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, 2023)

Academic Year 2023-24

Sem.	Paper Code	Title of Paper	No. of Credits
III	PSBT 311	Angiosperms and Evolution	4
	PSBT 312	Developmental Botany	4
	PSBT 313	Computational Botany	4
	PSBT 314 A 314 B 314 C 314 D	Advanced Plant Physiology- I OR Advanced Mycology and Plant Pathology-I OR Bryology- I OR Angiosperm taxonomy- I	4
	PSBT 315	Practicals Based on PSBT 311, 312 and 313	4
	PSBT 316 A PSBT 316 B PSBT 316 C PSBT 316 D	Practicals based on special paper Advanced Plant Physiology-I OR Practicals based on special paper Advanced Mycology and Plant Pathology-I OR Practicals based on special paper Bryology-I OR Practicals based on special paper Angiosperm Taxonomy-I	4
	CC-23	Certificate Course – II	2

	SD-23	Skill Development – I	2
IV	PSBT 411	Plant Pathology	4
	PSBT 412	Industrial Botany	4
	PSBT 413	Plant Biotechnology	4
	PSBT 414 A PSBT 414 B PSBT 414 C PSBT 414 D	Advanced Plant Physiology- II OR Advanced Mycology and Plant Pathology- II OR Bryology-II OR Angiosperm taxonomy- II	4
	PSBT 415	Practicals Based on 411, 412 and 413	4
	PSBT 416	Research Projects and Summer Training	4
	SD-24	Skill Development – II	2
		Total Credits	55

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

Paper Code : PSBT 311

Paper : I **Title of Paper : Angiosperms and Evolution**

Credit : 4 **Number of lectures : 60**

A) Learning Objectives:

1. To create awareness and inculcate knowledge of morphological and taxonomical diversity of local flora.
2. To give idea about economic importance of flowering plants.
3. To understand evolutionary concepts.

B) Learning Outcome:

1. Developing experts in diversity of flowering plants.
2. Inculcation of attitude of students towards research in plant taxonomy.
3. New methodology in development of conservation of RET plants.

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

1. **Systematics:** A key science, importance and relevance in 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 (ICBN):** Salient features-principles, importantrules 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, cladistics in taxonomy, angiosperm phylogeny group (APG). **(4L)**
4. **Recent Systems of Classifications:** By ArmenL.Takhtajan, ArthurCronquist, R. M. T. Dahlgren and Robert F. Thorne. **(3L)**

Credit II -Taxonomic Aspects of Angiosperms (15L)

1. Morphological variations, systematic position, inter-relationship, phylogeny and economic importance of families: Magnoliaceae,Ranunculaceae,Lauraceae, Moraceae, Urticaceae, Casuarinaceae, Alismataceae, Hydrocharitaceae, Aponogetonaceae, Bignoniaceae, Scrophulariaceae, Amaranthacaeae, Portulacaceae, Piperaceae, Aracaceae. (**10L)**
2. **Phytogeography:** Phytogeographic regions of India, endemism, hotspots and hottesthotspots. Endemism in Western Ghats, plant explorations, invasions and introductions. (**5L)**

Credit III: Evolution (15L)

1. **Emergence of evolutionary thought:** Steps and preview of evolution, Lamarkism, Darwinism- Concepts of variation, adaption, struggle for fitness and naturalselection; Neo-Darwinism, Spontaneity of mutations, evolutionary synthesis. (**3L)**
2. **Origin of cells and Unicellular evolution:** Origin of basic biological molecules, abioticsynthesis of organic monomers and polymers, Concepts of Opairn and Halden,Experiment of Miller (1953), The first cell, evolution of prokaryote, origin ofeukaryotic 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 toolsin phylogeny, classification and identification, protein and nucleotide sequenceanalysis, origin of new genes and proteins, gene duplication and divergence. (**4L)**
4. **The mechanism of evolution:** Concepts and rate of change in gene frequencythrough natural selection, migration and random genetic drift, adaptive radiation andmodification, isolation mechanism, speciation, allopatric and sympatricality,parapetric, convergent evolution, sexual selection, co-evolution. (**4L)**

