Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Botany

(Faculty of Science & Technology)

CBCS Syllabus

M. Sc. (Botany) Part-II, Semester -IV

For Department of Botany

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2024-2025

Title of the Programme: M.Sc. (Botany)

Preamble

AES's Tuljaram Chaturchand College of Arts, Science and Commerce (Autonomous) has made the decision to change the syllabi of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Botany and related subjects, the Board of Studies in Botany at Tuljaram Chaturchand College of Arts, Science and Commerce (Autonomous), Baramati - Pune, has developed the curriculum for the first semester of F.Y. B.Sc. Botany which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A Botany Post Graduates degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Post Graduates in Botany find opportunities in various fields, including urban planning, teaching, environmental science, all

plant sciences, Bioinformatics, Genetic Engineering, Biostatistics, Plant Biotechnology, Database analysis, Organic farming, nursery management, entrepreneurship mushroom cultivation, Plant physiology, Bryology, Taxonomy, Ethno botany, plant tissue culture method and many other domains. Throughout their Two-year degree program, students explore the significance of plant in life of each and every living organism on Earth. They learn tool, techniques, process which is required to set up agencies including pickles, jam, and jelly medicinal plant, fruit processing, vegetable processing, organic product, organic fertilizer and pesticides producing industries also the can earn the knowledge to produce natural remedies for varies diseases. They became expert in discovery and development of many new therapeutic compounds which can be used in pharmaceutical herbal cosmetics and other cosmetic based industries.

Overall, revising the Botany syllabi in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO1. **Knowledge and understanding of:** 1. The range of plant diversity in terms of structure, anatomy, function and environmental relationships. 2. The evaluation of plant diversity. 3. Identification and classification and the flora of Maharashtra. 4. The role of plants in the functioning of the global ecosystem. 5. A selection of more specialized, optional topics. 6. Application of Statistics to solve biological problems.

PSO2. **Intellectual skills – able to:** 1. Think logically and organize tasks into a structured form 2. Assimilate knowledge and ideas based on wide reading and through the internet. 3. Transfer of appropriate knowledge and methods from one concept to another within the subject. 4. Understand the evolving state of knowledge in a rapidly developing research field. 5. Construct and test hypothesis. 6. Plan, conduct and write a report on an independent term project.

PSO3. **Practical skills:** Students learn to carry out practical work, in the field and in the laboratory, with minimal risk. They gain introductory experience in applying each of the following skills and gain greater proficiency in a selection of them depending on their choice of optional modules. 1. Interpreting plant morphology and anatomy. 2. Plant identification. 3. Vegetation study techniques. 4. Analysis of chemical compounds in plant materials in the context of plant physiology and biochemistry. 5. Analyze data using appropriate statistical methods and computational softwares. 6. Plant pathology to be added for lab to land form.

PSO4. **Transferable skills:** 1. Use of IT (word-processing, use of internet, statistical packages and databases). 2. Communication of scientific ideas in writing and orally. 3. Ability to co-ordinate as part of team. 4. Ability to use library resources. 5. Time management. 6. Career planning.

PSO5. **Scientific Knowledge:** Apply the knowledge of basic plant science, life sciences and fundamental process of plants to study and analyze any plant form.

PSO6. **Problem analysis**: Identify the taxonomic position of plants, formulate the research literature and analyze RET structure and non-reported plants with substantiated conclusions using first principles and methods of nomenclature and classification in Botany.

PSO7. **Design/development of solutions**: Design solutions from medicinal plants to

solve health problems, disorders and disease of human beings and animals estimate the phytochemical content of plants which fulfill the specified needs to appropriate consideration for the public and animal health.

PSO8. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide scientific conclusions.

PSO9. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern instruments and equipment for Biochemical estimation, Molecular Biology, Biotechnology, Bioinformatics, Biophysics, Biostatistics, Plant Tissue culture experiments, cellular and physiological activities of plants with an understanding of the application and limitations.

PSO10. **The Botanist and society**: Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legaland environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.

PSO11. **Environment and sustainability**: Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable agricultural and environmental development.

PSO12. **Ethics**: Apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity conservation.

PSO13. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary task settings.

PSO14. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and interpret effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PSO15. **Project management and finance**: Apply knowledge and understanding of the engineering and management principles and apply these to one's own work,as a member and leader in a team, to manage projects and in multidisciplinary ecofriendly environments.

PSO16. **Life-long learning:** Identify the necessity, and have the preparation and ability to engage in independent and life-long learning in the broadest context of upcoming advanced technological.

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati.

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati is an autonomous & dynamic institute and has successfully implemented the National Education Policy-2020 since the academic year 2023-24. We are updating our academic policies as per local needs keeping in view the global perspectives. Accordingly, we have updated our program outcomes as per the graduate attributes defined in New Education Policy.

Program Outcomes for M.Sc.

1. **Comprehensive Knowledge and Understanding:**

   Postgraduates will possess a profound understanding of their field, encompassing foundational theories, methodologies, and key concepts within a multidisciplinary context.

2. **Practical, Professional, and Procedural Knowledge:**

   Postgraduates will acquire practical skills and expertise necessary for professional tasks, including industry standards, regulations, and ethical considerations, with effective application in real-world scenarios.

3. **Entrepreneurial Mindset, Innovation, and Business Understanding:**

   Postgraduates will cultivate an entrepreneurial mindset, identify opportunities, foster innovation, and understand business principles, market dynamics, and risk management strategies.

4. **Specialized Skills, Critical Thinking, and Problem-Solving**

   Postgraduates will demonstrate proficiency in technical skills, analytical abilities, effective communication, and leadership, adapting and innovating in response to changing circumstances.

