Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Botany

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Botany) Part-I Semester -II

For Department of Botany

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2019 Pattern)

M.Sc. Botany

Program Outcomes (Pos) for M. Sc. Program

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that forms a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise way and help reach conclusions in group settings.
PO4	**Research-related skills and Scientific temper :** Infer scientific literature, build a sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge:** Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Perform independently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

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

Autonomous

Course Structure For M. Sc. I (Botany)

Semester	Paper Code	Title of Paper	No. of Credits
I	BOT4101	Plant Systematics I	4
	BOT4102	Cell Biology	4
	BOT4103	Genetics and plant Breeding	4
	BOT4104	Advanced Botanical techniques	4
	BOT4105	Practicals based on BOT. 4101 and BOT. 4102	4
	BOT4106	Practicals based on BOT. 4103 and BOT. 4104	4
II	BOT4201	Plant Systematics II	4
	BOT4202	Plant Physiology and Biochemistry	4
	BOT4203	Molecular Biology and Genetic Engineering	4
	BOT4204	Plant Ecology and Biodiversity	4
	BOT4205	Practical on BOT 4201and BOT4202	4
	BOT4206	Practical on BOT 4203 and BOT 4204	4

SYLLABUS (CBCS) FOR M. Sc. Botany I (w. e. from June, 2019)

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

Paper Code : BOT 4201

Paper : I Title of Paper : Plant Systematics – II

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. Create awareness and need of conservation of Cryptogamic diversity.
2. To give idea of economic importance of cryptogams.

B) Course Outcome:

By the end of course students will be able to

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO2. Classify the cryptogams up to species level.
CO3. Get aware about the importance of Cryptogams.
CO4. Get knowledge about life history of algae, fungi bryophytes.
CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.
CO6. Aware about plant conservation in society.
CO7. Analyze industrial applications of algae.

Credit – 1. (15 Lectures)

1.1 Pteridophytes – Distinguishing characters, origin of Pteridophytes – comparison with Algal and Bryophyte origin; Apospory, Apogamy, Parthenogenesis, Telome Theory and Stelar Evolution **(5L)**

1.2 Classification of Pteridophytes as per Sporne System (1975), Indian Pteridology, Heterospory and seed habit and Economic importance of Pteridophytes **(3L)**

1.3 Fossil Pteridophytes - Psilopsida : *Rhynia*, Lycopsida : *Lepidodendron Lepidophyllum, Stigmaria, Lepidostrobus, Lepidocarpon, Sigillaria,* Sphenopsida : *Calamites, Annularia, Calamostachys, Cheirostrobus* **(7L)**

Credit - 2 (15 Lectures)

2.1 Psilopsida: Distribution, distinguishing characters, morphology and anatomy of sporophyte and gametophyte of *Psilotum* and *Tmesipteris* (**1L)**

2.2 Lycopsida : Distribution, distinguishing characters, affinities, morphology and anatomy of sporophyte and gametophyte of Lycopodiales, Selaginellales, Isoetales and their life cycle pattern **(4L)**

2.3 Sphenopsida : Distribution, distinguishing characters, morphology and anatomy of

sporophyte and gametophyte, Life cycle pattern of Equisetales **(2L)**

2.4 Pteropsida / Filicophyta : Distribution, distinguishing characters, morphology and anatomy of sporophyte and gametophyte of order Ophioglossales (1L), Marattiales (2L), Osmundales (1L), Filicales (2L) Marsileales (1L), Salviniales (1L) **(8L)**

Credit - 3 (15 Lectures)

3.1 Gymnosperm : Distinguishing characters, distribution, affinities of gymnosperms with pteridophytes and angiosperms and economic importance of gymnosperms. **(4L)**

3.2 Classification of gymnosperm as per Sahni (1920), Chamberlain (1934), Raizda and Sahni (1960), Sporne (1965) and Bierhorst (1971) **(3L)**

3.3 Pteridospermales w.r.t general characters- *Lyngiopteris*, *Heterangium*, *Medullosa*, *Neuropteris*, *Glossopteris* and *Caytonia.* **(4L)**

3.4 Cycadeoidales- General characters, structure of *Cycadeoidea* and *Williamsonia* **(1L)**

3.5 Pentoxylales- General characters, *Pentoxylon*, structure of secondary wood, male and female strobili, and contribution of Birbal Sahni **(2L)**

3.6 Cordaitales – General characters, structure of *Cordaites*, and *Cordaitanthus* **(1L)**

Credit - 4 (15 Lectures)

