Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Course Structure for M. Sc. I Sem II (Botany)

WEF: 2022-23 to 2024-25

Semester	Paper Code	Title of Paper	No. of Credits
I	PSBT111	Plant Systematics I	4
	PSBT112	Cell Biology	4
	PSBT113	Genetics and plant Breeding	4
	PSBT114	Advanced Botanical techniques	4
	PSBT115	Practical's based on PSBT1111 and PSBT1112	4
	PSBT116	Practical's based on PSBT1113 and PSBT1114	4
	HR1	Human Rights – I	4
	CYS1	Introduction to Cyber Security – I	4
II	PSBT 211	Plant Systematics II	4
	PSBT 212	Plant Physiology and Biochemistry	4
	PSBT 213	Molecular Biology and Genetic Engineering	4
	PSBT 214	Plant Ecology and Biodiversity	4
	PSBT 215	Practical's Based on PSBT	4
	PSBT 216	Practical's Based on PSBT	4
	HR	Human Rights – II	4
	CYS	Introduction To Cyber Security – II	4

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

Paper Code : PSBT 211

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.
3. To impart knowledge of plants of Cryptogamic diversity and their uses.

B) Learning Outcome:

1. Students will acquire knowledge of plants life cycle of plants.
2. Students will develop the basic understanding of important characteristics, anatomy, reproduction and evolution along with economic importance of these groups.
3. Students will expert in higher cryptogams and gymnosperms useful to save the diversity.

Credit – 1. (15)

Pteridophytes – Distinguishing characters, origin of Pteridophytes – Algal origin, Bryophyte origin; Apospory, Apogamy, Parthenogenesis, Telome Theory and Stelar Evolution **(6)**

Classification of Pteridophytes as per Sporne System (1975), Indian Pteridology, Heterospory and seed habit and Economic importance of Pteridophytes **(4)**

Fossil Pteridophytes - Psilopsida : *Rhynia*, **Lycopsida** : *Lepidodendron Lepidophyllum*, *Stigmaria* and *Lepidostrobus*, **Sphenopsida** : *Calamites* and *Annularia* **(5)**

Credit - 2 (15)

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

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

Sphenopsida : Distribution, distinguishing characters, morphology and anatomy ofsporophyte and gametophyte, Life cycle pattern of Equisetales **(2)**

Pteropsida / Filicophyta : Distribution, distinguishing characters, morphology and

anatomy of sporophyte and gametophyte of order Ophioglossales (1), Marattiales (2), Osmundales (1), Filicales (2) Marsileales (2) **(8)**

Credit - 3 (15)

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

Classification of gymnosperm as per Sahni (1920), Chamberlain (1934), Sporne (1965). **(3)**

Pteridospermales : w.r.t general characters- *Lyngiopteris*, *Neuropteris*, *Glossopteris* and *Caytonia*. **(4)**

Cycadeoidales- General characters, structure of *Cycadeoidea* (1)

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

Cordaitales – General characters, structure of *Cordaites*. (1)

Credit - 4 (15)

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

Cycadales **(3)**

Ginkgoales **(2)**

Coniferals **(5)**

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

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4. Rashid A. (1999). An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
5. Sharma O.P. (1990). Textbook of Pteridophyta. MacMillan India Ltd. Dehi.
6. Smith G.M. (1955). Cryptogamic Botany Vol II. McGraw Hill.
7. Sporne K.R. (1986). The morphology of Pteridophytes. Hutchinson University Library, London.
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20. Foster A.S and Gifford E.M 1959. Comparative Morphology of Vascular Plants. San Francisco.
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.

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

Paper Code : PSBT 212

Paper : II Title of Paper : Plant Physiology and Biochemistry

Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To give knowledge of physiobiochemical processes this occurs in plants.
2. To make aware about structure and role of biomolecules in plants.
3. It focuses on plant nutrient uptake and translocation, photosynthesis, respiration and nitrogen metabolism.

B) Learning Outcome:

1. Development of expertise in plant physiology and biochemistry.
2. Understand mechanism of various physiological processes involved in growth and development of plants
3. Setup plant experiment related to plant physiological process.

Credit -1 (15)

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

Photosynthesis 8

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

Respiration 6

EMP pathway, TCA cycle, Pentose phosphate pathway, Organisation of mitochondrial ETS, Gluconeogenesis, reverse gluconeogenesis, High energy compounds: Synthesis and utilization, ATP synthesis, Cyanide resistance pathway and role of Alternate oxidase, Photorespiratory pathway, Significance of Photorespiration and dark respiration.

Credit -2 (15)

Overview of Solute Transport 5

Uptake, Transport and translocation of water, ions, solutes and macronutrients from soil through cells, across membranes, through xylem and phloem,

transpiration, Translocation of photoassimilate, Transport in phloem, Source and Sink relationship, Diffusion, Osmosis, Uniport, Symport, Antiport channels.