5. **Research, Analytical Reasoning, and Ethical Conduct:**

   Postgraduates will exhibit observational and inquiry skills, formulate research questions, utilize appropriate methodologies for data analysis, and adhere to research ethics while effectively reporting findings.

6. **Communication, Collaboration, and Leadership:**

   Postgraduates will effectively communicate complex information, collaborate in diverse teams, demonstrate leadership qualities, and facilitate cooperative efforts toward common goals.

7. **Digital Proficiency and Technological Skills:**

   Postgraduates will demonstrate proficiency in using ICT, accessing information sources, analyzing data using appropriate software, and adapting to technological advancements.

8. **Multicultural Competence, Inclusive Spirit, and Empathy:**

   Postgraduates will engage effectively in multicultural settings, respect diverse perspectives, lead diverse teams, and demonstrate empathy and understanding of others' perspectives and emotions.

9. **Value Inculcation, Environmental Awareness, and Ethical Practices:**

   Postgraduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and promote sustainability and environmental conservation.

10. **Autonomy, Responsibility, and Accountability:**

    Postgraduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts, contributing to societal well-being.

Anekant Education Society's
Tuljaram Chaturchand College, Baramati
(Autonomous)
Board of Studies (BOS) in Botany

Sr. No.	Name	Designation
1.	Prof. Dr. Bhagwan Mali	Chairman
2.	Prof. Dr. Mahadev Kanade	Member
3.	Prof. Dr. Ajit Telave	Member
4.	Dr. Rupali Chitale	Member
5.	Dr. Madhuri Patil	Member
6.	Mr. Sauraj N. Torane	Member
7.	Ms. Ashwini B. Dudhal	Member
8.	Mr. Prasad J. Bankar	Member
9.	Mr. Sourabh R. Chandankar	Member
10.	Prof. Dr. B. M. Gaykar	Expert from SPPU, Pune
11.	Prof. D. K. Gaikwad	Expert from other university
12.	Dr. Jay Chavan	Expert from other university
13.	Dr. S. Gurumurthy	Expert from allied area
14.	Mr. Gore Nitin Anil	Meritorious Student
15.	Ms. Ligade Komal Sambhaji	Meritorious Student
16.	Mr. Zodage Ram Sanjay	Meritorious Student
17.	Ms. Gargade Rutuja Hanumant	Meritorious Student

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)
Credit Distribution Structure for M. Sc. Part: II, Sem. III (Botany)
(CBCS as per NEP 2020)
WEF: June 2024

Sem.	Course Type	Course Code	Course Title	Theory and Practical	No. of Credits
III	Major (Mandatory)	BOT-601-MJM	Angiosperms and Evolution	Theory	04
	Major (Mandatory)	BOT-602-MJM	Computational Botany	Theory	04
	Major (Mandatory)	BOT-603-MJM	Practicals based on BOT-601-MJM	Practical	02
	Major (Mandatory)	BOT-604-MJM	Practicals based on BOT-602-MJM	Practical	02
	Major (Elective)	BOT-611-MJE (A)	Advanced Plant Physiology-I	Theory	02
	Major (Elective)	BOT-611- MJE (B)	Advanced Mycology-I		
	Major (Elective)	BOT-612-MJE (A)	Practicals based on BOT-611-MJE (A)	Practical	02
	Major (Elective)	BOT-612- MJE (B)	Practicals based on BOT-611-MJE (B)		
	Research Project (RP)	BOT-621-RP	-	Practical	04
	Skill Development Course	BOT-631-SDC	Skill Development Course	Theory	02
	Total Credit Semester III				**20**
IV	Major (Mandatory)	BOT-651-MJM	Plant Pathology	Theory	04
	Major (Mandatory)	BOT-652-MJM	Advanced Plant Biotechnology	Theory	04
	Major (Mandatory)	BOT-653-MJM	Botany Practical - I	Practical	02
	Major (Elective)	BOT-661-MJE (A)	Advanced Plant Physiology-II	Theory	02
	Major (Elective)	BOT-661-MJE (B)	Advanced Mycology-II		
	Major (Elective)	BOT-662-MJE (A)	Practical based on BOT-661-MJE (A)	Practical	02
	Major (Elective)	BOT-662-MJE (B)	Practical based on BOT-661-MJE (B)		
	Research Project (RP)	BOT-681-RP	-	Practical	06
	Skill Development Course	BOT-691-SDC	Skill Development Course	Theory	02
	Total Credit Semester III				**20**
	Cumulative Credits Semester III and IV				**40**

Name of Programme : M.Sc. Botany
Programme Code : PSBOT
Class : M. Sc. II
Semester : IV
Course Type : Major (Mandatory) (Theory)
Course Code : BOT-651-MJM
Course Title : Plant Pathology
No. of Credits : 04
No. of Teaching Hours : 60

A) Course 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) Course Outcome:

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

CO1. Nature and concepts of plant diseases.
CO2. Plant disease epidemiology and forecasting of plant disease epidemics agricultural crop diseases.
CO3. Agricultural crop diseases.
CO4. Plant pathogenesis.
CO5. Mechanism of plant infection.
CO6. Effect of environmental factors and disease development.
CO7. Management of crop diseases and pathophysiological skills.