General characters, affinities, morphology of sporophytes and gametophytes of living gymnosperm orders :

4.1 Cycadales **(3L)**

4.2 Ginkgoales **(2L)**

4.3 Coniferals **(5L)**

4.4 Gnetales, Ephedrales and Welwitschiales **(5L)**

REFERENCES :

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21. Maheshwari P. and Vasil, Vimla 1961. *Gnetum*, Delhi.
22. Pande B.P 1997. Taxonomy of Angiosperms. S.Chand.
23. Vashishta P.C., A.R. Sinha, Anil Kumar. 2006. Gymnosperms. S. Chand.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. II) **Subject**: Botany
Course: Plant Systematics II **Course Code**: BOT 4201
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2		3							
CO 3			3						
CO 4	2								
CO 5			2						
CO 6								3	2
CO 7		3							

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.

CO4. Get knowledge about life history of algae, fungi bryophytes.

PO2: Critical Thinking and Problem Solving

CO2. Classify the cryptogams up to species level.

CO7. Analyze industrial applications of algae.

PO 3: Social competence

CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.

CO3. Get aware about the importance of Cryptogams.

PO 8: Environment and Sustainability

CO6. Aware about plant conservation in society.

PO 9: Self-directed and Life-long Learning

CO6. Aware about plant conservation in society.

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

Paper Code : BOT 4202

Paper : II Title of Paper : Plant Physiology and Biochemistry

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To give knowledge of physiological processes which occurs in plants.
2. To make aware about structure and role of biomolecules in plants.

B) Course Outcome:

CO1. Use knowledge for improvement of agricultural yield
CO2. Students aware about the plant to response environmental conditions.
CO3. Students get knowledge of internal activities in plant.
CO4. Development of expertise in plant physiology.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

Credit 1 = (15 Lectures)

1.1 Introduction, present status of plant physiology in India and abroad 1L

1.2 Photosynthesis: - 8L

Photosynthetic pigments, absorption and transformation of radiant energy, Light Harvesting complexes, Kok curve, Kautsky curve, ETS, photo inhibition O_2 and H_2 evolution, Regulation of Calvin cycle, RUBISCO activity, Photorespiration, CAM, C4 Pathway and its types.

1.3 Respiration 6L

EMP pathway, TCA cycle, PPP, Mitochondrial ETS, Cyanide resistance pathway, Gluconeogenesis, High energy compounds: Synthesis and utilization, ATP synthesis, Alternate oxidase, Photorespiratory pathway, Significance of Photorespiration and dark respiration.

Credit 2 = (15 Lecture)

2.1 Overview of Solute Transport 5L

Uptake, Transport and Translocation of water, ions, solutes and macronutrients from soil through cells, across membranes, through xylem and phloem, transpiration, mechanism of ATP driven active transport (Phloem loading and unloading) Diffusion, Uniport, Symport, Antiport channels.

2.2 Nitrogen metabolism 4L

Nitrate and ammonium assimilation amino acid biosynthesis

2.3 Stress Physiology **2L**

Response of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Mechanism of resistance to biotic stress and tolerance to abiotic stress.

2.4 Plant growth regulators **4L**

Biosynthesis and action mechanism of Auxins, Gibberellins (GA), Cytokinins, Ethylen and Abscisic Acid,

Credit 3 = (15 Lectures)

3.1 Energy Dynamics **3L**

Structure of atoms, molecules and chemical bonds, Principles of thermodynamics, free energy, Redox potentials, Dissociation and associations constants, Activation energy, Binding energy.

3.2 Principles of biophysical chemistry **3L**

pH, buffer, reaction kinetics, thermodynamics, colligative properties. Ions and electrical potentials – Nerst and Goldman equations

3.3 Enzymology **4L**

General classification of Allosteric mechanism, Isozymes, Factors affecting enzyme activity, Enzyme Kinetics, Michaelis – Menton equation, Competitive, uncompetitive and non competitive inhibition.

3.4 Amino acids and proteins **5L**

General classification of amino acids and proteins, Structure, synthesis and properties of amino acids, protein structure (Primary, secondary, tertiary and quaternary), Ramchandran plot.

Credit 4 = (15 Lectures)

4.1 Nitrogen metabolism **3L**

Nitrate and ammonium assimilation, Nitrogen uptake, NOD factor, root nodulation and nitrogen fixation.