Organic acid metabolism **3**

Role and metabolism of oxalic acid, ascorbic acid and malic acid

Stress Physiology **3**

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.

Plant growth regulators **4**

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

Credit -3 (15)

Energy Dynamics **3**

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

Principles of biophysical chemistry **3**

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

Enzymology **4**

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

Amino acids and proteins **5**

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)

Nitrogen metabolism **3**

Nitrate and ammonium assimilation, Nitrogen uptake, Nodulation (NOD) Factor, root nodulation and nitrogen fixation.

Secondary metabolites **5**

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

Carbohydrates metabolism **3**

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

Lipid metabolism **4**

General classification of Phospho, Spingo, Glyco lipid, Biosynthesis and breakdown (β -oxidation) of lipid.

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4. **Moore T.C.** (1989). Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.
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Class : M. Sc. I (Semester-II)

Paper Code : PSBT 213

Paper III Title of Paper : Molecular Biology and 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.
3. To give knowledge about Genetic engineering.

B) Learning Outcome:

1. Experts required in future for genetic library of plants.
2. Students will know about genetically modified organisms.
3. Students will know about regulation of molecular processes.

Credit1=(15Lectures)

The structure and function of DNA **6**

a. The importance of technological advances: the Hershey–Chase experiment
b. A model for the structure of DNA: the DNA double helix
c. Primary structure, secondary and tertiary structure of DNA , Alternative forms of DNA (A, B, C, D, Z)

Replication of DNA **5**

a. Principle
b. Modes of replication (Conservative, semiconservative and dispersive)
c. Biochemical mechanism of DNA Replication – Enzymes involved in DNA replication
d. Fidelity of replication
e. Bidirectional and Rolling circle replication

DNA damage and repair **4**

a. Types of DNA Damages
b. DNA repair mechanisms
c. Coping with DNA Damage Without Repairing It
d. Transposition – types of transposons

Credit2=(15Lectures)

Structural organization of Gene **4**

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

Transcription RNA synthesis **5**

a. Different types of RNA m-RNA, r-RNA and (t-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 capping, methylation, polyadenation and splicing

Translation protein synthesis **6**

a. Translation in prokaryotes and eukaryotes (initiation, elongation and termination)
b. Controlling factors of translation
c. Gene Regulation (Lac operon, trp operon)
d. Translational proof-reading, translational inhibitors, Post- translational modification of proteins

Credit3=(15)

Molecular gene cloning **6**

a. Introduction, tools of recombinant DNA technology, Preparation of recombinant DNA.
b. Enzymes used in genetic engineering: Restriction enzymes.

Methods of expressing cloned genes **6**

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

Identification of recombinants **3**

a. PCR principle and applications
b. DNA probes
c. DNA sequencing methods

Credit4=(15)

Isolation of gene and gene libraries **3**

a. Techniques of DNA isolation and methods of purification
b. Preparation of cDNA, Genomic DNA library

Plant Genetic Engineering **6**

a. Gene Transfer Methods- direct and indirect gene transfer in plants.
b. *Agrobacterium* mediated Gene transfer methods
c. Screening for transformants
d. Transgenic plants-molecular approaches 2

Application of genomics and proteomics

a. Concept of genomics and proteomics, Human genome project, objective of proteomics,
b. Methodologies of proteomics(2D gel electrophoresis)

Application of Genetic Engineering **4**

c. Transgenic plants for draught, cold and disease resistance
d. Lignin modification

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14. Watson J.D. et al. Molecular Biology of Gene. Forth Edition, Benjamin and Cummings Publishing Co., California

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

Paper Code : PSBT 214

Paper : IV Title of Paper : Plant Ecology and Biodiversity

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To create awareness about the plants and its environment
2. To understand the need for conservation of species and the biodiversity
3. To make aware about the rules and regulations for protection of biodiversity

B) Learning Outcome:

1. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.
2. Students will be able to identify plant vegetative.
3. Students will be understood the concepts, types and functions of various ecosystems and their communication.

Credit-1=(15)

Basic Ecological Concept **6**

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

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

Plant relation with the environment **4**

Plant interaction with the biotic and abiotic environment (Climatic, edaphic, Hydrological), Plant distribution with respect to topographic factors.

