

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 2023-2024

Sem.	Paper Code	Title of Paper	No. of Credits	
III	PSBT 231	Angiosperms and Evolution	4	
	PSBT 232	Developmental Botany	4	
	PSBT 233	Computational Botany	4	
	PSBT 234 A	Advanced in Plant Physiology	OR	4
	PSBT 234 B	Advanced Mycology and Plant Pathology	OR	
	PSBT 234 C	Bryology	OR	
	PSBT 234 D	Angiosperm taxonomy		
	PSBT 235	Practical's Based on PSBT 231, 232 and 233		4
	PSBT 236 A	Practical's based on special paper Advanced Plant Physiology	OR	4
	PSBT 236 B	Practical's based on special paper Advanced Mycology and Plant Pathology	OR	
PSBT 236 C	Practical's based on special paper Bryology	OR		
PSBT 236 D	Practical's based on special paper Angiosperm Taxonomy			
	CC-23	Certificate Course – II	2	
	SD-23	Skill Development – I	2	
IV	PSBT 241	Plant Pathology	4	
	PSBT 242	Industrial Botany	4	
	PSBT 243	Plant Biotechnology	4	
	PSBT 244 A	Advanced Plant Physiology	OR	4
	PSBT 244 B	Advances in Mycology and Plant Pathology		

	PSBT 244 C	Bryology	OR	
	PSBT 244 D	Angiosperm taxonomy		
	PSBT 245	Practical's Based on PSBT 241, 242 and 243.		4
	PSBT 246	Research Projects, Review of Literature and Summer Training		4
	SD-24	Skill Development – II		2
		Total Credits		55

Class	:	M. Sc. II (Semester- IV)		
Paper Code	:	PSBT 241		
Paper	:	Title of Paper: Plant Pathology		
Credit	:	4	No. of lectures	: 60

A) Learning Objectives:

1. To give knowledge of nature and concepts of plant diseases.
2. To give idea about plant disease epidemiology and forecasting of plant disease epidemics.
3. To impart the knowledge about agricultural crop diseases.
4. To impart the knowledge of plant pathogenesis.
5. To impart the knowledge of mechanism of plant infection.
6. To idea about effect of environmental factors and disease development.
7. To impart the knowledge about management of crop diseases and pathophysiological skills.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Nature and concepts of plant diseases.
2. Plant disease epidemiology and forecasting of plant disease epidemics agricultural crop diseases.
3. Agricultural crop diseases
4. Plant pathogenesis.
5. Mechanism of plant infection.
6. Effect of environmental factors and disease development.
7. Management of crop diseases and pathophysiological skills.

Credit I - Introduction to Plant Pathology (15L)

- | | |
|---|-----------|
| 1.1 Plant Pathology- Milestones in plant pathology | 1L |
| 1.2 Plant pathology and its objectives | 1L |
| 1.3 Nature and concept of plant disease, classification of plant diseases | 2L |
| 1.4 Causes of plant diseases, symptoms of plant diseases, disease cycle | 2L |
| 1.5 Bacterial and mollicutes diseases of plants. | 2L |
| 1.6 Viral diseases of plants Diseases caused by viruses. | 2L |
| 1.7 Nematodal diseases of plants | 2L |
| 1.8 Plant disease epidemiology and forecasting of plant disease epidemics. | 2L |
| 1.9 Effect of plant diseases on human affairs | 1L |

Credit II - Pathogenesis

- | | |
|--|--------------|
| | (15L) |
| 2.1 Pathogenesis: Penetration, Infection and spread of diseases | 4L |
| 2.2 Effect of pathogen on plant physiological functions | 4L |
| 2.3 Enzymes and toxins in plant disease | 4L |
| 2.4 Pathogenicity of biotrophic and necrotrophic pathogens | 3L |

