saprotrophs** **(10L)**
   a) Fungi as decomposers in nature
   b) Return of carbon dioxide to the atmosphere
   c) Humus formation
   d) Types of organic compounds decomposed
   e) Cellulose structure and its decomposition
   f) Hemicelluloses decomposition
   g) Decomposition of pectic compounds
   h) Decomposition of lignin
   i) Fungi in biodeterioration
   j) Fungi in bioremediation
   k) Fungi in food spoilage

4. **Fungi in pathological relationships with other organisms** **(10L)**
   a) Fungi as plant parasites
   b) Fungi as human pathogens
   c) Entomogenous fungi
   d) Fungi parasitic on other fungi
   e) Fungi parasitc on lichens
   f) Allergenic fungi
   g) Poisonous fungi
   h) Toxins from fungi

Credit - III

5. **Industrial and biotechnological applications of fungi** **(10L)**
   a) Medicinal uses
   b) Transformation of steroids
   c) Enzymes from fungi
   d) Vitamins from fungi
   e) Fungi as source of organic acids
   f) Fungi in fermentation and food processing
   g) Asian and oriental foods
   h) Edible fungi
   i) Mycoproteins
   j) Fungi in cheese production
   k) Fungi in biological assay
   l) Fungi in biological control of pests
   m) Myconematicides
   n) Mycoinsecticides
   o) Other application of fungal biotechnology

6. **Mushroom cultivation (10L)**
   a) Introduction, types of edible mushrooms, nutritional values and their economic importance.
   b) Cultivation of oyster and button mushroom (spawn preparation, seed bed preparation, compost preparation, spawn running, mushroom development, harvesting).
   c) Mushroom diseases and their control

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11. Vashista B. R. and Sinha A.K. 2008. Botany for Degree students- Fungi, S. Chand's Publication.

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Class : M.Sc. (Semester- IV)
Paper Code : BOT 5304 (C)
Paper : IV Title of Paper : Bryology
Credits : 4 No. of lectures : 60

A) Learning Objectives:

1. To understand deep knowledge of season, collection, life-cycle of plants.
2. To study reproductive structures and develop In-situ and Ex-situ conservation techniques.

B) Learning Outcome:

Students will get detail knowledge of bryophytes from different localities.

Credit –I :

Different aspects of bryophytes ecology, growth forms effects of climatic, edaphic, and biotic factors parts played by liverworts, hornworts and mosses in plant communities role in plant succession terrestrial, aquatic and epiphytic. ..... (15 L)

Credit –II :

Important elements of microclimatetology, micro-climate – Importance in the study of bryophytes, methods . (15 L)

Credit –III : Eco-physiological and climatic adaptations. Bryophytes as indicators of Pollution. … .. (15 L)

Credit –IV :

Morphogenesis in vivo and in-vitro, general techniques of tissue culture- callus, organ, free cell and protoplast, their implications. Mycorrhiza in gametophytes and sporophytes, Mode of penetrationand establishment of mycorrhizal association, role of mycorrhiza in nutrition, germination, salt absorption and growth. ..... (15 L)

References :

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https://www.researchgate.net/publication/317644372_AUSTRALASIAN_BRYOLOGICAL_NEWSLETTER_Participants_at_the_Xth_Australasian_Bryophyte

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https://www.jstor.org/stable/1221137?seq=1

Indian Bryological Society
https://www.google.com/search?q=Indian+Bryological+Society&rlz=1C1CHWL_enIN909IN909&sxsrf=ALeKk023HYYE2mATYEdgv6xi8Yfevl1t-Q:1594468636630&ei=HKkJX7D_Jcvez7sPwOmYqAU&start=10&sa=N&ved=2ahUKEwiw_cPFksXqAhVL73MBHcA0BlUQ8tMDegQICxAt&biw=1366&bih=657

World Bryological Society
https://www.google.com/search?q=Indian+Bryological+Society&rlz=1C1CHWL_enIN909IN909&sxsrf=ALeKk023HYYE2mATYEdgv6xi8Yfevl1t-Q:1594468636630&ei=HKkJX7D_Jcvez7sPwOmYqAU&start=10&sa=N&ved=2ahUKEwiw_cPFksXqAhVL73MBHcA0BlUQ8tMDegQICxAt&biw=1366&bih=657

Class : M.Sc. (Semester- IV)

Paper Code : BOT 5404 (D)

Paper : IV **Title of Paper: Angiosperm Taxonomy**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

7. To know the origin and evolution of Angiosperms.
8. To study features and importance of families.

B) Learning Outcome:

Students will get detail knowledge of origin and evolution of Angiosperms

Credit I **(15 lectures)**

ORIGIN OF ANGIOSPERMS: Pre-cretaceous and Cretaceous fossil angiosperms; Time of origin of angiosperms; Cradle of angiosperms; monophyletic verses polyphyletic origin of angiosperms. Importance and need for classification, hierarchical classification. Criteria used for classification; phases of plant classification. Overview on pre- and post-Darwinian systems of classification. Floral Biology: Evolution of flower, co-evolution of flowering plant and insects, sex distribution in flowers and plants, types of pollinations; cleistogamy, chasmogamy

Credit II: **(15 lectures)**

FOSSIL ANGIOSPERMS OF INDIA

Brief account of fossil angiosperms of India- Palmae: Palmoxylon, Rhizopalmoxylon, Palmocarpon; Cyclanthaceae:Cyclanthodendron, Tricoccites; Pandanaceae: Viracarpon; Musaceae: Musa Gramineae: Graminocarpon; Sonnertiaceae: Sonnertioxylon, Sahnianthus, Enigmocarpon; Guttiferae: Indocarpa, Myrtaceae: Sahnipushpam;Malvaceae:Sahniocarpon, Chitaleypushpam. Fossil angiosperms and palaeoecology of India.

Credit III: **(15 lectures)**

PHYTOGEOGRAPHY: Geological time scale, geographical history,

Continental Drift, Land Bridges, shifting of poles, theories of differentiation and natural selection, centre of origin, types and areas of natural distribution, phytogeographic

regions of the world, Botanical provinces of India and their characteristic vegetation with emphasis on Vegetation and Phytogeography of the Western Ghats

Phytogeography and speciation: ecological variations, adaptations, plant systematics and genetic variations.

Credit IV: (15 lectures)

General Knowledge and distinguishing features of the following families:

a) Dicotyledons: Bixaceae, Sterculiaceae, Agavaceae, Melastomaceae, Rubiaceae, Convolvulaceae

Gentianaceae, Podostemonaceae, Santalaceae, Scrophulariaceae, Casuarinaceae, Salicaceae Scrophulariaceae

b) Monocotyledons: Liliaceae, Eriocaulaceae, Pandanaceae, Hydrocharitaceae, Lemnaceae, Poaceae

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Class : M.Sc. (Semester- IV)

Paper Code : BOT 5405

Paper : I , II, III **Title of Paper: Practical's on BOT 5401,5402,5403**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To give hands on training plant pathological, biotechnological, gardening techniques,
2. To provide the knowledge required for setting up of nursery, labs.

B) Learning Outcome:

Hands on training to students for plant disease management, plant biotechnological techniques.

Practical's based on BOT 5401 Plant pathology

Plant Pathology

1. Study of any two each- bacterial, nematodal and viral diseases **1P**
2. Study of any six fungal diseases **1P**
3. Isolation of fungal pathogens from leaves, stem and roots by cultural methods **1P**
4. Demonstration of Koch's postulates for fungal pathogens **1P**
5. Study of pure culture of fungi by streak plate and pour plate method **1P**

Practical's based on BOT 5402 Industrial Botany

1. Qualitative tests for carbohydrates, starch, proteins, lipids, alkaloids and tannins **1P**
2. Study of any four post harvest diseases of fruits and submission of report on general postharvest technology methods followed by farmer. 1P
3. Study of nursery media, preparation of nursery beds and raising of nursery seedlings. 1P
4. Collection and preparation of soil samples for analysis. 1P
5. Design and layout of Nutrition Garden. 1P
6. Study methods of training and pruning. 1P
7. Study of major pests and diseases vegetables and their control measures. 2P
8. Study of threshing and seed extraction methods. 1P
9. Study of physiological and harvest maturity for seed. 1P
10. Study of seed drying principles and methods, seed treatment and seed packing. 1P

Practical's based on BOT 5403 Plant Biotechnology

1. Preparation of M. S. Media.
2. Ex-plant Surface Sterilization, Callus Culture and Organ Culture
3. Anther Culture / Production of haploids.
4. Study of *Agrobacterium* mediated transformation.
9. Study of bacterial growth pattern.
10. Estimation of alcohol.
11. Isolation of root nodule bacteria.
13. In vitro rooting and acclimatization.
14. Protoplast isolation and culture.

Note:

Visit to Krishi Vigyan Kendra to see home garden, Olericulture practices and submission of report.

Class : M.Sc. (Semester- IV)

Paper Code : BOT 5406
Paper : VI **Title of Paper: Research Projects and Summer Training**
Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To give hands on training and practical skills to the students.

2. To provide the knowledge required for writing review and case studies.

B) Learning Outcome:

To develop experts in research

Credit - 1 and 2 : Research Project **30L**

Projects will be allotted in third semester and students will submit project work having Introduction, review of literature, well defined material and methods, results and discussion, conclusions and references. The project should be presented at the end of fourth semester.

Credit – 3 and 4 : Summer Training **30 L**

1. Report submission based on one summer training in research institutes / Laboratory / industry for at least one month with certificate from respective authority.