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 -III

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.

M.Sc. Botany

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, legal and 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
	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-MJM (A)	Advanced Plant Physiology-II	Theory	02
	Major (Elective)	BOT-661-MJM (B)	Advanced Mycology-II		
	Major (Elective)	BOT-662-MJM (A)	Practical based on BOT-661-MJM (A)	Practical	02
	Major (Elective)	BOT-662-MJM (B)	Practical based on BOT-661-MJM (B)		
	Research Project (RP)	BOT-681-RP	-	Practical	06
	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- III)**
Semester : **III**
Course Type : **Major (Mandatory)**
Course Code : **BOT-601-MJM**
Course Title : **Angiosperms and Evolution**
No. of Credits : **04**
No. of Teaching Hours : **60**

A) Learning Objectives:

1. To describe the morphological and anatomical features of angiosperms.
2. To classify angiosperms based on their taxonomic characteristics, including flower structure, leaf arrangement, and other key features.
3. To analyze the evolutionary trends and relationships among different groups of angiosperms.
4. To explain the various mechanisms of reproduction in angiosperms.
5. To know angiosperm ecology and diversity.
6. To learn angiosperm physiology and adaptations.
7. To apply angiosperm knowledge to conservation and agriculture.

B) Course Outcomes:

CO1. Students will be able to demonstrate a thorough understanding of the morphological and anatomical features of angiosperms.
CO2. Students will be able to proficient in angiosperm taxonomy and classification.
CO3. Student will able to analyze angiosperm evolutionary trends.
CO4. Student will able to contribute to research in plant reproductive biology and plant breeding programs.
CO5. Examining Angiosperm Ecology and Diversity.
CO6. Students should be able to interpret the physiological processes and adaptations that enable angiosperms to thrive in diverse environments.
CO7. Student able to identify, conserve and able to address real-world challenges in biodiversity conservation and sustainable agriculture.

Credit I **(15L)**

Unit- 1: Systematics and Classification of Angiosperms

1.1 **Systematics:** Importance and relevance of systematics in conservation, taxonomic structure - taxonomic hierarchy, the species concept, categories and ranks, alpha, beta and omega taxonomy. **5L**

1.2 **International Code of Botanical Nomenclature (ICBN):** Salient features-principles, important rules and recommendations, provisions for the governance of the code, appendices. **3L**

1.3 **Systems of Angiosperm classification:** Brief history of Pre-Darwinian and Post- Darwinian classification systems (any four), Phenetic versus phylogenetic systems, cladistics in taxonomy, overview of Angiosperm Phylogeny Group (APG). **4L**

1.4 **Recent systems of plant classification:** By Armen Takhtajan and Arthur Cronquist **3L**

Credit II **(15L)**

Unit- 2: Taxonomic Aspects of Angiosperms

2.1 Systematic position, morphological variations, economic importance of families: Magnoliaceae, Ranunculaceae, Moraceae, Urticaceae, Casuarinaceae, Alismataceae, Aponogetonaceae, Scrophulariaceae, Amaranthaceae, Aracaceae. **10L**

2.2 **Phytogeography:** Phytogeographical regions of India, endemism, biodiversity hotspots of India. Endemism in Western Ghats, invasions and introductions. **5L**

Credit III **(15L)**

Unit – 3: Evolution

3.1 **Emergence of evolutionary thought:** Steps and preview of evolution, Lamarkism, Darwinism- Concepts of variation, adaptation, struggle for fitness and natural selection; Neo-Darwinism, Spontaneity of mutations. **3L**

3.2 **Origin of cells and Unicellular evolution:** Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, Concepts of Opairn and Haldene, Experiment of Miller (1953), The first cell, evolution of prokaryote, origin of eukaryotic cells, RNA world theory. **4L**

3.3 **Molecular Evolution:** Concepts of natural evolution, molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence. **4L**

3.4 **The mechanism of evolution:** Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modification, isolation mechanism, speciation : allopatric, sympatric, parapetric, and peripatric, convergent and divergent evolution, sexual selection, co-evolution. **4L**

Credit IV **(15L)**

Unit- 4: Modern techniques in angiosperm taxonomy

4.1 **Anatomy in relation to taxonomy**: Wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding the interrelationships. **3L**

4.2 **Palynotaxonomy**: Pollen morphology, Polarity, symmetry, NPC of pollen, exine stratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomic importance. **3L**

4.3 **Chemotaxonomy**: Classes of compounds and their biological significance, stages in chemotaxonomic investigations. Criteria for use of chemical in plant taxonomy; Proteins and taxonomy- seed proteins, techniques of protein electrophoresis. **6L**