Credit III–Disease Development	(15 L)
3.1 Environmental factors and disease development- Effect of temperature, humidity, soil pH, soil texture, light, CO ₂ and O ₂ levels, nutrients and disease development	4L
3.2 Genetics of plant pathogen interactions- Genetics of host parasitic interactions, phytoalexin and antigen hypothesis, vertical and horizontal resistance, physiological specialization, adaptation of fungi to different hosts	3L
3.3. 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
3.4 Molecular biology of host pathogen interactions, pathogenesis genes, avirulence genes, host- R genes, effector molecules, miRNA	3L
3.5 Concept of post-harvest diseases of fruits, vegetables and seeds	2L
Credit IV-Disease Management and Related Aspects	(15 L)
4.1 Diagnostic methods for detecting pathogens	2L
4.2 Breeding methods for improving resistance in plants	3L
4.3 Control of disease using fungicides and other chemicals	2L
4.4 Bio-control agents for controlling disease	2L
4.5 Disease control using biological and chemical activators of resistance	2L
4.6 Plant disease assessment	2L
4.7 Biotechnology and its role in plant pathology	2L

References:

1. Plant Pathology by R. S. Mehrotra, first edition, McGraw-Hill Education publication, 1982.
2. Plant Pathology by George N Agrios, fifth edition, Academic Press, London, 2005.
3. Plant Nematode: Morphology, Systematics, Biology and Ecology by M. R. Khan, first edition, Science Publishers, 2008.
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

Class	:	M. Sc. II (Semester- IV)	
Paper Code	:	PSBT 242	
Paper	:	II	
Title of Paper	:	Industrial Botany	
Credits	:	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.
3. To learn about regulatory requirements and compliance related to plant-based industries.
4. To impart the knowledge of Algal products.
5. To impart the knowledge of Bioethanol Technology.
6. To idea about Fermentation Technology.
7. To impart the knowledge about Nutrition Garden and Entrepreneurship.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Know the future of use of plant at commercial level.
2. Find out applications of plants and plant-derived materials in industries.
3. Get idea about specific plant species that are used in various industries.
4. Know algal products.
5. Understand about bioethanol technology.
6. Get expert in fermentation technology.
7. learn nutrition garden and entrepreneurship.

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

A. Algal Technology

1.1. Introduction to Algal Technology 2L

Resource potential of algae, commercial utility of algae- food and feed, pigments, pharmaceuticals and nutraceuticals, fuel and biofertilizers, seaweeds extracts as biofertilizers.

1.2 Algal Products 5L

SCP- *Spirulina* mass cultivation and its applications, biodiesel from algae, advantages. liquid seaweed fertilizers – method of preparation and application.

1.3 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, *Trichogramma*
3. **Fungal-** *Trichoderma*, its isolation, mass multiplication and applications
4. **Bacterial-** *Bacillus thurengensis*
5. **Viral-** Nuclear Polyhydrosis Virus (NPV), Helicoverpa Nuclear Polyhydrosis Virus (HNPV)

Credit II - Biofuel Technology	(15 L)
2.1 Environmental implications of fossil fuel, concept of biofuel, alternatives for fossilfuels– ethanol, vegetable oil, biodiesel.	3L
2.2. 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.	
2.3 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	
2.3 Bio-hydrogen- Application and future prospects	2L
2.4 Methanogenesis from agro industrial residues	2L
Credit III -Fermentation Technology	(15L)
3.1 Introduction	5L
History, fermentation process, fermenters- design and construction, basic functions, types of fermenters, maintenance, types of fermentation process, batch fermentation, fed-batch fermentation, continuous fermentation, scale up of fermentations, industrial processes- upstream and down-stream processes.	
3.2 Alcohol and Beverage Industry	2L
Sources and methods of production of alcohol, beer and wine	
3.3 Organic Acid Industry	1L
Sources and methods of production of vinegar, and citric acid	
3.4 Antibiotic Industry	2L
Sources and methods of production of Penicillin, Cephalosporins, and Griseofulvins	
3.5 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, (<i>Agaricus</i>) Paddy straw mushroom (<i>Volvariella</i>) and Dhingrimushroom (<i>Pleurotus</i>).	
Credit IV. Nutrition Garden and Entrepreneurship	2L
4.1 Need of Nutritional Garden: Nutritional awareness, nutritional deficiencies and disorders, balanced diet and knowledge of indigenous vegetables and its nutrient content.	