Credit I - Introduction to Plant Pathology (15L)

Unit- 1

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)

Unit- 2

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 **(15L)**

Unit- III

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

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

3.3 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, pathogenesity genes, avirulance genes, host- R genes, effecter molecules, miRNA 3L

3.5 Concept of post-harvest diseases of fruits, vegetables and seeds 2L

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

Unit- IV

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, firstedition, 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. Bio control of Plant Diseases by P. C. Trivedi, first edition, Aavishkar Publishers andDistributors, 2007.
7. Concise Encyclopedia of Plant pathology by P. Vidhyasekaran, first edition, CRCPress, 2004.
8. Topics in Mycology and Pathology by L. N. Nair, first edition, New Central BookAgency Kolkata, 2007.

Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. IV) **Subject**: Botany
Course: Elective Papers – Plant Pathology **Course Code**: **BOT-651-MJM**
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO 1	3	3		3	3				3	
CO 2	3	3		3	3		2		3	
CO 3	3	3		3	3	3				
CO 4	3	3		3	3				3	
CO 5	3	3		3	3				3	
CO 6	3	3	3			3		3		
CO 7	3	3	3	3	3					

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO1: Nature and concepts of plant diseases.
CO2: Plant disease epidemiology and forecasting of plant disease epidemics in agricultural crop diseases.
CO3: Agricultural crop diseases.
CO4: Plant pathogenesis.
CO6: Effect of environmental factors on disease development.
CO7: Management of crop diseases and pathophysiological skills.

PO2 Practical, Professional, and Procedural Knowledge:
CO1: Nature and concepts of plant diseases.
CO2: Plant disease epidemiology and forecasting of plant disease epidemics in agricultural crop diseases.
CO3: Agricultural crop diseases.
CO4: Plant pathogenesis.
CO6: Effect of environmental factors on disease development.
CO7: Management of crop diseases and pathophysiological skills.

PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO7: Management of crop diseases and pathophysiological skills.

PO4 Specialized Skills, Critical Thinking, and Problem-Solving
CO1: Nature and concepts of plant diseases.
CO2: Plant disease epidemiology and forecasting of plant disease epidemics in agricultural crop diseases.
CO3: Agricultural crop diseases.
CO4: Plant pathogenesis.
CO6: Effect of environmental factors on disease development.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO1: Nature and concepts of plant diseases.
CO2: Plant disease epidemiology and forecasting of plant disease epidemics in agricultural crop diseases.
CO3: Agricultural crop diseases.
CO4: Plant pathogenesis.
CO6: Effect of environmental factors on disease development.
CO7: Management of crop diseases and pathophysiological skills.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1: Nature and concepts of plant diseases.
CO2: Plant disease epidemiology and forecasting of plant disease epidemics in agricultural crop diseases.
CO3: Agricultural crop diseases.
CO4: Plant pathogenesis.
CO6: Effect of environmental factors on disease development.

Class : M.Sc. (Semester-IV)
Paper Code : BOT-652-MJM (Theory)
Paper : III
Title of Paper : Advanced Plant Biotechnology
Credit : 4
No. of lectures : 60

A) Learning Objective

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) Course Outcome

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

CO1. Understanding of the fundamental concepts, scope, and importance of plant biotechnology.
CO2. Explore specific tissue culture techniques such as shoot tip culture, embryo culture, and embryo rescue.
CO3. Understand the different plant transformation methods.
CO4. Student's expertise in skills of crop improvements and plant production.
CO5. Development of basic knowledge about applications of biotechnology.
CO6. Understand the different concepts in r-DNA technology.
CO7. 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, Somaclonal 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, 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) Apomixis.
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, QTL). 4L

Credit-III **15L**

Applications of Plant Biotechnology

3.1 Commercial micro-propagation, metabolic engineering & Industrial products. Plant secondary metabolites, Shikimate pathway. 5L

3.2 Industrial enzymes, Bio-degradable plastics, Therapeutic proteins, lysosomal enzymes, Antibodies, edible vaccines, Purification strategies. 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. 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 and 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. Text book of plant biotechnology, Chawala P.K. (2002), Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and M. K. Razdan1996. 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. Agro-biotechnology and plant tissue culture, Bhojwani S S, Soh W Y, Oxford & IBH Publ, India.
8. Agricultural biotechnology, (2005), Kumar H D, Daya Publ House, India.
9. Plant molecular breeding,(2009), Newbury H J, 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 N S (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), HKD as, Wiley India Pvt. Limited, India.
14. Biotechnology – Fundamental &Application: S.S. Purohit.
15. Plant Tissue Culture – Rojdov. 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).

Choice Based Credit System Syllabus

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. IV) **Subject**: Botany
Course: Plant Biotechnology **Course Code**: PSBT 243
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10
CO1	3		3		3		3	3		
CO2	3			3		3			3	
CO3		3	2				2			
CO4						2		3		3
CO5	3			3	3				2	
CO6		2					2			2
CO7	1	2		1		2		2		2

Justification for the mapping

1. **Comprehensive Knowledge and Understanding:**
   CO1. Understanding of the fundamental concepts, scope, and importance of plant biotechnology.
   CO2. Explore specific tissue culture techniques such as shoot tip culture, embryo culture, and embryo rescue.
   CO5. Development of basic knowledge about applications of biotechnology.
   CO7. Expertise in different molecular techniques.
2. **Practical, Professional and Procedural Knowledge:**
   CO1. Understanding of the fundamental concepts, scope, and importance of plant biotechnology.
   CO3. Understand the different plant transformation methods.
   CO6. Understand the different concepts in r-DNA technology.
   CO7. Expertise in different molecular techniques.
3. **Entrepreneurial Mindset, Innovation and Business Understanding:**
   CO1. Understanding of the fundamental concepts, scope, and importance of

plant biotechnology.
CO3. Understand the different plant transformation methods.