4.4 **Ultra structural Systematics**: SEM and TEM studies in plant systematics; SEM and plant surface structure, TEM and dilated cisternae of endoplasmic reticulum and sieve element, plastids, applications of data in the classification of higher taxa. **3L**

References:

1. Plant Taxonomy & Biosystematics: Classical & Modern, T. S. Rana, 2014. New India Publishing Agency.

2. Vashishta P. C., Sinha A. R., Anil Kumar, 2006. Gymnosperms. S. Chand.
3. Shivanna K. R. and N. S. Rangaswamy, 1992. Pollen Biology- A Laboratory Manual. *Springer*-Verla.
4. Stuessy T. F. 2002. Plant taxonomy. The systematic Evaluation of comparative data.Biseu Singh Mahendra Pal Sign Pehra Duk.
5. Verma P. S. and Agarwal V. K., 2006. Cell Biology, Genetics, Molecular Biology,
6. Evolution and Ecology. S. Chand and Company, New Delhi.
7. Cooper G. M. and Hausman R. E., 2007. The Cell molecular approach Sinauer associate, Inc, Suderland (USA).
8. Roy S. C. and De K. K., 2005. (2nd Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
9. Plant Systematics by Michael G. Simpson, 2nd Edition, 2010.
10. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant body: Their Structure,Function, and Development by Ray F. Evert; Susan E. Eichhorn (Contribution by), 2006.

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Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Angiosperms and Evolution **Course Code**: BOT-601-MJM

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	2				2	2				
CO 2	3				3			2		
CO 3	2			3	2					
CO 4	2	3			3					
CO 5	2					3	2			
CO 6	2		2			3				
CO 7	2			2					3	

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding

CO1. Demonstrate a thorough understanding of the morphological and anatomical features of angiosperms.
CO2. Proficient in angiosperm taxonomy and classification.
CO3. Analyze angiosperm evolutionary trends.
CO4. Contribute to research in plant reproductive biology and plant breeding programs.
CO5. Examine Angiosperm Ecology and Diversity.
CO6. Interpret the physiological processes and adaptations that enable angiosperms to thrive in

diverse environments.
CO7. Identify, conserve and able to address real-world challenges in biodiversity conservation and sustainable agriculture.

PO2. Practical, Professional, and Procedural Knowledge.
CO4. Contribute to research in plant reproductive biology and plant breeding programs.

PO3. Entrepreneurial Mindset, Innovation, and Business Understanding.
CO6. Interpret the physiological processes and adaptations that enable angiosperms to thrive in diverse environments.

PO4. Specialized Skills, Critical Thinking, and Problem-Solving.
CO3. Analyze angiosperm evolutionary trends.
CO7. Identify, conserve and able to address real-world challenges in biodiversity conservation and sustainable agriculture.

PO5. Research, Analytical Reasoning, and Ethical Conduct.
CO1. Demonstrate a thorough understanding of the morphological and anatomical features of angiosperms.
CO2. Proficient in angiosperm taxonomy and classification.
CO3. Analyze angiosperm evolutionary trends.
CO4. Contribute to research in plant reproductive biology and plant breeding programs.

PO6. Communication, Collaboration, and Leadership.
CO1. Demonstrate a thorough understanding of the morphological and anatomical features of angiosperms.
CO5. Examine Angiosperm Ecology and Diversity.
CO6. Interpret the physiological processes and adaptations that enable angiosperms to thrive in diverse environments.

PO7. Digital Proficiency and Technological Skills.
CO5. Examine Angiosperm Ecology and Diversity.

PO8. Multicultural Competence, Inclusive Spirit, and Empathy.
CO2. Proficient in angiosperm taxonomy and classification.

PO9. Value Inculcation, Environmental Awareness, and Ethical Practices.
CO7. Identify, conserve and able to address real-world challenges in biodiversity conservation and sustainable agriculture.

Name of Programme : M. Sc. Botany
Programme Code : PSBOT
Class : M. Sc. II (Semester- III)
Semester : III
Course Type : Major (Mandatory)
Course Code : BOT-602-MJM
Course Title : Computational Botany
No. of Credits : 04
No. of Teaching Hours : 60

A) Learning Objectives:

1. To inculcate knowledge of use of computer for biological data analysis.
2. Critical Thinking and Problem-Solving
3. To develop Proficiency in Data Analysis.
4. To understand Protein Structure and Function Prediction:
5. To give idea of importance of different software's used in bioinformatics.
6. To make aware about database significance
7. To introduce Mathematical Concepts.