4.2 Secondary metabolites **5L**

General classification of Major pathways, Phenolics (Lignins, tannins) Flavonoids, terpenoids (steroids), Alkaloids, pigments (Carotenoids, Anthocynins)

4.3 Carbohydrates metabolism **3L**

General classification, Synthesis and breakdown of carbohydrates (starch, glycogen, pectin, Glucose)

4.4 Lipid metabolism **4L**

General classification of Phospho, Spingo, Glyco Lipid biosynthesis and oxidation.

REFERENCES:-

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Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. II) **Subject**: Botany
Course: Plant Physiology and Biochemistry **Course Code**: BOT 4202
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3	3							
CO 3				3					
CO 4									
CO 5	2			2					
CO 6	3			3					
CO 7	3			3					

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Use knowledge for improvement of agricultural yield.
CO3. Students get knowledge of internal activities in plant.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

PO2: Critical Thinking and Problem Solving

CO2. Students aware about the plant to response environmental conditions.

PO 3: Social competence

CO1. Use knowledge for improvement of agricultural yield.

PO 4: Research-related skills and Scientific temper

CO3. Students get knowledge of internal activities in plant.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

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

Paper Code : BOT 4203

Paper : III Title of Paper : Mol.Biol. & Genetic Engineering

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To give knowledge about nucleic acid structure, role and synthesis of protein.
2. To make aware about methods required for r- DNA technology.

B) Course Outcome:

CO1. Experts required in future for genetic library of plants.
CO2. The main outcome of this course is to acquaint students with some cytological techniques.
CO3. Experts required in future for genetic library of plants.
CO4. Acquaint the students with synthesis of nucleic acids and PCR technique.
CO5. Students get knowledge of genetical heredity.
CO6. Students become expertise in Plant Breeding Techniques.
CO7. Get knowledge for improving the new crop variety.

Credit 1 = (15 Lectures)

1.1 Structure and Properties of Nucleic acids: - 8L

a. Structure, Chemical, Physical, properties of nucleic acids.forms of DNA. (A, B, C, Z).
b. Packaging of genome in viruses, bacteria, organelle and nuclei structure of
c. Chromatin, nucleosome.
d. Dissociation and reassociation kinetics of DNA, hypo and hyperchromicity of DNA, C-value paradox, Cot curves and its significance.

1.2 DNA Replication: - 4L

a. Mechanism of prokaryotic and eukaryotic DNA replication, enzymes involved inreplication.
b. Origins of replication and replication fork
c. Rolling circle and theta (Ø) models in prokaryotes
d. Fidelity of replication, Extrachromosomal replications.

1.3 DNA damage and repair: - 3L

a. Types of DNA damage,
b. Enzymes involving in repairing of DNA,
c. Type of DNA repair, Photoreactivation, excision repair, recombination repair and
d. Mismatch repair systems, SOS.

Credit 2 = (15 Lectures)

2.1 Structural organization of Gene **2L**

a. Organization and Structure of prokaryotic and eukaryotic genes;
b. Structure and role of promoters, enhancers and terminators, exons and introns.

2.2 RNA synthesis and processing (Transcription) **5L**

a. Structure and function of different types of RNA.(t-RNA, r-RNA and m-RNA)
b. Transcription apparatus.
c. RNA polymerases and their role.
d. Transcription in prokaryotes and eukaryotes- Initiation, elongation and termination.
e. RNA processing- RNA editing caping, methylation, polyadenation and splicing
f. Ribonucleoproteins

2.3 Translation and Protein synthesis **4L**

a. Mechanism of Translation in prokaryotes and eukaryotes (Initiation, elongation and termination)
b. Translational and post translational modifications.
c. Targeting of organelle proteins.
d. Protein folding and processing, translational inhibitors.

2.4 Controlling factors of Transcription: - **4L**

a. Operon concept (Lac, Tryptophan, Arabinose) - Positive and negative regulation
b. Role of chromatin in gene expression and gene silencing

Credit 3 = (15 Lectures)

3.1 Introduction to recombinant DNA technology **6L**

Steps involved in construction of recombinant DNA molecule,Enzymeused in genetic engineering: Restriction endonucleases,Exonucleases, Ligases, Polymerases, Kinase, Phosphatase and Reverse transcriptase

3.2 Vectors used in recombinant DNA technology **6L**

Plasmids: pUC, pBR etc., Phages: Lambda and T4 phages, Cosmids, BACs and YACs, Shuttle vectors,Ti-plasmids and Ri- plasmids, Plant DNA viruses

3.3 Screening and selection of recombinants (Plasmids and phages) **3L**

Credit 4 = (15 Lectures)