4. **Specialized Skills, Critical Thinking and Problem-Solving**
   CO2. Explore specific tissue culture techniques such as shoot tip culture, embryo culture, and embryo rescue.
   CO5. Development of basic knowledge about applications of biotechnology.
   CO7. Expertise in different molecular techniques.
5. **Research, Analytical Reasoning and Ethical Conduct:**
   CO1. Understanding of the fundamental concepts, scope, and importance of plant biotechnology.
   CO5. Development of basic knowledge about applications of biotechnology.
6. **Communication, Collaboration and Leadership:**
   CO2. Explore specific tissue culture techniques such as shoot tip culture, embryo culture, and embryo rescue.
   CO4. Student's expertise in skills of crop improvements and plant production.
   CO7. Expertise in different molecular techniques.
7. **Digital Proficiency and Technological Skills:**
   CO1. Understanding of the fundamental concepts, scope, and importance of plant biotechnology.
   CO3. Understand the different plant transformation methods.
   CO6. Understand the different concepts in r-DNA technology.
8. **Multicultural Competence, Inclusive Spirit and Empathy:**
   CO1. Understanding of the fundamental concepts, scope, and importance of plant biotechnology.
   CO4. Student's expertise in skills of crop improvements and plant production.
   CO7. Expertise in different molecular techniques.
9. **Value Inculcation, Environmental Awareness, and Ethical Practices:**
   CO2. Explore specific tissue culture techniques such as shoot tip culture, embryo culture, and embryo rescue.
   CO5. Development of basic knowledge about applications of biotechnology.
10. **Autonomy, Responsibility and Accountability:**
    CO4. Student's expertise in skills of crop improvements and plant production.
    CO6. Understand the different concepts in r-DNA technology.
    CO7. Expertise in different molecular techniques.

Class : M.Sc. (Semester-IV)
Paper Code : BOT-653-MJM
Paper : Practical-I
Title of Paper : Practical's on BOT -651- MJM & BOT-652. MJM
Credits : 2
No. of lectures : 60

A) Learning Objective

1. To give knowledge about fungal, bacterial, nematodeal 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) Course Outcome

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

CO1. Study fungal, bacterial, nematodal and viral diseases.

CO2. Know the techniques isolation of fungal pathogens from leaves, stem and roots by cultural methods.

CO3. Gain a detailed understanding of the major types of plant diseases

CO4. Acquire hands-on experience in isolating fungal pathogens from various plant parts.

CO5. Understand post-harvest diseases of fruits.

CO6. Gain experience in the isolation and culture of protoplasts, a critical skill in plant genetic engineering and biotechnology research.

CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

Practical's based on BOT -651 -MJM Plant Pathology

1. Study of any two bacterial plant diseases. 1P
2. Study of any two nematodal plant diseases. 1P
3. Study of any two viral plant diseases. 1P
4. Study of any six fungal plant diseases. 2P
5. Isolation of fungal pathogens from leaves, stem and roots. 2P
6. Study of pure culture of fungi by streak plate and pour plate method. 1P

Practical's based on PSBT 243 Plant Biotechnology

1. Preparation of M.S. Medium. 1P
2. Study of Callus and Embryo Culture. 1P
3. Study of Anther Culture. 1P

4. Isolation of root nodule bacteria. 1P
5. Protoplast isolation and culture. 1P
6. Isolation of root nodule bacteria. 1P
7. Study of *Agrobacterium* mediated transformation. 1P

Note:

Visit to Krishi Vigyan Kendra or Tissue culture laboratory nearby you and submit the visit report in semester end examination.

Choice Based Credit System Syllabus

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. IV) **Subject**: Botany
Course: Practical based on BOT 651& BOT652 **Course Code**: BOT-653-MJM
Weightage: 1=weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10
CO1	3			3				1		
CO2		3					2		2	1
CO3	3				3				2	
CO4		3		3		2	2			
CO5	3		2					2	3	
CO6					3	2	3		2	
CO7		3	3	3	3	2		2		2

Justification for the mapping

1. **Comprehensive Knowledge and Understanding:**
   CO1. Study fungal, bacterial, nematodal and viral diseases.

   CO3. Gain a detailed understanding of the major types of plant diseases.
   CO5. Understand post-harvest diseases of fruits.

2. **Practical, Professional and Procedural Knowledge:**
   CO2. Know the techniques isolation of fungal pathogens from leaves, stem and roots by cultural methods.
   CO4. Acquire hands-on experience in isolating fungal pathogens from various plant parts.
   CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

3. **Entrepreneurial Mindset, Innovation and Business Understanding:**
   CO5. Understand post-harvest diseases of fruits.
   CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

4. **Specialized Skills, Critical Thinking and Problem-Solving**
   CO1. Study fungal, bacterial, nematodal and viral diseases.
   CO4. Acquire hands-on experience in isolating fungal pathogens from various plant parts.
   CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

5. **Research, Analytical Reasoning and Ethical Conduct:**
   CO3. Gain a detailed understanding of the major types of plant diseases.
   CO6. Gain experience in the isolation and culture of protoplasts, a critical skill in plant genetic engineering and biotechnology research.
   CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

6. **Communication, Collaboration and Leadership:**
   CO4. Acquire hands-on experience in isolating fungal pathogens from various plant parts.
   CO6. Gain experience in the isolation and culture of protoplasts, a critical skill in plant genetic engineering and biotechnology research.
   CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

7. **Digital Proficiency and Technological Skills:**
   CO2. Know the techniques isolation of fungal pathogens from leaves, stem and roots by cultural methods.
   CO4. Acquire hands-on experience in isolating fungal pathogens from various plant parts.
   CO6. Gain experience in the isolation and culture of protoplasts, a critical skill in plant genetic engineering and biotechnology research.