Conservation ecology: **5**

Principles of conservation, major approaches in management, role of WWF, IUCN, MAB,UNESCO, and UNEP in environmental education

Credit2=(15)

Population Ecology **7**

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

Community Ecology **4**

Nature of communities; community structure and attributes; measurement of diversity, Diversity types -alpha, beta, gamma, ecotone and edge effect **4**

Credit-3=(15Lectures)

Ecosystem Ecology **7**

Ecosystem: Components and organization; energy flow in ecosystem; mineral cycling (C, N, and P cycle); Ecosystem productivity- primary, secondary, GPP, NPP, structure and functions of some of the ecosystems: terrestrial (forest, grassland, Desert) and aquatic (fresh water, marine, estuarine).

Ecological Succession **3**

Plant succession: Autogenic and allogenic, mechanism and phases; pioneer, seral and climax communities, primary and secondary succession, Hydroseres, lithoseres, xeroseres and haloseres

Applied Ecology **5**

Environmental pollution its impact (Air, water, soil and noise), global environmental change; Environmental Impact Assessment, Concepts- Carbon sequestration, Global Climate Change, toxicology

Credit4: Biodiversity

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

Value and use of biodiversity-

Ethical, aesthetic, food, fodder, ornamentals, medicinal, economical and socio-ecological approach etc. **2**

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 4

Conservation of Biodiversity: 7

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 Conventionon WetLands,

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1. **Ambhast, R. S.** (1998).A Text Book of Plant Ecology, 9th edition, Friend and Co.
2. **Begon, M., Townsend, C. R., Harper, J. L.** (2005). Ecology: From Individuals to Ecosystems, 4th edition ,Wiley Black well..
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Class : M. Sc. I (Semester- II)

Paper Code : PSBT 215

Paper : Practicals based on PSBT 211 and PSBT 212

A) Learning Objectives:

1. To generate awareness on habit of plants with reference to its habitats and conservation.
2. To impart the knowledge of modern techniques in plant physiology.
3. To impart the knowledge about applications and their significance of plant physiology.

B) Learning Outcome:

1. The students will develop understanding about the diversity, identification and classification of lower plants.
2. Students will gain knowledge about economic importance of lower plants
3. Students get the knowledge about preparation of standard solutions and uses of instruments.

Practicals Based on Based on PSBT 211

1. Psilopsida: *Psilotum* (1)
2. Lycoposida and Sphenopsida: *Selaginella, Isoetes* (2)
3. Pteropsida: *Ophioglossum*, *Marsilea,* (2)
4. Fossil Pteridophytes: Any four forms (At least one from each group)(1)
5. Study of external, internal, reproductive morphology of *Cycas Pinus* (1)
6. Study of external, internal and reproductive morphology of *Gnetum* (1)
7. Study of fossil specimens of gymnosperm (any six) from order Pteridospermales, Cycadeoidales and Pentoxylales (1)

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.

Practical's Based on PSBT 212

1. Preparation of solution of different concentrations, Buffers, Conductivity and pH Measurements. **(**1)
2. Extraction and estimation of enzyme activity- Catalase/peroxidase. (1)
3. Estimation of soluble proteins in germinating seeds by Lowry's method. (1)
4. Isolation and estimation of chlorophylls / carotenoid or separation of pigment using column chromatography. (1)
5. Estimation of ascorbic acid in ripe and unripe fruits. (1)
6. Effect of salt stress on proline accumulation and its estimation. (1)

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

Paper Code : PSBT 216

Paper : Practicals based on PSBT 213and PSBT 214

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.
3. This knowledge can help to form strategies for conservation.

B) Learning Outcome:

1. Skilled molecular biologist and ecologists can help to solve the critical problems related with plant diseases and improvement of characteristics of plants.
2. This skill helps to examine the relationships between plants and their physical and biotic environment.
3. Student will gain Knowledge of GPS.

Practical's based on PSBT 213

1. Restriction digestion of plasmid DNA, electrophoresis and molecular weight determination of DNA fragments. **2**
2. Isolation of plant genomic DNA and quantification. **2**
3. Effect of temperature and alkali on absorption of DNA: hyperchromicity **1**
4. Separation of seed storage proteins from leguminous seeds and quantification of each fraction **2**
5. SDS-PAGE separation of seed storage proteins from legumes. Determination of molecular size of the globulin subunits. **3**

Practical's based on PSBT 214

1. Determination of frequency, density, abundance, dominance of the species among the plant communities using quadrat method **1**
2. Interpretation of satellite imageries and aerial photographs with respect to major vegetation. **1**
3. Mapping of vegetation in given area using GPS. 1
4. Physicochemical analysis of soil - Water holding capacity, Mg, Ca. **2**
5. Physicochemical analysis of water (clean and polluted): -Hardness, Cl **2**
6. Biological analysis of water samples (clean and polluted): Phytoplankton 1
7. Biological analysis of water samples (clean and polluted): DO, CO_2 2
8. Comparison of stomata index and pollen fertility of the plants from polluted and non-polluted area. 1