Credit IV: Modern techniques in angiosperm taxonomy (15L)

1. **Anatomy in relation to taxonomy**: Wood and floral anatomy, anatomical characters oftaxonomic 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, exinestratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomicimportance. (**3L)**
3. **Chemotaxonomy**: Classes of compounds and their biological significance, stages in chemotaxonomic investigations. 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. (**6L)**
4. **Ultrastructural Systematics**: SEM and TEM studies and plant systematics; SEM andplant surface structure, TEM and dilated cisternae of endoplasmic reticulum and sieveelement, plastids, applications of data in the classification of higher taxa. **(3L)**

References:

1. Flowers: How They Changed the World by William C. Burger,2006.
2. Plant Taxonomy & Biosystematics: Classical &Modern,T. S. Rana, New India Publishing Agency, 2014
3. Vashishta P.C., A.R. Sinha, Anil Kumar. 2006. Gymnosperms. S.Chand.
4. Shivanna, K. R. and N. S. Rangaswamy. 1992. Pollen Biology- A LaboratoryManual. Springer-Verla
5. Stuessy T. F. 2002. Plant taxonomy. The systematic Evaluation of comparativedata. Biseu Singh MahendraPal SignPehraDuk.
6. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology,
7. Evolution, Ecology. S. Chand and Company, New Delhi.
8. Cooper G.M and Hausman R.E. (2007) (4thEdn). The Cell molecular approachSinauer associate, Inc, Suderland (USA).
9. Roy S.C and De K.K. (2005). (2ndEdition). Cell Biology, New central BookAgency Private Ltd., Kolkata.
10. Plant Systematics by Michael G.Simpson, 2nd Edition, 2010.
11. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant body: Their Structure, Function, and Development by Ray F. Evert; Susan E. Eichhorn (Contribution by), 2006.

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

Paper Code : PSBT 312

Paper	**: II**	**Title of Paper**	**: Developmental Botany**
Credit	**: 4**	**Number of lectures**	**: 60**

A) Learning Objectives:

1. To study structure of plant development process.
2. To pertain knowledge of different embryological techniques.
3. To acknowledge the economic uses of plants

B) Learning Outcome:

1. Enhancement in knowledge regarding anatomical techniques of students.
2. Students will develop the understanding of growth, development and reproduction in plants.
3. Development of entrepreneur.

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, redifferentiation and dedifferentiation. Polarity and symmetry, organization of cells, tissues and tissue system of whole plant. Cell-cell interaction. (**6L)**
3. **Factors affecting on 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, primordium to organ, juvenility – characteristics, transition to adult phase. (**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 malegerm unit development, carpel and megasporogenesis, female gametophyte or femalegerm 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, unorganized or reduced embryo. (**3L)**
5. **Polyembryony, apomictic phenomenon Polyembryony** – Concept and classification of polyembryony, special cases and causes of polyembryony, apomixes 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, cellfate mapping, specific gene expression. (**6L)**
2. Case study of organ culture, anther, pollen and protoplast culture and its role in understanding plant development (**3L)**
3. **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. (**6L)**

Credit IV - Economic Botany (15L)

Source, method of cultivation and economic uses of

1. **Cereals**-Wheat, Rice. (**1L)**
2. **Millets** -*Sorghum*, Pear millet, Finger millet. (**1L)**
3. **Legumes and nuts**- Soybean, Peanut. (**2L)**
4. **Vegetables**- Brinjal, Onion, Garlic. (**1L)**
5. **Fruits-** Guava, Papaya, Dragon fruit. (**2L)**

6. **Plant fibres**- Cotton, Coir. **(1L)**
7. **Wood and Cork** – Babul, Teak. **(2L)**
8. **Rubber and its products**. **(1L)**
9. **Fatty oils**- Soybean oil, Peanut oil. **(1L)**
10. **Essential oils-** *Citronella* oil, *Geranium* oil, Rose oil, Wild basil. **(1L)**
11. (a) **Sugarcane and its byproducts.** **(2L)**
    (b) **Spices-** Turmeric, Ginger, Chilli.