8. **Multicultural Competence, Inclusive Spirit and Empathy:**
   CO1. Study fungal, bacterial, nematodal and viral diseases.
   CO5. Understand post-harvest diseases of fruits.
   CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

9. **Value Inculcation, Environmental Awareness, and Ethical Practices:**
   CO2. Know the techniques isolation of fungal pathogens from leaves, stem and roots by cultural methods.
   CO3. Gain a detailed understanding of the major types of plant diseases
   CO5. Understand post-harvest diseases of fruits.
   CO6. Gain experience in the isolation and culture of protoplasts, a critical skill in plant genetic engineering and biotechnology research.

10. **Autonomy, Responsibility and Accountability:**
    CO1. Study fungal, bacterial, nematodal and viral diseases.
    CO7. Explore the use of Agrobacterium-mediated transformation, providing them with foundational knowledge in plant genetic modification.

Class : M.Sc. (Semester- IV)
Paper Code : BOT 661 -MJE (A)
Paper : IV
Title of Paper : Advanced Plant Physiology (Theory)
Credits : 2
No. of lectures: 30

A) Learning Objectives:

1. To understand methodology of preparation and standardization of chemicals
2. To study the physiological instruments and their working
3. To get idea response of plant towards stress
4. To understand knowledge of statistical analysis
5. To understand Physiological and molecular mechanism of disease resistance in plants
6. To get idea about role of plant physiology in agriculture.
7. To get knowledge about action mechanism of allellochemicals.

B) Course Outcomes:

At the end of this course students will able to:
CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
CO3. Able to identify mechanism of stress tolerance.
CO4. Develope knowledge of biostatistic.
CO5. Identify plant response towards biotic stress.
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

Credit I: Allellochemicals and experimental Plant physiology 15L

1. Major Allelochemicals nature in plants: Alkaloides, phenolics, terpenoides, glucosinolates, isothyosinates. **3L**
2. Release and regulation of allellochemicals production and release **2L**
3. Mode of action of allellochemicals on physiological process. **2L**
4. Physiological and molecular mechanism of disease resistance in plants : Hypersensitive response, elicitors, phytoalexins, physiology of disease resistance, SAR(System Aquired Resistance) **3L**
5. Applications of allellochemicals. **1L**
6. Preparation of solutions normal, molar, percent, ppm solutions and buffers. **2L**
7. Biostatistics: Graphical and diagrammatical representation of data. t-test, Chi-square test.**2L**

Credit II : Crop Physiology and Enzymology 15L

1. Physiological basis of yield of Jowar, Pea, Maize, Soyabean
2. Role of crop physiology in agriculture, crop growth and productivity.

8L

3. Enzyme structure and properties, classification, Enzymes as biocatalysts, Importance of enzyme kinetics, factors affecting rates of enzyme mediated reaction, Michaelis-menton substrate equation, Lineweaver- Burke plot, Haldane-Briggs relationship. **7L**

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) Springeer Verlag
4 Buchana B. b., Gruissem, W and Jones, R. l. 2000. Biochemistry ans 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 (2nd 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 allellochemicals / 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,2016Wiley – 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.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. IV) **Subject**: Botany

Course: Advanced Plant Physiology I **Course Code**: **BOT 661 -MJE (A)**

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3		3			2			
CO 2	3		3	3		1			
CO 3	1					3			
CO 4	2	3		2					
CO 5	2			3					
CO 6	3			3		3	3		
CO 7		3				3	3		

Justification for the mapping

PO 1 : Disciplinary Knowledge

CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
CO3. Able to identify mechanism of stress tolerance.
CO4. Develope knowledge of data analysis using statistic.
CO5. Identify plant response towards biotic stress.
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

PO 2 : Critical Thinking and Problem solving

CO4. Develope knowledge of data analysis using statistic.
CO7. Use knowledge of applications of allellochemicals.

PO 3 : Research-related skills and Scientific temper

CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.

PO 6 : Self-directed and Life-long learning

CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
CO3. Able to identify mechanism of stress tolerance.
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

PO 7 Critical Thinking and Problem solving:

CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

Class : M.Sc. (Semester- IV)
Paper Code : BOT 662 -MJE (A)
Paper : IV
Title of Paper : Advanced Plant Physiology
Credits : 4
No. of lectures : 60

A) Learning Objectives:

1. To understand methodology of preparation and standardization of chemicals
2. To study the physiological instruments and their working
3. To get idea response of plant towards stress
4. To understand knowledge of statistical analysis
5. To understand Physiological and molecular mechanism of disease resistance in plants
6. To get idea about role of plant physiology in agriculture.
7. To know and understand the experimental strategies and tools allowing widening and deepening the knowledge in plant physiology.