4.2 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.

4.3 Quality seed production techniques (indigenous): Agronomy and seed treatments

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

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

4.5 Entrepreneur: Concept, characteristics of entrepreneur, types and functions of entrepreneur, difference between entrepreneur and a manager. 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, 2013.
2. Biofuel technology Handbook, Dominik Rutz, Rainer Janseen, WIP RenewableEnergies, Germany, 2007.
3. Biopesticides for sustainable agriculture: prospects and constraints, Editor(s): Nutan Kaushik, 2009.
4. Entrepreneur Developments, S. S. Khanka, S. Chand., 2005
5. A Text Book of Biotechnology. R C Dube, Publisher. S Chand · Publication2007

Class : M. Sc. II (Semester- IV)
Paper Code : PSBT 243
Paper : III **Title of Paper: Plant Biotechnology**
Credit : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To impart the fundamental aspects of plant tissue culture for the production of transgenics.
2. To make expertise students in tissue culture.
3. To understand basic plant transformation methods.
4. To develop the different skills of crop improvements and plant production.
5. To develop the knowledge about applied biotechnology.
6. To know about basics of recombinant DNA technology.
7. To make expertise the students in different molecular techniques.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Students will understand basic concepts in plant tissue culture.
2. Expertise in micropropagation techniques.
3. Understand the different plant transformation methods.
4. Student's expertise in skills of crop improvements and plant production.
5. Development of basic knowledge about applications of biotechnology.
6. Understand the different concepts in r-DNA technology.
7. Expertise in different molecular techniques.

Credit- I **15L**
Basics of Plant biotechnology and plant tissue culture

1.1 Plant biotechnology: Introduction, Scope and importance. Plant Tissue Culture: Principles (Totipotency, cellular differentiation and competency). **3L**

1.2 Micro propagation: Stages of Micro propagation (Stage 0 to Stage 4), Organogenesis, Somatic Embryogenesis. Shoot tip culture/ Auxiliary bud culture, Embryo Culture & Embryo Rescue. **4L**

1.3 Design & lab setup of Plant Tissue Culture laboratory, Tissue culture Media (Composition preparation), Initiation and Maintenance of callus & Suspension culture. **4L**

1.4 Acclimatization of Plants, Soma clonal Variations / *In-vitro* mutagenesis Selected successful examples of Plants of Diverse Origin using Tissue Culture technology, Rescue of endangered plants. **4L**

Credit - II **(15L)**

Agricultural Biotechnology

2.1 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. **5L**
- 2.2** Crop improvement – Advantages of biotechnological methods over conventional methods of crop improvement. **6L**
- a) Homozygous plant production through anther & pollen culture.
- b) Endosperm culture & production of triploids.
- c) Apomixes.
- d) Induced Polyembryony and their applications in crop improvement.
- 2.3** Use of bioreactors in plant production & Scale-up Marker assisted selection – introduction to markers (RFLP, AFLP, microsatellites, RAPD, QTL). **4L**

Credit -III **15L**

Applications of Plant Biotechnology

- 3.1** Commercial micropropagation, Metabolic engineering & Industrial products. Plant secondary metabolites, control mechanisms & manipulation of Phenyl Propanol pathway, Shikimate pathway. **5L**
- 3.2** Industrial enzymes, Biodegradable plastics, Therapeutic proteins, lysosomal enzymes, Antibodies, edible vaccines, Purification strategies, oleosin partitioning technology. **5L**
- 3.3** Integration of Genetic Engineering of Plants in Agriculture Diseases resistant, Biotic & Abiotic stress resistance, Enhancement of nutritional value of crop Plants & molecular farming. **5L**

Credit- IV **15L**

Recombinant DNA Technology

- 4.1** General concept, principle, scope and Applications, enzymes involved in recombinant DNA technology.
2) Cloning vectors: a) Prokaryotic - Plasmid, Lambda phage and Cosmid; b) Eukaryotic-YAC (Yeast Artificial Chromosomes). Gene library, c-DNA library molecular probes. **4L**
- 4.2** Blotting techniques: Southern blotting and Northern Blotting. **4L**
- 4.3** DNA fingerprinting: DNA marker – RAPD, ISSR, RFLP. **3L**
- 4.4** Polymerase chain reactions (PCR): Procedure (Denaturation, Annealing, Extension), Types of PCR, Applications, Advantages and Limitation of PCR. **4L**