REFERENCES:

1. Bhojwani S.S, Bhatnagar S.P. & Dantu P.K. (2015). Embryology of Angiosperms; Publisher, Vikas Publishing House.
2. Pandey S. N. & A. Chadha (1997): Plant Anatomy and Embryology, Vikas Publishing, 476.
3. Verma V. (2009). Text book of Economic Botany: Ane Books Pvt Ltd, 352.
4. Verma V (1985). Economic Botany,Edition, 4 ; Publisher, Emkay Publications, ; 291.
5. Sant S Bhojwani and M. K. Razdan. Plant Tissue Culture: Theory and Practice (1983).
6. Kumar Shailesh (2015). Plant Tissue Culture: Theory and Techniques; Scientific Publishers Journals Dept. 211.
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9. Pawar C. B. (2010). Cell Signaling; Himalaya Publishing House, 205.
10. Jaime Kigel and Gad Galil (1995). Seed Development and Germination. Marcal Dekker Inc.
11. Galstone A.W. (1989). Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA.
12. Moore T.C. (1989). Biochemistry and Physiology of Plant Hormones Springer –Verlag, New York, USA.
13. Singh,Pandey and Jain (2017). Economic Botany, Rastogi Publication, Meerut.
14. Samba Murty and Subrahmanyam (2011).Textbook of Modern Economic Botany, CBS Publishers and Distributors, New Delhi.

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

Paper Code **:** PSBT 313

Paper **: III**

Title of Paper **: Computational Botany**

Credits: 4 **Number 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.
3. To make aware about database significance.

B) Learning Outcome:

1. Development of students expertise in biostatistics.
2. Development of students expertise in bioinformatics and biomathematics.
3. Make expert in data analysis.

TOPICS / CONTENTS:

Credit I **(15L)**

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, and 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: **(15L)**

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 pair wise 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: (15L)

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

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

a.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. Specific activity of radioisotopes, making radioisotope solutions. (**2L)**
3. Cell counting using serial dilutions, haemocytometry. (**2L)**
4. Probability distribution- Hypergeomatric, binomial, normal distribution. (**2L)**
5. Data types- Logical and Numerical. (**1L**
6. Logarithms and Co-ordinate geometry. **(1L)**
7. Permutations and combinations. (**1L)**
8. Fundamental principle of counting (The multiplication principle). (**1L)**

9. Fractional indices, Law of indices. **(2L)**

10. Data condensation and graphical methods. **(2L)**

References:

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4. Clewer, A.G. and Scarisbrick, A.H. John Wiley, 2001. Practical statistics and experimental design for plant and crop science. New York.
5. Bioinformatics - Westhead, DR, Parish JH and Twyman, RM, 2003 BIOS Scientific PublishersLtd., Oxford.
6. D.W.Mount 2003 Bioinformatics – Sequence and genome analysis CBS Publishers, NewDelhi.
7. Bioinformatics and Molecular Evolution – Higgs PG and Attwood, TK.
8. Irfan Ali Khan & Atiya Khanum, Ukaaz Publication 2009. Fundamentals of Biostatistics Hyderabad ISBN : 81-900441-0-9:
9. P. Rastogi and N. Mendiritta. 2013. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th Revised edition.
10. Advanced biotechnology, Dr. R. C. Dubey, S. Chand and Company Pvt. Ltd.New Delhi.
11. Gamaji Deore, Ramdas Sonawane, Dr. Sujata Tapare and Surekha deshmukh., Biomathematics & Biostatistics. Vision publication.

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

Paper Code : **PSBT 314(A)**

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

Credits : **4** **Number of lectures** : **60**

A) Learning Objectives:

1. To train the students to understand physiological processes of plants.
2. To make technosavy students for analysis of plant material.
3. To make students to acquire deep knowledge of Plant Physiology.

B) Learning Outcome:

1. Student will enriched with development of expertise in advanced plant physiology.
2. Students will be able to entrepreneur in seed production and plant growth hormone industry.
3. Development of critical thinkers on physiology of plants.