B) Course Outcomes:

At the end of this course students will able to:

CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
CO3. Able to identify mechanism of stress tolerance.
CO4. Develope knowledge of biostatistic.
CO5. Identify plant response towards biotic stress.
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

Practicals Based on Based on BOT 661 MJE (A)

1. Preparation of Normal, Molar, Percent, PPM solution	2P
2. Preparation of Phosphate Buffer	1P
3. Estimation of Hydrocyanic acid released from plant tissues.	1P
4. Estimation of Catalase activity from normal and infected tissue.	2P
5. Measurement of leaf Area by graph paper method.	1P
6. Calculation of Growth indices: Leaf Area Index, Leaf Area ratio, Leaf Weight Ratio, Specific Leaf Area	1P
7. Measurement of Relative Water Content (RWC) of leaf.	1P
8. Measurement of Aerenchyma.	1P

Mapping of Program Outcomes with Course Outcomes
Class: M. Sc. II (Sem. IV) **Subject**: Botany
Course: Advanced Plant Physiology I **Course Code**: **BOT 662 -MJE (A)**

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3		3			2			
CO 2	3		3	3		1			
CO 3	1					3			
CO 4	2	3		2					
CO 5	2			3					
CO 6	3			3		3	3		
CO 7		3				3	3		

Justification for the mapping

PO 1 : Disciplinary Knowledge
CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
CO3. Able to identify mechanism of stress tolerance.
CO4. Develope knowledge of data analysis using statistic.
CO5. Identify plant response towards biotic stress.
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

PO 2 : Critical Thinking and Problem solving
CO4. Develope knowledge of data analysis using statistic.
CO7. Use knowledge of applications of allellochemicals.

PO 3 : Research-related skills and Scientific temper
CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
PO 6 : Self-directed and Life-long learning
CO1. Prepare different chemicals.
CO2. Handle different instruments and their working.
CO3. Able to identify mechanism of stress tolerance.
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

PO 7 Critical Thinking and Problem solving:
CO6. Utilize knowledge of plant physiology in agriculture production.
CO7. Use knowledge of applications of allellochemicals.

Name of Programme : M.Sc. Botany
Programme Code : PSBOT
Class : M. Sc. II
Semester : IV
Course Type : Major (Elective)
Course Code : BOT-611- MJE (B)
Course Title : Advanced Mycology-II
No. of Credits : 02
No. of Teaching Hours : 30

A) Course Objectives:

1. To study fungal habitat and habit diversity.
2. To give knowledge about different classification system of fungi.
3. To study fungal physiology.
4. To understand the fungal association in various ecological aspects.
5. To give knowledge of industrial and agricultural potential of fungi.
6. To demonstrate an impact of fungi on human affairs.
7. To create awareness about the medicinal potential of local fungal flora.

B) Course Outcome:

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

CO1. Identify fungal habitat and habit diversity.
CO2. Classify different fungi.
CO3. Acquire different factor affecting on their growth with respect to physiology.
CO4. Use knowledge of fungal ecology in bioremediation.
CO5. Use the knowledge of industrial and agricultural potential of fungi.
CO6. Identify different impacts on human health and their control measures.
CO7. Explore medicinal potential of local fungal flora.

Credit – I

Unit- I **(10L)**

1.1 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. 05L

1.2 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. 05L

Credit- II

Unit- II **(10L)**

2.1. 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. **10**L

Credit- III

Unit- III **(10L)**

3.1 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.

P. G. Research Centre Department of Botany M. Sc. II, Sem.-IV

Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. IV) **Subject**: Botany
Course: Elective Papers – Advanced Mycology-I **Course Code**: BOT-661- MJE (B)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10
CO 1	3				3			3		
CO 2	3	3		3					3	
CO 3	3	3		3						
CO 4	3		3					3		
CO 5	3		3					3		
CO 6	3	3					3			
CO 7	3			3	3					

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO1: Identify fungal habitat and habit diversity.
CO2. Classify different fungi
CO3. Acquire different factors affecting their growth with respect to physiology
CO4. Use knowledge of fungal ecology in bioremediation
CO5. Use the knowledge of industrial and agricultural potential of fungi
CO7. Explore medicinal potential of local fungal flora
PO1 Disciplinary Knowledge
CO1. Identify fungal habitat and habit diversity
CO2. Classify different fungi
CO3. Acquire different factors affecting their growth with respect to physiology
PO3 Social competence
CO4. Use knowledge of fungal ecology in bioremediation
CO5. Use the knowledge of industrial and agricultural potential of fungi
PO4 Research-related skills and Scientific temper
CO2. Classify different fungi
CO3. Acquire different factors affecting their growth with respect to physiology
CO7. Explore medicinal potential of local fungal flora
PO5 Trans-disciplinary knowledge
CO1. Identify fungal habitat and habit diversity
PO7 Effective Citizenship and Ethics
CO7. Explore medicinal potential of local fungal flora
PO8 Environment and Sustainability
CO1. Identify fungal habitat and habit diversity
CO4. Use knowledge of fungal ecology in bioremediation
CO5. Use the knowledge of industrial and agricultural potential of fungi.

P. G. Research Centre Department of Botany M. Sc. II, Sem.-IV

Name of Programme	**:**	**M.Sc. Botany**
Programme Code	**:**	**PSBOT**
Class	**:**	**M. Sc. II**
Semester	**:**	**IV**
Course Type	**:**	**Major (Elective) (Practical)**
Course Code	**:**	**BOT-662-MJM (B)**
Course Title	**:**	**Practicals based on Advanced Mycology-II**
No. of Credits	**:**	**02**
No. of Teaching Hours	**:**	**30**

A) Course Objectives:

1. To study plant pathogenic fungi from root, stem, leaf and fruits.
2. To give knowledge about different group of fungi with applications.
3. To discuss the life cycle pattern of fungi.
4. To study plant pathogenic fungi from root, stem, leaf and fruits.
5. To learn about preparation of culture media and pure culture.
6. To study pathogenic and non-pathogenic seed borne fungi.
7. To create awareness about the local fungal flora and skills of their conservation.