References:

1. An introduction to Plant Tissue Culture 2nd edition. 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 Publications.
4. Chrispeels, M. J. (2002). Plant Tissue Culture: Genetical Aspects. Jones and Bartlett Publishers, International.
5. Chopra V. L. *et al.*, (1999). Applied Plant biotechnology. Science Publishers Inc.
6. Verpoorte, R. and A.W. Alfermann (Eds) (2000). Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
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 Publication House, India.
11. Ashwani Kumar, Shekhawat NS (2009) – Plant tissue culture and molecular markers: their role in improving crop productivity (IK International).
12. Rashid, A. 2009. Molecular physiology and Biotechnology of Flowering plants. Narosa Publishing House Pvt. Ltd., New Delhi
13. Biotechnology, 4th edition, (2010), H K Das, Wiley India Pvt. Limited, India.
14. Biotechnology – Fundamental & Application: S.S. Purohit.
15. Plant Tissue Culture – Rojgov. 7. Plant Tissue Culture (Practical) – H.S. Chawla.
16. Plant Biotechnology – B.D. Singh, Kalyani Publication.
17. Plant Biotechnology – R.S. Chawla – Oxford and IBH Publishing Co. Pvt. Ltd.
18. A text book of Biotechnology – Indu Shekhar Thakur, I.K. International Pvt. Ltd (New Delhi).

Class	: M.Sc. (Semester- IV)	
Paper Code	: PSBT 244 (A)	
Paper	: IV	Title of Paper : Advanced Plant Physiology
Credits	: 4	No. of lectures : 60

A) Learning Objectives:

1. To impart the knowledge about Stress physiology.
2. To develop the different skills physiological mechanism of drought tolerance.
3. To understand basics of allelochemicals.
4. To develop the different skills of crop physiology and enzymology.
5. To develop the knowledge about.
6. To know about basics of recombinant DNA technology.
7. To make expertise the students in different molecular techniques.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Students will understand basic concepts in plant tissue culture.
2. Get expertise in micro propagation techniques.
3. Understand the different plant transformation methods.
4. Get expertise in skills of crop improvements and plant production.
5. Develop basic knowledge about applications of biotechnology.
6. Understand the different concepts in r-DNA technology.
7. Get expertise in different molecular techniques.

Credit- I Stress physiology (15L)

- 1.1 Water Stress:** Membranes and water stress, Stomatal response to water stress, Photosynthesis and water stress, Osmotic adjustments, physiological mechanism of drought tolerance **2L**
- 1.2. Waterlogging stress:** Waterlogging injury, Metabolic damage, Hormonal imbalance, Soil toxins Tolerance mechanisms **2L**
- 1.3 Low temperature:** Chilling and freezing effects on germination, Physiological mechanism of low temperature tolerance, Effect of low temperature on plant productivity **2L**
- 1.4. Heat Stress:** Cellular response on high temperature, enzyme activities and photosynthesis ultra-structural effects. Functions of HSPs, role of membrane lipids in high temperance tolerance. **2L**
- 1.5 Metal stress:** Metal toxicity and tolerance with special reference to Aluminum, Manganese, Iron, Zinc, Role of phytochelatins (heavy, metal binding proteins). **1L**
- 1.6 Salt Stress:** Mechanism of salt stress, Effects of salts on physiology of plants. **2L**
- 1.7 UV stress:** Plant response to UV radiation in chemical composition of plants, Effect of UV

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

Credit II Allelochemicals (15L)

- 2.1** Major Allelochemicals nature in plants: Alkaloids, Phenolics, terpenoids, Glucosinolates, Isothiocyanates. **4L**
- 2.2** Release and regulation of allelochemicals production and release **3L**
- 2.3** Mode of action of allelochemicals on physiological process. **3L**
- 2.4** Physiological and molecular mechanism of disease resistance in plants: Hypersensitive response, elicitors, phytoalexins, physiology of disease resistance, SAR (Systemic Acquired Resistance) **4L**
- 2.5** Applications of allelochemicals. **1L**