TOPICS/CONTENTS:

Credit –I: Seed Germination **(15L)**

- Concept, seed viability and dormancy, methods of breaking seed dormancy, factors affecting on seed germination ,Seed soaking ,seed hardening and seed dressing (**7L)**
- Physiological changes takes place during seed germination. Mobilization of reserve food
- (Glyoxylate pathway , mobilization efficiency) . (**8L)**

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

- **Growth**, phases, Qualitative and quantitative characters of growth, measurement of growth, nature of growth curve and formulae for growth curve, Metabolism and allocation of resource during vegetative and reproductive growth, RGR, NAR LAR. Factors affecting growth. Root – Shoot ratio C/ N ratio. (**4L)**
- **Plant hormones** – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action and mode of application. Activators (Auxins, GA, Cytokinins) Inhibitors (ABA, Ethylene) and Polyamines. (**5L)**
- Application of plant growth regulators in Agriculture. (**1L)**

- Physiology of flowering, Circadian Rhythms, photoperiodism and its significance, vernalization. (**2L)**
- **Sensory photobiology** - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement and biological clocks. (**3L)**

Credit- III Senescence and Ageing (15L)

- **Senescence**: Concept, definition, patterns of cellular senescence –cell, tissue, organ, whole plant,biological significance of senescence. (**7L)**
- Physiological and chemical changes takes place during senescence (pigment, protein, photosynthesis, oxidative, nucleic acid), functional and ultrastructural changes in chloroplast,mitochondrion and cell wall during senescence, PCD (Programmed Cell Death) in life cycle of plants. (**8L)**

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

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

References

1. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology.
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3. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant
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11. Leninger A.C 1987. Principles of Biochemistry, CBS Publishers and Distributers (Indian Reprint).
12. Introduction to Plant Physiology (Forth Edition) William G. Hopkins and Norman.
13. Plant Physiology- Hans Mohr, Peter Schopfer, Springer Berlin publishers.

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

Paper Code : **PSBT 314 B**

Paper : **IV**

Title of Paper : **Advanced Mycology and Plant Pathology - I**

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

A) Learning Objectives:

1. To study fungal habitat and habit diversity.
2. To study fungal ecology, physiology and genetics.
3. To understand industrial, agricultural and medicinal potential of fungi.

B) Learning Outcome:

1. Development of expertise in fungal identification.
2. Encourage the students for raising fungal based small scale industries.
3. To develop expertise the students in plant disease management w.r.t. bio-controlling.

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

1. Fungi and their significance. (1L)
2. Relationship of fungi with microbes, 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)

   Alexopoulos and Mims System (1979),

   Ainsworth system (1973),

   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 – Auricularials, 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. **FungalAssociation**- Lichens,Mycorrhizae. (3L)
3. **Fungalecology**- 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.
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4. Deacon J. W. Fungal Biology (4th Edition) , Blackwell Publishing, ISBN 1405130660

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6. Mehrotra R. S. and Aneja K.R., 1990. An Introduction to mycology, New Age Publication.
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11. Sharma O. P. 2011. Fungi and allied microbes. McGraw Hill Education Private Ltd., New Delhi.
12. H. C. Dube 2013. An introduction to fungi, Scientific Publishers.
13. Davis Z. 2013. Introduction to fungi, AgriHorti Press.

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

Paper Code : PSBT 314C

Paper : IV **Title of Paper : Bryology-I**

Credits : 4 **Number of Lectures : 60**

A) Learning Objectives:

1. To understand deep knowledge of season, collection, identification and life-cycle of Bryophytes.
2. To study reproductive structures of Bryophytes.
3. To develop innovative *Ex-situ* conservation techniques for Bryophytes.

B) Learning Outcome:

1. Students are able to identify Bryophytes from different localities.
2. Students are acquainted knowledge of reproductive structure of Bryophytes.
3. Students are able to develop *Ex-situ* conservation techniques of Bryophytes.

Credit –I : Hepaticopsida.

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 : Anthoceropsida.

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

Credit –III : Bryopsida.

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

Credit –IV : Modern taxonomy.