B) Course Outcome: Student will be

CO1. Expert in use of computer to solve biological problems.
CO2. Learn how to critically evaluate the results of hypothesis tests.
CO3. Gain an appreciation for the interdisciplinary nature of computational botany
CO4. Expertise in microscopic techniques.
CO5. Learn about various types of experimental designs
CO6. Train to use different electrochemical techniques.
CO7. Apply their knowledge in various branches of biology.

TOPICS / CONTENTS:
Credit I- (15L)
Unit- I

1.1 **Introduction to Statistics :** Population, Sample, variable, Attributes-Concepts Measures of central tendency – arithmetic mean, median, mode. Measures of dispersion range Variance, combined Standard Deviation. BOX plot and coefficient of variation. Skewness and kurtosis. **8L**

1.2 **Correlation and regression:** Bivariate Data, Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's Rank correlation coefficient, Interpretation. Regression – Equations of regression lines. Regression coefficient, Coefficient of Determination, Interpretation. **7L**

Credit II **(15L)**

Unit- 2

2.1 **Design of experiments and Analysis of Variance**

Basic Principles of design of experiment– Randomization, Replication, Local Control. Guidelines for designing the experiments, size of plot, number of replications Completely Randomized Design (CDR), Randomized Block Design (RBD), Latin Square Design (LSD), Analysis of Variance (ANOVA), One way and Two way ANOVA, Tukey's test for pairwise comparison of treatments Dunnet's test for comparison of treatment means with control Duncan's multiple range test Mann Whitney U test. **9L**

2.2 **Testing of hypothesis**

Hypothesis, statistical hypothesis, critical region, level of significance, p-value. T-test for mean, chi-square test: chi-square test for goodness of fit, F- test. **6L**

NOTE – Emphasis be given on methodology and numerical problem solving rather than derivations and proofs.

Credit III - Bioinformatics **(15L)**

Unit- III

3.1 Bioinformatics concept, Information resources of NCBI and Functions **1L**

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

3.3 Sequences used in bioinformatics (genomic DNA, cDNA, organellar DNA, expressed sequence tags (EST). Gene Sequence Tags (GST). **3L**

3.4 Statistical analysis and evaluation of BLAST results. **3L**

3.5 Multiple sequence alignments (Dynamic programming, progressive methods, iterative methods) **3L**

3.6 Use of Bioinformatics tools in analysis **2L**

3.7 Protein structure prediction, motifs and domains, designing of primers. **1L**

Credit IV: Bio- analytical techniques (**15L**)

4.1 Types of measurement and their units. **1L**

4.2 Making solutions and Media – moles and molarity, stock solutions and dilutions, Media: PTC, PDA and NA. **4L**

4.3 Ions and electrical potentials – Nernst and Goldman equations. **1L**

4.4 Osmolarity and osmotic pressure measurements. **2L**

4.5 Quantification of chemical reactions – equilibrium constant and reaction rates. **1L**

4.6 pH measurements and preparation of buffers. **2L**

4.7 Specific activity of radioisotopes, making radioisotope solutions. 2L
4.8 Cell counting using serial dilutions, haemocytometry. 2L

References:

1. Lab Math – Adams, D.S. I.K. Internations Pvt Ltd. New Delhi, 2004
2. Statistical Methods – Snedecor G.W. and Cochran W.G. Affiliated East-West Press Pvt. Ltd.1989
3. Statistical methods in Agriculture and Experimental Biology – Mead, R. and Curnow, R.N. Chapman and Hall, 1983
4. Practical statistics and experimental design for plant and crop science – Clewer, A.G. and Scarisbrick, A.H. John Wiley, New York, 2001
5. Bioinformatics - Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003
6. Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, New Delhi,2003
7. Bioinformatics and Molecular Evolution – Higgs PG and Attwood, TK
8. Fundamentals of Biostatistics by Irfan Ali Khan &AtiyaKhanum, Ukaaz Publication, Hyderabad ISBN: 81-900441-0-9: 2009.
9. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th revised edition. P. Rastogi and N. Mendiritta. 2013
10. Advanced biotechnology, Dr. R. C. Dubey, S. Chand and Company Pvt. Ltd. New Delhi.