Credit III : Crop Physiology and Enzymology 15L

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

Credit IV Experimental Plant Physiology (15L)

- 4.1** Preparation of solutions normal, molar, percent and ppm solutions. **2L**
- 4.2** Methods of setting of physiological experiments. **2L**
- 4.3** Physiological instruments-titrimetry, polarity and their protocols. **1L**
- 4.4** Post harvest physiology, ripening of fruits and its regulation, Metabolism of stored seeds and leafy vegetables. **5L**
- 4.5** Biostatistics: Graphical and diagrammatical representation of data. Measures of v central tendency, t-test, Chi-square test and ANOVA. **5L**

References:

- 1 Annual reviews of plant physiology and plant molecular biology.
- 2 Aspinall D. and Paleg, L. G. (eds.) 1981. The physiology and biochemistry of drought resistance in plants, academic Press. London.
- 3 Bewley, J. D. and Black, M. 1982 Physiology and biochemistry of seeds (vol 1 &2) Springer Verlag.

- 4 Buchana B. B., Gruissem, W and Jones, R. I. 2000. Biochemistry and molecular biology of plants. American Society of plant physiologists, Maryland, USA
- 5 Freifelder, D. Physical biochemistry
- 6 Goodwin, T. W. and Mercer L. E. 1989. Introductory Plant Biochemistry, Pergamon Press, New York, USA
- 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
- 9 Co-Evolution of Secondary Metabolites, Editors: Mérillon, Jean- Michel, Ramawat, Kishan Gopal (Eds.) Springer International Publishing.
- 10 Isolation, identification and characterization of allelochemicals / Natural Products, S.S. Narwal, International Allelopathy Foundation, 101, Sector - 14, Rohtak -124 001, India.
- 11 Sergey Shabala, Plant stress physiology, 2nd edition, Boston, MA : CABI, 2017.
- 12 Narendra Tuteja and Sarvajeet S. Gill, Abiotic Stress Response in Plants, 2016 Wiley –VCH verlag GmbH and Co.
- 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	:	PSBT 244 (B)	
Paper	:	IV	Title of Paper : Advanced Mycology and Plant Pathology
Credits	:	4	No. of lectures: 60

A) Learning Objectives:

1. To give knowledge of primary and secondary metabolites of fungi.
2. To give knowledge about heterothallism, heterokaryosis and parasexual cycle.
3. To give idea about fungal hormones and physiological specialization.
4. To impart the knowledge about role of fungi as saprotrophs.
5. To impart the knowledge of fungi as pathological relationships with other organisms.
6. To impart the knowledge of industrial and biotechnological applications of fungi.
7. To impart the basic skills and entrepreneurship development in the field of mushroom cultivation.

C) Learning Outcome:

By the end of the course, students will be able to:

1. Analyze primary and secondary metabolites of fungi.
2. Understand heterothallism, heterokaryosis and parasexual cycle.
3. Get idea about fungal hormones and physiological specialization.
4. Role of fungi as saprotrophs.
5. Know fungi as pathological relationships with other organisms.
6. Understand Industrial and biotechnological applications of fungi.
7. Get knowledge about entrepreneurship development in the field of mushroom cultivation.

Credit – I

(20L)

1.1 Heterothallism, heterokaryosis and parasexual cycle: Homothallism, Heterothallism (sexual incompatibility), Bipolar (unifactorial) heterothallism or two-factor heterothallism, Multi-factor heterothallism, Bipolar multiple – factor heterothallism, Tetrapolar (multi-factor) heterothallism, Octopolar (trifactorial) heterothallism, Heterogenic incompatibility (semi- incompatibility), Heterokaryosis and Parasexual cycle. **10L**