4.1 Isolation of gene and gene libraries **3L**

a. Techniques of DNA isolation and methods of purification

b. Preparation of cDNA ,Genomic DNA library, cDNA libraries

4.2 Plant Genetic Engineering **6L**

1. Gene Transfer Methods- direct and indirect gene transfer in plants.
2. *Agrobacterium* mediated Gene transfer methods
3. Screening for transformants
4. Transgenic plants- molecular approaches

4.3 Blotting Methods **2L**

a. Southern, Northern, Western, and Dot Blot method

4.4 Application of Genetic Engineering **4L**

a. Transgenic plants for insect, fungal, bacteria disease resistance
b. Transgenic plants for salt, drought, heavy metal stress tolerance
c. Lignin modification,
d. Genomics and its application to health and agriculture - gene therapy.

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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. II) **Subject**: Botany
Course: Molecular Biology and Genetic Engineering **Course Code**: BOT 4203
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1					2				
CO 2						2			
CO 3									
CO 4				3					
CO 5	3								
CO 6									3
CO 7	2								

Justification for the mapping

PO1: Disciplinary Knowledge
CO5. Students get knowledge of genetical heredity.
CO7. Get knowledge for improving the new crop variety.

PO 4: Research-related skills and Scientific temper
CO4. Acquaint the students with synthesis of nucleic acids and PCR technique.

PO5: Trans-disciplinary Knowledge

CO1. Experts required in future for genetic library of plants.

PO6: Personal and Professional Competence

CO2. The main outcome of this course is to acquaint students with some cytological techniques.

PO 9: Self-directed and Life-long Learning

CO6. Students become expertise in Plant Breeding Techniques.

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

Paper Code : BOT 4204

Paper : IV Title of Paper : Plant Ecology and Biodiversity

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To generate awareness on habit of plants with reference to its habitats and conservation of ecology.
2. To make knowledgeable persons in evolution flora.

B) Course Outcome:

CO1. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

CO2. The student can analyse and interpret the plant relation with the environment and impactof human interventions on ecosystem.

CO3. Provide plant description, describe the morphology and reproductive structure of cryptogams.

CO4. Gain the proficiency in the identification of cryptogams.

CO5. Knowledge of comparison between cryptogams and other plant groups.

CO6. Knowledge of scope of the cryptogams diversity.

CO7. Knowledge about habitat conservation of cryptogams diversity.

Credit-1 = (15 Lectures)

1.1 Basic Ecological Concept 4L

Habitat ecology, systems ecology, synecology, autecology; Ecosystem concept; Structure and functions of biotic and abiotic components; Energy in ecosystems; Energy exchange and productivity-food chains and food webs-ecological pyramids

1.2 Niche: 2L

Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement

1.3 Plant relation with the environment 4L

Plant relation with the climatic factors, edaphic factors, Hydrological Factors. Plant distribution with respect to topographic factors.

1.4 Conservation ecology: 5L

Principles of conservation, major approaches to management, Environmental Education Programmes : WWF, IUCN, MAB, UNESCO, UNEP,
Environment impact Assessment (EIA)

Credit 2 = (15 Lectures)

2.1 Population Ecology 7L

Characteristics of population, population growth curves, factors affecting population size, Life history strategies, r and k selection, C-S-R triangle, Concept of metapopulation, extinction events, age structured population.

2.2 Community Ecology 4L

Nature of communities; community structure and attributes; levels of species diversity and its measurement

2.3 Diversity types and levels (alpha, beta, gamma), ecotone and edge effect **4L**

Credit-3 = (15 Lectures)

3.1 Ecosystem Ecology **7L**

Ecosystem: Components and organization; energy flow in ecosystem; mineral cycling (C, N, P); primary production and decomposition; structure and function of some ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

3.2Ecological Succession **3L**

Plant succession: Autogenic and allogenic, mechanism and phases; mechanisms; changes involved in succession; concept of climax. Cerial communities and climax communities: Hydroseres, lithoseres, xeroseres, haloseres

3.3Applied Ecology **5L**

Environmental pollution its impact (Air, water, soil and noise) global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. carbon sequestration.