Choice Based Credit System Syllabus

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany
Course: Computational Botany **Course Code**: BOT-602-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
CO1		3					3			
CO2					3					
CO3	3		3					3		
CO4				3					3	
CO5					3					3
CO6				3			3			
CO 7	3					3	3			

Justification for the mapping

PO1. Comprehensive Knowledge and Understanding
CO3. Gain an appreciation for the interdisciplinary nature of computational botany
CO7. Apply their knowledge in various branches of biology.
PO2. Practical, Professional, and Procedural Knowledge

CO1. Expert in use of computer to solve biological problems.
PO3. Entrepreneurial Mindset, Innovation, and Business Understanding
CO3. Gain an appreciation for the interdisciplinary nature of computational botany
PO4. Specialized Skills, Critical Thinking, and Problem-Solving
CO4. Expertise in microscopic techniques.
CO6. Train to use different electrochemical techniques.
PO5. Research, Analytical Reasoning, and Ethical Conduct
CO2. Learn how to critically evaluate the results of hypothesis tests.
CO5. Learn about various types of experimental designs
PO6. Communication, Collaboration, and Leadership
CO7. Apply their knowledge in various branches of biology.
PO7. Digital Proficiency and Technological Skills
CO1. Expert in use of computer to solve biological problems.
CO6. Train to use different electrochemical techniques.
CO7. Apply their knowledge in various branches of biology.
PO8. Multicultural Competence, Inclusive Spirit, and Empathy
.CO3. Gain an appreciation for the interdisciplinary nature of computational botany
PO9. Value Inculcation, Environmental Awareness, and Ethical Practices
CO4. Expertise in microscopic techniques.
PO10. Autonomy, Responsibility, and Accountability
CO5. Learn about various types of experimental designs

Name of Programme : **M.Sc. Botany**
Programme Code : **PSBOT**
Class : **M. Sc. II (Semester- III)**
Semester : **III**
Course Type : **Major Mandatory (Practical)**
Course Code : **BOT-603-MJM**
Course Title : **Practical's based on BOT-601-MJM**
No. of Credits : **02**
No. of Teaching Hours : **60 (No. of Practical's-15)**

A) Learning Objectives:

1. To pertain taxonomical techniques.
2. To provide the knowledge of different local families.
3. To develop the ability to recognize and identify different angiosperm families based on morphological key features.
4. To acquire the ability to identify angiosperms in their natural habitat.
5. To learn how to effectively use taxonomic keys.
6. To develop the skill to create accurate taxonomic descriptions using appropriate botanical terminologies.
7. To gain proficiency in using microscopes to examine plant tissues.

B) Course Outcome:

By the end of course students will be able to

CO1. Develop identification skill in cryptogams.
CO2. Proficiency in applying taxonomic principles to classify angiosperms.
CO3. Understand basic knowledge about life cycle of cryptogams.
CO4. Internal and external structure of cryptogams.
CO5. Explain basic knowledge about evolution of lower cryptogams.
CO6. Ability to employ microscopy to study plant tissues.
CO7. Understand variations in cryptogamic diversity.

TOPICS/CONTENTS: (All Practicals are compulsory)

Practical's based on BOT-601-MJM Angiosperm Taxonomy

1. Study of plant families (at least 12 locally available families- 8 of Dicotyledons and 4 of monocotyledons. **a) Dicotyledons:** Ranunculaceae, Polygalaceae, Rutaceae, Asclepidaceae, Meliaceae, Rosaceae, Moraceae, Passifloraceae, Plumbaginaceae, Sapotaceae, Boraginaceae. **b) Monocotyledons:** Orchidaceae, Commelinaceae, Araceae, Arecaceae, Cyperaceae.

   12P
2. Identification of genus and species of locally available wild plants (any four) **1P**
3. Preparation of vegetative and reproductive botanical keys of any six plants from different

Families **1P**

4. One day botanical excursion to study cryptogam's diversity. **1P**

Note: Botanical excursion of at least two days for collection and preparation of field notes and its report submission.

Choice Based Credit System Syllabus (NEP Pattern-2020)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany
Course: Practical based on BOT-601-MJM **Course Code**: BOT-603-MJM
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)									
Course Outcomes	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10
CO 1				3						
CO 2	3									
CO 3	3									
CO 4	3									
CO 5	3									
CO 6		3								
CO 7	3									

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO2. Proficiency in applying taxonomic principles to classify angiosperms.
CO3. Understand basic knowledge about life cycle of cryptogams.
CO4. Internal and external structure of cryptogams.
CO5. Explain basic knowledge about evolution of lower cryptogams
CO7. Understand variations in cryptogamic diversity.
PO2: Practical, Professional, and Procedural Knowledge
CO6. Ability to employ microscopy to study plant tissues.
PO4: Specialized Skills, Critical Thinking, and Problem-Solving.
CO1. Develop identification skill in cryptogams.