1.2 Fungal hormone, physiological specialization and phylogeny: Fungal hormones, Sirenin, Antheridiol and oogonial, Trisporic acidm, Yeast a-factor, Physiological specialization, Phylogeny of fungi, Theories of algal ancestry, Protozoans ancestry of fungi, Sparrow’s view with regard to the origin of lower fungi, Biochemical support for evolutionary relationships, Origin of Zygomycetes, Origin of Ascomycetes, Origin of Basidiomycetes, Recent concept on origin and phylogeny of fungi. **10L**

Credit – II**(20L)**

- 2.1 Role of fungi as saprotrophs:** Fungi as decomposers in nature, Return of carbon dioxide to the atmosphere, Humus formation, Types of organic compounds decomposed, Cellulose structure and its decomposition, Hemicelluloses decomposition, Decomposition of pectic compounds, Decomposition of lignin, Fungi in biodeterioration, Fungi in bioremediation and Fungi in food spoilage. **10L**
- 2.2 Fungi in pathological relationships with other organisms:** Fungi as plant parasites, Fungi as human pathogens, Entomogenous fungi, Fungi parasitic on other fungi, Fungi parasitic on lichens, Allergenic fungi, Poisonous fungi, Toxins from fungi. **10L**

Credit- III**(10L)**

- 3.1 Industrial and biotechnological applications of fungi:** Medicinal uses Transformation of steroids, Enzymes from fungi, Vitamins from fungi, Fungi as source of organic acids, Fungi in fermentation and food processing, Asian and oriental foods, Edible fungi & Mycoproteins, Fungi in cheese production, Fungi in biological assay, Fungi in biological control of pests, Myconematicides, Mycoinsecticides, Other application of fungal biotechnology. **10L**

Credit- IV**(10L)**

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

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. J. Alexopoulos, C. W. Mims, M. Blackwell 1996. Introductory Mycology (4th Edition), Willey, New York.
4. J. W. Deacon 2005. Fungal Biology (4th Edition), Blackwell Publishing, ISBN 1405130660.
5. Kirk *et al.*, 2001. Dictionary of fungi, 9th edition, Wallingford.
6. R. S. Mehrotra and K. R. Aneja, 1990. An introduction to mycology, New Age Publication.
7. J. Webster and W. Roland 2007. Introduction to fungi (3rd Edition), Cambridge University Press.
8. H. C. Dube, 2010. An Introduction to fungi, Vikas Publication.
9. R. Vashista and A. K. Sinha 2008. Botany for degree students- Fungi, S. Chands Pub.
10. O. P. Sharma, 2011. Fungi and allied microbes. McGraw Hill Education Private Ltd., New Delhi.

Class	:	M.Sc. (Semester- IV)			
Paper Code	:	PSBT 244 (C)			
Paper	:	IV	Title of Paper	:	Bryology
Credits	:	4	No. of lectures	:	60

A) Learning Objectives:

1. To understand deep knowledge of season, collection and life-cycle of plants.
2. To study vegetative, reproductive structures of plants
3. To develop In-situ and Ex-situ conservation techniques.
4. To identify the environmental and economic uses.
5. To understand the alternation of generations.
6. To understand an overview of diversifying bryophytes.
7. To understand evolution, morphology, physiology and ecology of bryophytes.

B) Learning Outcome:

1. Knowledge of bryophytes at different localities.
2. Understanding of practical applications of bryophytes.
3. Development of Ex-situ conservation techniques.
4. Protocols for In-vitro general techniques of tissue culture in bryophytes.
5. Students are able to develop Ex-Situ conservation techniques of bryophytes.
6. Understanding of economic importance of bryophytes.
7. Understanding the alternation of generations and evolution of bryophytes.

Credit –I (15L)

- 1.1** Different aspects of bryophytes ecology, growth forms effects of climatic, edaphic and biotic factors, role of liverworts, hornworts and mosses in plant communities and succession in terrestrial, aquatic and epiphytic ecosystem. **15L**

Credit –II (15L)

- 2.1** Important elements of micro-climate as local -topography, soil surface, air temperature, wind, precipitation and humidity, micro-climate importance in the study vegetation and methods as land forms, microclimate fluctuation correlated with Beta Diversity of Epiphyllous Bryophyte Communities site preservation, factors affecting microclimate w.r.t. topography, soil, water, vegetation, erosion and artificial structures. **15L**