Credit 4: Biodiversity

4.1 **Biodiversity:** Concept, Scope and definitions, types of biodiversity- genetic diversity, species Diversity, ecosystem diversity 2L

4.2 **Value and use of biodiversity**- Ethical, aesthetic, food, fodder, ornamentals, medicinal, economical and socio-ecological approach etc 2L

4.3 **Loss of biodiversity**: Factors affecting diversity, natural verses anthropogenic, loss of biodiversity and its consequences on the human life. Factors affecting loss of genetic diversity, species diversity and ecosystem diversity 4L

4.4 Conservation of Biodiversity: **7 L**

Indian initiatives in biodiversity conservation- biodiversity act 2002, Biodiversity Rules, 2004, national biodiversity strategy and action plan (NBSAP), Plant Varieties Protection and Farmer's Rights Act, 2001, National biodiversity authority (NBA) etc; protected area network (PAN)- ecological sensitive zone; important protected areas of India

International program for biodiversity conservation, convention on biological diversity (CBD), CITES, Kyoto Protocol, Ramsar Convention on Wet Lands,

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4. **De, A. K.** (1994). Environmental Chemistry, Wiley Eastern publication.
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Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. II) **Subject**: Botany
Course: Plant Ecology and Biodiversity **Course Code**: BOT 4204
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1		3							
CO 2							2		
CO 3	3								
CO 4				2					
CO 5	3								
CO 6	3								
CO 7	3							3	

Justification for the mapping

PO1: Disciplinary Knowledge

CO3. Provide plant description, describe the morphology and reproductive structure of cryptogams.
CO5. Knowledge of comparison between cryptogams and other plant groups.
CO6. Knowledge of scope of the cryptogams diversity.

CO7. Knowledge about habitat conservation of cryptogams diversity.

PO2: Critical Thinking and Problem Solving

CO1. The student can analyse and interpret the plant relation with the environment and impactof human interventions on ecosystem.

PO 4: Research-related skills and Scientific temper

CO4. Gain the proficiency in the identification of cryptogams.

PO 7: Effective Citizenship and Ethics

CO2. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

PO 8: Environment and Sustainability

CO 7. Knowledge about habitat conservation of cryptogams diversity.

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

Paper Code : BOT 4205

Paper : Practicals based on BOT 4201and BOT 4202

A) Learning Objectives:

1. To generate awareness on habit of plants with reference to its habitats and conservation of ecology.
2. To train skilled students in physiological and biochemical techniques.

B) Course Outcome:

By the end of course students will be able to

CO1. Develop identification skill in cryptogams.
CO2. Train in cell biology techniques.
CO3. Understand basic knowledge about life cycle of cryptogams.
CO4. Internal and external structure of cryptogams.
CO5. Explain basic knowledge about evolution of lower cryptogams.
CO6. Discuss spore dispersal mechanism.
CO7. Understand variations in cryptogamic diversity.

Practicals Based on Based on BOT 4201 (Any 12 Practicals)

Pteridophytes : Morphological, anatomical and reproductive studies

1. Psilopsida: *Psilotum* and *Tmesipteris* (Figure of *Tmesipteris* must be shown) (1P)
2. Lycoposida and Sphenopsida: *Lycopodium, Selaginella, Equisetum, Isoetes* (2P)
3. Pteropsida: *Ophioglossum, Angiopteris, Osmunda, Salvia, Azolla, Marsilea, Lygodium, Pteris, Adiantum, Gleichenia, Cheilanthus, Blechnum, Acrostichum* (4P)
4. Fossil Pteridophytes: Any eight forms (At least one from each group) (2P)

Gymnosperms :

5. Study of external, internal and reproductive morphology of *Cycas* and *Zamia* (1P)
6. Study of external, internal and reproductive morphology of *Pinus, Cupressus, Araucaria, Agathis* and *Podocarpus* (1P)
7. Study of external, internal and reproductive morphology of *Gnetum* and *Ephedra* (1P)
8. Study of fossil specimens of gymnosperm (any six) from order Pteridospermales, Cycadeoidales and Pentoxylales (1P)

Note: Botanical excursion tour is compulsory to study Pteridophytes and Gymnosperms, submission of tour report and any 10 photographs of Pteridophytes and Gymnosperms of each is mandatory at the time of practical examination.