Name of the Programme	**:**	**M.Sc.**
Subject	**:**	**Botany**
Program Code	**:**	**PSBOT**
Class	**:**	**M.Sc. II**
Semester	**:**	**III**
Course Type	**:**	**Mandatory Practical**
Course Name	**:**	**Practicals based on BOT-602-MJM**
Course Code	**:**	**BOT -604-MJM**
No. of Credits	**:**	**02**

A) Course objectives:

1. To demonstrate proficiency in representing data through various graphical methods.
2. To understand the principles of statistical testing, specifically focusing on Student's t-test, F test and Chi Square test.
3. Gain knowledge about databases and database searching for DNA and protein sequence comparisons.
4. To comprehend the concepts of correlation and regression and apply these statistical techniques to analyze relationships between variables in botanical data.
5. To conduct a comprehensive study on the accuracy of different sequence alignment tools in plant genome annotation.
6. To determine phylogenetic relationships using DNA and protein sequences.
7. To understand the principles of ANOVA and its application in analyzing variance among multiple groups.

B) Course outcome:

CO1. Student will acquire proficiency in visually representing and interpreting botanical data through various graphical methods**.**

CO2. Student will able to apply statistical reasoning to solve problems related to the computational botany.

CO3. Student will gain knowledge about databases and database searching for DNA and protein sequence comparisons.

CO4. Student will able to enhance critical thinking skills through the application of statistical and bioinformatics methods in botanical research.

CO5. Student will gain a deeper understanding of genetic variation and relationships among plant species through the analysis of DNA and protein sequences..

CO6. Student will get hands on experience in using tools such as SPSS, Excel, and bioinformatics software for computational botany analysis.

CO7. Student will understand the principles of ANOVA and its application in analyzing variance among multiple groups.

Practicals (All Practicals are compulsory)

1) Statistical problem solving based on Student's't' test. **1P**
2) Representation of data by various graphical methods**.** **1P**
3) Measures of Skewness and measures of Kurtosis (grouped and ungrouped data). **1P**
4) Statistical problem solving based on F- test. **1P**
5) Study of Correlation and Regression. **1P**
6) Study of Chi-square test for goodness of fit and independent attributes. **1P**
7) Analysis of variance on the given data (ANOVA). **1P**

8) Tukey's test for pairwise comparison of treatments. **1P**
9) Duncan's multiple range test for comparing treatment means using SPPS/Excel. **1P**
10) Determination of Karl-Pearson's coefficient of correlation from the given grouped and ungrouped data. **1P**
11) Databases and database searching for DNA and protein sequence comparisons. **1P**
12) Determination of Multiple sequence alignments, progressive methods, CLUSTAL. **1P**
13) Determination of phylogenetic relationships using DNA and protein sequences. **1P**
14) Pairwise comparison of DNA and protein sequences using BLAST. **1P**
15) A Comprehensive Study on the Accuracy of Different Sequence Alignment Tools in Plant Genome Annotation. **1P**

Choice Based Credit System Syllabus (NEP Pattern-2020)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany
Course: Practical based on BOT-602-MJM **Course Code**: BOT-604-MJM
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes(POs)									
Course Outcomes	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10
CO 1				3						
CO 2				3						
CO 3							3			
CO 4				3						
CO 5	3									
CO 6		3								
CO 7				3						

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO5.Student will gain a deeper understanding of genetic variation and relationships among plant species through the analysis of DNA and protein sequences..
PO2: Practical, Professional, and Procedural Knowledge
CO6. Student will get hands on experience in using tools such as SPSS, Excel, and bioinformatics software for computational botany analysis.
PO4: Specialized Skills, Critical Thinking, and Problem solving.
CO1. Student will acquire proficiency in visually representing and interpreting botanical data through various graphical methods**.**
CO2.Student will able to apply statistical reasoning to solve problems related to the computational botany.
CO4.Student will able to enhance critical thinking skills through the application of statisticaland bioinformatics methods in botanical research.

CO 7. Student will understand the principles of ANOVA and its application in analyzing variance among multiple groups.

PO 7. Digital Proficiency and Technological Skills

CO3. Student will gain knowledge about databases and database searching for DNAand protein sequence comparisons.