Credit –III (15L)

- 3.1** Eco-physiological and climatic adaptations in bryophytes- Ecology of bryophytes, adaptations in bryophytes- canopy, epiphytes and epiphyllous, physiology of bryophytes

and water relations, oil bodies, bryophytes as indicators of altitude, air pollution and water pollution. **15L**

Credit –IV (15L)

4.1 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 penetration and establishment of mycorrhizal association, role of mycorrhiza in nutrition, germination, salt absorption and growth. **15L**

References:

1. S. R. Kashyap, 1929. Liverworts of Western Himalaya and Punjab Plain, Part-I. 1932, Part-II.
2. T. T. Mahabale, 1941. On the chromosomal complex of two species of *Riccia*, *Jour. univ. Bombay*, 16: 1-16.
3. T. S. Mahabale, and Gorji, 1941. Chromosomes in *Riccia himalayensis*. *Curr. Sci.*10:28.
4. P. N. Mehra, 1967. Evolutionary trends in the Hepaticae. *Phytomorphology*. 17: 47-58
5. N. S. Parihar, 1967. An Introduction to Embryophyta. Vol. I Central Book Depot, Allahabad.
6. A. Rashid, 1998. An Introduction to Bryophyta (Diversity, Development and Differentiation)
7. G. M. Smith, 1955. Cryptogamic Botany, Vol-II Bryophytes and Pteridophytes. Edi. 2, New York.
8. R. Udar, 1950. Studies in Indian Ricciaceae. *Proc. 37th Indian Sci. Cong.*40.
9. B. R. Vashishtha, 1993. Botany for Degree Students: Bryophyta.
10. E. V. Watson, 1955. British mosses and liverworts. Cambridge, 419 p.
11. R. S. Chopra, 1975. Taxonomy of Indian mosses.
12. R. N. Chopra and P. K .Kumra, 2005. Biology of Bryophytes.
13. A. J. E. Smith, 1982. Bryophyte Ecology.
14. R. N. Chopra and S. Bhatiya, 1990. Bryophyte Development- Physiology and Biochemistry.

Class	:	M. Sc. (Semester- IV)			
Paper Code	:	PSBT 244 (D)			
Paper	:	IV	Title of Paper	:	Angiosperm Taxonomy
Credits	:	4	No. of lectures	:	60

A) Learning Objectives:

1. To give knowledge about Origin of Angiosperms.
2. To learn about Importance and need for classification, hierarchical classification.
3. To learn about pre- and post- Darwinian systems of classification.
4. To impart the knowledge of fossil angiosperms of India.
5. To impart the knowledge of Floral Biology.
6. To idea about phytogeography.
7. To impart the knowledge about Dicotyledons and Monocotyledons families.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Origin of Angiosperms.
2. Importance and need for classification, hierarchical classification.
3. Pre- and post- Darwinian systems of classification.
4. Fossil angiosperms of India.
5. Floral Biology.
6. Phytogeography.
7. Dicotyledons and Monocotyledons families.

Credit I (15L)

1.1 Origin of angiosperms: Pre-cretaceous and Cretaceous fossil angiosperms; Time of origin of angiosperms; Cradle of angiosperms; monophyletic verses polyphyletic origin of angiosperms. **5L**

1.2 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 and chasmogamy. **10L**

Credit II (15 lectures)

2.1 Fossil angiosperms of India:

Brief account of fossil angiosperms of India- Palmae: Palmoxylon, Rhizopalmoxylon, Palmocarpon; Cyclanthaceae: Cyclanthodendron, Tricocites; Pandanaceae: Viracarpon; Musaceae: Musa Gramineae: Graminocarpon; Sonneriaceae: Sonnerioxylon, Sahnianthus, Enigmocarpon; Guttiferae: Indocarpa, Myrtaceae: Sahnipushpam; Malvaceae: Sahnioocarpon, Chitaleypushpam. Fossil

angiosperms and palaeoecology of India.