4. Modern taxonomy of Bryophytes with reference to epidermal tissue system, palynology and cytology w.r.t. Hepaticopsida, Anthoceropsida and Bryopsida. Innovative strategies for *Ex-situ* conservation. (15 L)

Recommended References :

1. Kashyap, S.R. 1929. Liverworts of Western Himalaya and Punjab Plain, Part-I.
2. Mahabale , T.T. 1941. On the chromosomal complex of two species of Riccia.
3. Jour.univ.Bombay, 16 : 1-16.
4. Mahabale, T.S. andGorji, 1941. Chromosomes in *Ricciahimalayensis*. Curr. Sci.10:28.
5. Mehra, P.N. 1967. Evolutionary trends in the Hepaticae. Phytomorphology. 17 : 47-58 1969-70. with particular refrence to Marchantiales.
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7. Rashid, A. 1998. An Introduction to Bryophyta (Diversity, Development and Differntiation)
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15. Chopra R.N and Satish Bhatiya 1990. Bryophyte Development- Physiology and Biochemistry.

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	**: PSBT 314 D**		
Paper	**: IV**	**Title of Paper**	**: Angiosperm Taxonomy-I**
Credits	**: 4**	**No. of lectures**	**: 60**

A) Learning Objectives:

1. To pertain classification and taxonomy of Angiosperms.
2. To know the rules to name a new plant species.
3. To know the brief account of different systems of classification.

B) Learning Outcome:

1. Production of expert in plant taxonomy.
2. Development of expertise in principle of general taxonomy.
3. Development of knowledgeable persons in identification and cultivation of rare medicinal plants.

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 of taxonomy.

Botanical Nomenclature: history, scientific names, International Code of Nomenclature for Algae, Bryophytes, Angiosperms (ICBN): Salient features-Principles, Important Rules and Recommendations, Provisions for the governance of the Code, Appendices.

Taxonomy tools: Floras, monographs, revisions, Journals, Herbarium and botanical gardens, their role in teaching, research and conservation, important herbaria and botanical gardens. (Ex. Royal Botanical garden Kew, England, The Acharya Jagadish Chandra Bose, Howrah, west Bengal, Botanical garden of Shivaji University, 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) Cytology

c) Biochemistry d) Palynology e)Anatomy f)Embryology g) DNA sequence

Modern trends of taxonomy: 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: Allopatric, Peripatric, Sympatric, Parapatric, 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, Asclepidaceae, Meliaceae, Rosaceae, Moraceae, Passifloraceae, Plumbaginaceae, Sapotaceae, Boraginaceae.

b) **Monocotyledons:** Orchidaceae, Commelinaceae, Araceae, Arecaceae, Cyperaceae.

References:

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4. Endress Peter, K. 1994. **Diversity and Evolutionary Biology of Tropical Flowers**. Cambridge.
5. Erdtman, G. 1952. **Pollen Morphology and Plant Taxonomy. Angiosperms**. Hafner Publ. Co. New York.
6. Hutchinson, J. 1959. **Families of Flowering plants**.
7. Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. **A Handbook of Taxonomic Training**. DST, New Delhi.
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10. Primak, R. B. 2004. **A Primer of Conservation Biology**. SinauerAssociales, Inc. Publishers
11. Shivanna, K. R. and B. M. Johri 1985. **The Angiosperm Pollen: structure and Function**. Wiley Eastern limited, New Delhi.
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14. Michel G. Shimpson**, Plant Systematics**, Third Edition, Elsevier Academic Press
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Class **: M.Sc. II (Semester- III)**

Paper Code **: PSBT 315**

Paper **: V**

Title of Paper **: Practical's based on PSBT 311, 312 and 313**

Credits **: 4** **(15 Practicals)**

A) Learning Objectives:

1. To pertain taxonomical, embryological, computational techniques.
2. To provide the knowledge of different local families
3. To use different software's in bioinformatics.

B) Learning Outcome:

1. The learning outcome of this training useful to develop new methods in plant taxonomy and Embryology, Bioinformatics.
2. Apply the knowledge of fundamental process of plants.
3. Students will apply the knowledge of phylogenetic relationships using DNA and protein sequences.