Practicals Based on Based on BOT 4202 (Any 12 Practicals)

1. Preparation of solution of different concentrations, Buffers, Conductivity and pH Measurements 1P
2. Enzyme assays – extraction and estimation of enzyme activity- Catalase//peroxidase 1P
3. Effect of substrate concentration on rate of enzyme action and calculation of Km by Michaelis Menten Curve 2P
4. Estimation of soluble proteins in germinating seeds by Lowry's method 2P
5. Estimation of total free amino acid in germinating and non germinating seed 1P
6. Isolation and estimation of chlorophylls and carotenoids. Separation of pigment using column Chromatography. 2P
7. Estimation of ascorbic acid in ripe and unripe fruits 1P
8. Studies on induction of amylase activity by GA 3 in germinating cereal grains 1P
9. Estimation of reducing sugars 1P
10. Estimation of lipids. 1P
11. Effect of salt stress on proline accumulation and its estimation 1P

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. II) **Subject**: Botany
Course: Practical based on BOT 4201 and BOT 4202 **Course Code**: BOT 4205
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1		3					3		
CO 2				3					
CO 3	3								
CO 4				2					
CO 5	2								
CO 6	3								
CO 7								2	3

Justification for the mapping

PO1: Disciplinary Knowledge

CO3. Provide plant description, describe the morphology and reproductive structure of

cryptogams.

CO5. Knowledge of comparison between cryptogams and other plant groups.

CO6. Knowledge of scope of the cryptogams diversity.

PO2: Critical Thinking and Problem Solving

CO1. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

PO 4: Research-related skills and Scientific temper

CO2. The student can analyse and interpret the plant relation with the environment and impactof human interventions on ecosystem.

CO4. Gain the proficiency in the identification of cryptogams.

PO 7: Effective Citizenship and Ethics

CO1. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

PO 8: Environment and Sustainability

CO7. Knowledge about habitat conservation of cryptogams diversity.

PO 9: Self-directed and Life-long Learning

CO7. Knowledge about habitat conservation of cryptogams diversity.

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

Paper Code : BOT 4206

Paper : Practicals based on BOT 4203 and BOT 4204

A) Learning Objectives:

1. To give hands on training on molecular techniques and analysis of water and soil.
2. To provide the knowledge required for the molecular biologist and ecologist.

B) Course Outcome:

By the end of course students will be able to

CO1. Explain basic cell structure.
CO2. Understand basic biological concepts.
CO3.Get acquainted with some cytological techniques.
CO4. Understand basic knowledge about structure of cell organelles.
CO5. Explain mechanism of cells in plant.
CO6. Train in different isolation techniques in cell organelle.
CO7. Interprets cell structure and their function.

Practical's based on BOT 4203 Molecular Biology and Genetic engineering (Any 12 Practicals)

1. Isolation of Plasmid DNA and quantification **2P**

2. Electrophoretic separation of plasmid isoforms. **1P**

3. Restriction digestion of plasmid DNA, electrophoresis and molecular weight determination of DNA fragments. **2P**

4. Isolation of plant genomic DNA and quantification and agarose gel electrophoresis **2P**

5. Effect of temperature and alkali on absorption of DNA: hyperchromicity **1P**

6. Separation of seed storage proteins from leguminous seeds and quantification of each fraction **2P**

7. SDS-PAGE separation of seed storage proteins from legumes. Determination of molecular size of the globulin subunits. **3P**

8. Isolation of RNA and its quantification by UV-spectrophotometer and agarose gel electrophoresis **2P**

Practicals based on BOT 4204 Plant Ecology and Biodiversity

1. Determination of frequency, density, abundance, dominance of the species among the plant communities using quadrat method **1P**
2. Study of vegetation by line /belt transect method **2P**
3. Interpretation of satellite imageries and aerial photographs with respect to major vegetation. **1P**

4. Measurement of different Biodiversity Indices : Simpson's and Shannon's biodiversity Index 2P
5. Mapping of vegetation in given area using GPS. 1P
6. Physicochemical analysis of soil - Water holding capacity, Mg, Ca. **2P**
7. Physicochemical analysis of water (clean and polluted):- Hardness, Cl **2P**
8. Biological analysis of water samples (clean and polluted): Phytoplankton **1P**
9. Biological analysis of water samples (clean and polluted): DO, CO_2 **2P**
10. Comparison of stomatal index and pollen fertility of the plants from polluted and non-polluted areas. **1P**

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. II) **Subject**: Botany
Course: Practical based on BOT 4203 and BOT 4204 **Course Code**: BOT 4206
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3						3			
CO 4	2								
CO 5	2								
CO 6									3
CO 7					3				

Justification for the mapping

PO1: Disciplinary Knowledge
CO1. Explain basic cell structure.
CO2. Understand basic biological concepts.
CO4. Understand basic knowledge about structure of cell organelles.
CO5. Explain mechanism of cells in plant.

PO5: Trans-disciplinary Knowledge
CO7. Interprets cell structure and their function.

PO6: Personal and Professional Competence
CO3.Get acquainted with some cytological techniques.

PO 9: Self-directed and Life-long Learning
CO6. Train in different isolation techniques in cell organelle.