Credit III

(15 L)

3.1 Phytogeography: Geological time scale, geographical history, Continental Drift, Land Bridges, shifting of poles, theories of differentiation and natural selection, Center of origin, types and areas of natural distribution, phytogeographical regions of the World, Botanical provinces of India and their characteristic vegetation with emphasis on Vegetation and Phytogeography of the Western Ghats.

3.2 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 and Scrophulariaceae.
- b) **Monocotyledons:** Liliaceae, Eriocaulaceae, Pandanaceae, Hydrocharitaceae, Lemnaceae and Poaceae.

References

1. M. Ahmedullah, and M. P. Nayar. 1987. Endemic Plants of the Indian Region Vol I. Botanical Survey of India.
2. T. Cooke, 1903-1908. The Flora of Presidency of Bombay, Vol. I-III.
3. P. H. Davis, and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.
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. K. S. Manilal, and M. S. Muktesh Kumar [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
8. V. N. Naik, 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi.
9. K. Paech, and M.V. Tracey. 1956. Modern Methods of Plant Analysis. Vol-I & II. Springer-Verlag.

10. R. B. Primak, 2004. A Primer of Conservation Biology. Sinauer Associates, Inc. Publishers.
11. K. R. Shivanna, and B. M. Johri 1985. The Angiosperm Pollen: structure and Function. Wiley Eastern limited, New Delhi.
12. Synge, Hugh (ed.) 1980. The biological aspects of Rare Plant Conservation. John Wiley & Sons.
13. A. Takhtajan, 1962. Flowering plants- Origin and Dispersal.

Class	:	M.Sc. (Semester- IV)			
Paper Code	:	PSBT 245			
Paper	:	I, II & III Title of Paper: Practical's on PSBT 241, 242 & 243.			
Credits	:	4	No. of lectures	:	60

A) Learning Objectives:

1. To give knowledge about fungal, bacterial, nematodal and viral diseases.
2. To learn about isolation of fungal pathogens from leaves, stem and roots by cultural methods.
3. To learn about pure culture of fungi.
4. To impart the knowledge of qualitative analysis of primary and secondary metabolites.
5. To impart the knowledge of post-harvest diseases of fruits.
6. To idea about nursery media, preparation of nursery beds and raising of nursery seedlings.
7. To impart the knowledge about Plant Biotechnology.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Study fungal, bacterial, nematodal and viral diseases.
2. Know the techniques isolation of fungal pathogens from leaves, stem and roots by cultural methods.
3. Get expertise in pure culture of fungi.
4. Qualitative analysis of primary and secondary metabolites.
5. Understand post-harvest diseases of fruits.
6. Know the techniques of nursery media, preparation of nursery beds and raising of nursery seedlings.
7. Understand the Plant Biotechnology.

Practical's based on PSBT 241 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. Study of pure culture of fungi by streak plate and pour plate method | 1P |

Practical's based on PSBT 242 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 |

Practical's based on PSBT 243 Plant Biotechnology

- | | |
|---|-----------|
| 1. Preparation of M. S. Media. | 1P |
| 2. Ex-plant Surface Sterilization, Callus Culture and Organ Culture | 1P |
| 3. Isolation of root nodule bacteria. | 1P |
| 4. Protoplast isolation and culture. | 1P |

Note:

(Visit to Krishi Vigyan Kendra to see Kavivarya Botanical Garden T. C. College Baramati, Olericulture practices and submission of report.

Class	:	M.Sc. (Semester- IV)		
Paper Code	:	PSBT 246		
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 of review and case studies.
3. To give knowledge about review of literature.
4. To learn about results and discussion.
5. To learn about conclusion and references.
6. To impart the knowledge of writing thesis.
7. To impart the knowledge of power point presentation.

B) Learning Outcome:

By the end of the course, students will be able to:

1. Conduct hands on training and practical skills.
2. Write of review.
3. Understand the review of literature.
4. Write of results and discussion of research project.
5. Write of Conclusion and references.
6. Write thesis.
7. Prepare Power Point Presentation (PPT).

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. **15L**

Credit – 3 and 4: Summer Training (30L)

Report submission based on one summer training in research institutes Laboratory/ industry for at least one month with certificate from respective authority. **15L**