B) Course Outcome:

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

CO1. Isolate plant pathogenic fungi associated with plant.
CO2. Apply knowledge for commercial exploration of different group of fungi.
CO3. Understand life cycle pattern of fungi.
CO4. Isolate plant pathogenic fungi associated with plant.
CO5. Prepare and make pure culture of fungi.
CO6. Understand the pathogenic and non-pathogenic seed borne fungi.
CO7. Conservation techniques of local fungal flora.

Practicals based on BOT-661- MJE (B) Advanced Mycology-I (08P)

1. Isolation of plant pathogenic fungi from roots, stems and fruits.
2. Study of seed borne fungi.
3. Study of Red rot of Sugarcane and Downy Mildew of Grape.
4. Study of wart disease of Potato and Ergot of Bajra.
5. Study of white rusts of crucifers and Anthracnose of Chilli.
6. Study of Black rust of wheat and Grain smut of Jowar.
7. Study of Tikka disease of groundnut.
8. Preparation of pure culture for primary and secondary metabolites analysis.
9. Cultivation of oyster mushroom.

❖ **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.**

Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class : M. Sc. II (Sem. III) **Subject : Botany**
Course Type : Major (Elective) (Practical) **Course Code : BOT-612- MJE (B)**
Course Title : Practicals based on Advanced Mycology-I
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10
CO 1	3									
CO 2			3							
CO 3	3									
CO 4					3					
CO 5										
CO 6								3		
CO 7									3	

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO1. Use different isolation techniques and identification of aquatic fungi.
PO2 Practical, Professional, and Procedural Knowledge:
CO3. Understand life cycle pattern of fungi.
PO3 Entrepreneurial Mindset, Innovation, and Business Understanding:
CO1. Use different isolation techniques and identification of aquatic fungi.
PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO6. Understand the pathogenic and non-pathogenic seed borne fungi.
PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO7. Conservation techniques of local fungal flora.
PO10 Autonomy, Responsibility, and Accountability:

P. G. Research Centre Department of Botany M. Sc. II, Sem.-IV

Name of the Programme : M. Sc. Botany
Program Code : PSBOT
Class : M. Sc. II
Semester : IV
Course Type : Research Project - Practical
Course Code : BOT-681-RP
Course Title : Research Project
No. of Credits : 06
No. of Teaching Hours : 90

A) Learning Objectives:

1. To give information of research work.
2. To set objectives of the project.
3. To write review of literature.
4. To prepare methodology of the project
5. To interpret results of the project.
6. To write down discussion and references.
7. To find out new conclusions or outputs of the project.

B) Learning Outcome:

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

CO1. Get information about research work.
CO2. Set objectives of the project.
CO3. Write review of literature.
CO4. Prepare methodology of the project.
CO5. Interpret results of the project.
CO6. Write down discussion and references.
CO7. Find out new conclusions or outputs o the project.

Credit: 1 and 2: **(30L)**

Research proposal development, Introduction, Review of literature, Material Methods and Experimental design.

Credit: 3 and 4: **(30L)**

Field visit and data collection, Data analysis, Report writing.

Credit: 5 and 6: **(30L)**

Research Paper and PowerPoint presentation based on Research project work.

Choice Based Credit System Syllabus (NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem. IV) **Subject**: Botany
Course: Research Project- Practical **Course Code:** BOT-681-RP
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

P. G. Research Centre Department of Botany M. Sc. II, Sem.-IV

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3	2			3					2
CO 2	2			3						2
CO 3	3				3		2			
CO 4		3		3						4
CO 5				3	3	2				
CO 6	2					3	2			
CO 7			3	3	3					

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1: Get information about research work.
CO2: Set objectives of the project.
CO3: Write review of literature.
CO6: Write down discussion and references.
PO2: Practical, Professional, and Procedural Knowledge
CO1: Get information about research work.
CO4: Prepare methodology of the project.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO7: Find out new conclusions or outputs of the project.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO2: Set objectives of the project.
CO4: Prepare methodology of the project.
CO5: Interpret results of the project.
CO7: Find out new conclusions or outputs of the project.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO1: Get information about research work.
CO3: Write review of literature.
CO5: Interpret results of the project.
CO7: Find out new conclusions or outputs of the project.
PO6: Communication, Collaboration, and Leadership
CO5: Interpret results of the project.
CO6: Write down discussion and references.

PO7: Digital Proficiency and Technological Skills
CO3: Write review of literature.
CO6: Write down discussion and references.
PO10: Autonomy, Responsibility, and Accountability
CO1: Get information about research work.
CO2: Set objectives of the project.
CO4: Prepare methodology of the project.

Standard Operating Protocols for Research Project Practical

PG (Semester-IV)

1. Choose a research topic in consultation with your guide.
2. Write a research proposal including the objectives, hypothesis, significance, and expected outcomes of the project.
3. Conduct a thorough literature review using academic databases, journals, and books.
4. Write the introduction and literature review sections, summarizing existing research and identifying gaps your project will address.
5. Develop a detailed methodology section outlining the materials, methods, and experimental design you will use.
6. Include details on controls, variables, and the statistical methods for data analysis.
7. Conduct fieldwork as per the project's requirements, collecting plant specimens and other necessary data.
8. Record all observations and measurements in a lab notebook, ensuring accuracy and thoroughness.
9. Analyze the collected data using appropriate statistical tools and software.
10. Interpret the results, comparing them with the literature review and objectives set in the proposal.
11. Draft a comprehensive report detailing the research process, including the introduction, methodology, results, discussion, and references.
12. Ensure the report is well-organized and follows academic standards for scientific writing.
13. Convert your report into a research paper suitable for publication or academic presentation.
14. Include an abstract, introduction, methodology, results, discussion, and references.
15. Create a PowerPoint presentation summarizing your research project.
16. The presentation should cover the objectives, methodology, results, and conclusions in a clear and concise manner.
17. Practice delivering the presentation to ensure it is within the allotted time and effectively communicates your findings.
18. Double-check all data entries and calculations for accuracy.
19. Follow the experimental procedures strictly to ensure consistency and reliability of results.
20. Review the report and research paper for clarity, coherence, and adherence to academic standards.
21. Always wear appropriate PPE (lab coat, gloves, safety goggles) during lab work and field visits.
22. Handle chemicals, plant specimens, and equipment according to the lab's safety guidelines.
23. In case of an accident or safety concern, immediately inform the instructor and follow the emergency protocols.
24. Maintain a detailed lab notebook with records of all experiments, data collected, and any observations.
25. Submit all required documents (research proposal, literature review, methodology, final report, research paper) by the deadlines set by the instructor.