TOPICS/CONTENTS:

Practical's based on PSBT 311 Angiosperm Taxonomy (Any four)

1. Study of plant families (at least 6 locally available families- 4 of Dicotyledons and two of Monocotyledons. **5P**
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**

Note:

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

Practicals based on PSBT 312 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**

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

Practicals based on PSBT 313 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 : **PSBT 316 (A)**

Paper : **VI**

Title of Paper : **Practicals based on PSBT 314 (A) Advanced Plant Physiology-I**

Credits : **4** **Number of Practicals 15**

A) Learning Objectives:

1. To create hands on training on physiological techniques.
2. To give idea of experimental methodologies for crop physiology.
3. To achieve up- to date level of understanding of plant physiology.

B) Learning Outcome:

1. Students will acquire knowledge of plants physiology.
2. Students will learn about response of plants to various abiotic stress.
3. Students will gain ability to conduct research, pursue lifelong learning.

Practical's based on PSBT 314A 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. Comparative studies of accumulation of superoxide dismutase (SOD) in normal and salt stressed plants. **2P**
7. Effect of weed extracts on seed germination. **2P**
8. Studies on changes in acidity and TSS during grape/ guava ripening. **1P**
9. Studies on changes in NR activity during leaf senescence. **1P**
10. Estimation of Total flavonoids. **1P**

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

Class	**: M.Sc. (Semester- III)**		
Paper Code	**: PSBT 316 B**		
Paper	**: VI**		
Title of Paper	**: Practicals based on PSBT 314 B Advanced Mycology and Plant Pathology-I**		
Credits	**: 4**	**Number of practicals**	**: 15**

A) Learning Objectives:

1. To study the identification of fungi and preparation of their pure cultures.
2. To identify soil, air and water borne fungal pathogens.
3. To maintain industrially and agriculturally useful fungi for its biological potential.

B) Learning Outcome:

1. Development of expertise in fungal identification.
2. Students will expertise in different techniques of isolation of soil, air and water fungal pathogens.
3. Students will understand the pathogenesis and their management.

Practicals based on PSBT 314 (B) Advanced Mycology and Plant Pathology-I

1. Preparation of culture medium for fungi CDA medium and Sabourard's medium (1P)
2. Isolation of aquatic by baiting method (1P)
3. Isolation of fungi from rhizosphere soil. (1P)
4. Isolation of plant pathogenic fungi from root, stem and fruits (2P)
5. Study of seed borne fungi. (2P)
6. Study of fungi from the following groups – (10P)

   Myxomycetes- any two

   Chytridiomycetes- any two

   Oomycetes- any four

   Pyrenomycetes- any four

   Loculoascomycetes- any two

   Discomycetes- any four

Teliomycetes – any four

Gasteromycetes- any four

Hymenomycetes- any four

Deuteromycetes- any four

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 : **PSBT 316 (C)**

Paper : **VI**

Title of Paper : **Practical's based on PSBT 314 (C) Bryology- I**

Credits : **4** **Number of practicals : 11**

A) Learning Objectives:

1. To understand deep knowledge of season, collection, identification and life cycle of Bryophytes.
2. To study reproductive structures of Bryophytes.
3. To develop innovative *Ex-situ* conservation techniques for Bryophytes.

B) Learning Outcome:

1. Students are able to identify Bryophytes from different localities.
2. Students are acquainted knowledge of reproductive structure of Bryophytes.
3. Students are able to develop *Ex-situ* conservation techniques of Bryophytes.

Practical's based on PSBT 314 (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)
5. *Ex-situ* conservation techniques of Bryophytes. (any two) (01)

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

Paper Code : **PSBT 316 (D)**

Paper : **VI**

Title of Paper : **Practical's based on PSBT 314 (D) Angiosperm Taxonomy-I**

Credits : **4** **(Number of practicals : 15)**

A) Learning Objectives:

1. To pertain classification and taxonomy of Angiosperms.
2. To know the rules to name a new plant species.
3. To know the brief account of different systems of classification.

B) Learning Outcome:

1. Student will specify characteristics of recently discovered species and to arrange them in respective 'taxa' after looking at their similarities and give them scientific names.
2. Student will understand principles of general taxonomy and they can use nomenclature rules plants.
3. Student will understand historical development of taxonomy.

Practical's based on PSBT 314 (D) Angiosperm Taxonomy -I

1. Study of at least 15 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.