26. Store digital copies of your work securely on the university's platform or a backup device.
27. Use APA citation style for all references included in your research proposal, literature review and final report.
28. Ensure all sources used in the research are properly cited to avoid plagiarism.

P. G. Research Centre Department of Botany M. Sc. II, Sem.-IV

Name of the Programme : M. Sc. Botany
Program Code : PSBOT
Class : M. Sc. II
Semester : IV
Course Type : Research Project - Practical
Course Code : BOT-691-SDC
Course Title : Skill Development Course
No. of Credits : 02
No. of Teaching Hours : 30

A) Learning Objectives:

1: To understand the historical significance and classification of medicinal and aromatic plants in India.
2: To learn about the geographical distribution and uses of key medicinal plants like *Acorus calamus, Adhatoda vasica*, and *Aloe vera*.
3: To acquire practical knowledge of cultural practices such as nursery raising, transplantation, and plant protection for medicinal plants.
4: To explore the classification and economic importance of aromatic plants in the Indian perfumery industry.
5: To gain insights into the advancements in the perfume industry and their impact on aromatic plant cultivation.
6: To understand the chemical extraction processes, including distillation and preparation of essential oils.
7: To learn techniques for value addition through the preparation of powders, tinctures, and extractives from medicinal and aromatic plants.

B) Learning Outcome:

By the end of the course, students will be able to:
CO1: Understand the historical significance and classification of medicinal and aromatic plants in India.
CO 2: Learn about the geographical distribution and uses of key medicinal plants like *Acorus calamus, Adhatoda vasica*, and *Aloe vera*.
CO 3: Acquire practical knowledge of cultural practices such as nursery raising, transplantation, and plant protection for medicinal plants.
CO 4: Explore the classification and economic importance of aromatic plants in the Indian perfumery industry.
CO 5: Gain insights into the advancements in the perfume industry and their impact on aromatic plant cultivation.
CO 6: Understand the chemical extraction processes, including distillation and preparation of essential oils.
CO 7: Learn techniques for value addition through the preparation of powders, tinctures, and extractives from medicinal and aromatic plants.

Credit: I

Unit- 1 Commercial Cultivation of Medicinal Plants (10L)

1. History, Classification of medicinal plants. Important medicinal plants of India with their systematics, geographical distribution and uses. Acorus calamus, Adhatoda vasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona. 4L
2. Raising of plants: Cultural practices for nursery raising, transplantation, hoeing, weeding, irrigation, fertigation, plant protection etc. 6L

Credit: I

Unit-2 Commercial Cultivation of Aromatic Plants (20L)

3. Classification of Aromatic Plants. Indian perfumery industry, Advancements in perfume industry. 10L
4. Primary Processing and Value Addition: Chemical extraction processes, distillation of essential oils, preparation of powders, tinctures, extractives etc. 10L

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem. IV) **Subject**: Botany

Course**: Skill Development Course** Course Code: **BOT-691-SDC**

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3								3	
CO 2	3							2		
CO 3		3		3						
CO 4	1		3							
CO 5			3			2				
CO 6		3					3			
CO 7		3	3							

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1: Understand the historical significance and classification of medicinal and aromatic plants in India.
CO 2: Learn about the geographical distribution and uses of key medicinal plants like *Acorus calamus*, *Adhatoda vasica*, and *Aloe vera*.
CO 4: Explore the classification and economic importance of aromatic plants in the Indian perfumery industry.

PO2: Practical, Professional, and Procedural Knowledge
CO 3: Acquire practical knowledge of cultural practices such as nursery raising, transplantation, and plant protection for medicinal plants.
CO 6: Understand the chemical extraction processes, including distillation and preparation of essential oils.
CO 7**:** Learn techniques for value addition through the preparation of powders, tinctures, and extractives from medicinal and aromatic plants.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO 4: Explore the classification and economic importance of aromatic plants in the Indian perfumery industry.
CO 5: Gain insights into the advancements in the perfume industry and their impact on aromatic plant cultivation.
CO 7**:** Learn techniques for value addition through the preparation of powders, tinctures, and extractives from medicinal and aromatic plants.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO 3: Acquire practical knowledge of cultural practices such as nursery raising, transplantation, and plant protection for medicinal plants

PO6: Communication, Collaboration, and Leadership
CO 5: Gain insights into the advancements in the perfume industry and their impact on aromatic plant cultivation.

PO7: Digital Proficiency and Technological Skills
CO 6: Understand the chemical extraction processes, including distillation and preparation of essential oils.

PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO 2: Learn about the geographical distribution and uses of key medicinal plants like *Acorus calamus*, *Adhatoda vasica*, and *Aloe vera*.

PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1**:** Understand the historical significance and classification of medicinal and aromatic plants in India.