Name of the Programme	**:**	**M.Sc. Botany**
Program Code	**:**	**PSBOT**
Class	**:**	**M.Sc. II**
Semester	**:**	**III**
Course Type	**:**	**Major Elective (Theory)**
Course Code	**:**	**BOT-611-MJE**
Course Title	**:**	**Advanced Plant Physiology- I**
No. of Credits	**:**	**02**
No. of Teaching Hours	**:**	**30**

A) Course Objectives:

1. To give the knowledge about agricultural improvement.
2. To make aware the students about response of plants to environmental conditions.
3. To give knowledge about different activities take place in plants.
4. To develop the knowledge about physiology of plants.
5. To give the knowledge about different metabolic activities in plants.
6. To study about metabolic events take place in plants.
7. To gain knowledge of different biomolecules.

B) Course Outcomes:

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

TOPICS/CONTENTS:

Credit I
Unit- I

1.1 Germination and Mineral Nutrition (15L)

Concept, seed viability and dormancy, methods of breaking seed dormancy, factors affecting on seed germination and seedling vigour. **2L**

Physiological changes takes place during seed germination. Mobilization of reserve food. **2L**

1.2 Plant Growth and Development

Definition, RGR, Phloem loading and unloading, Source and sink relationship, metabolism and allocation of resource during vegetative and reproductive growth, Factors affecting growth. **3L**

1.3 Plant hormones and Photo-morphogenesis

Biosynthesis, breakdown and transport; physiological effects (Auxins, GA, Cytokinins, ABA, Ethylene, brassinosteroides, salicylic acid, CCC, growth retardents), Application of plant growth regulators in Agriculture. **4L**

Physiology of flowering, Circadian Rhythms, photoperiodism and its significance, vernalization. **2L**

Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; biological clocks. **2L**

Credit II

Unit- II

2.1 Senescence and Ageing (15L)

Senescence: Concept, definition, patterns of cellular senescence –cell, tissue, organ, whole plant, biological significance of senescence. PCD (Programmed Cell Death. **2L**

Physiological changes take place during senescence (pigment, protein, photosynthesis, nucleic acid), functional and ultrastructural changes in chloroplast, mitochondria and cell wall during senescence, hormonal regulation of senescence. **5L**

2.2 Bioactive molecules and Secondary metabolites

Composition, structure and function of bioactive molecules (Caroteniods, flavonoids, Carnitine and choline). **4L**

Secondary metabolites - Biosynthesis of terpenes (IPP), Alkaloid (barberine) and Phenolics (Phenylpropanoid), Role of shikkimic acid pathway in the production of secondary metabolites. **4L**

References

1. Buchanan B. B., Gruissem W. and Jones R. L. 2000. Biochemistry and Molecular Biology.
2. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3. Dennis D. T., Turpin, D. H. Lefebvre D. D. and Layzell D. B. (eds) 1997. Plant
4. Metabolism (Second Edition) Longman, Essex, England.
5. Nobel P. S. 1999. Physiochemical and Environmental Plant Physiology (Second Edition) Academic Press, San Diego, USA.
6. Salibury F. B. and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
7. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
8. Taiz L. and Zeiger E. 1998. Plant Physiology (Sixth Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
9. Thomas B. and Vince-Prue D. 1997. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA.

10. Verma S. K. and Verma Mohit 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.
11. Leninger A. C 1987. Principles of Biochemistry, CBS Publishers and Distributers (Indian Reprint).
12. Introduction to Plant Physiology (Forth Edition) William G. Hopkins and Norman.
13. Plant Physiology- Hans Mohr, Peter Schopfer, Springer Berlin publishers.
14. Lincoln Taiz , Eduardo Zeiger, Ian M. Møller, Angus Murphy. 2018. Plant Physiology and Deveopment. OUP USA.

Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Elective Paper – Advanced Plant Physiology - I **Course Code: BOT-611-MJE**

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					3					
CO 6	3									
CO 7					3					

Justification for the mapping.

PO1 Comprehensive Knowledge and Understanding:
CO6. Students get knowledge of plant cycle.
PO2 Practical, Professional, and Procedural Knowledge:
CO4. Development of expertise in plant physiology.
PO4 Specialized Skills, Critical Thinking, and Problem-Solving
CO3. Students get knowledge of internal activities in plant.
PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO5. Get knowledge of plant metabolism.
PO7 Digital Proficiency and Technological Skills:
CO7. Students get knowledge of biomolecules.
PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO3. Students get knowledge of internal activities in plant.
PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1. Use knowledge for improvement of agricultural yield.

Name of Programme : M.Sc. Botany
Programme Code : PSBOT
Class : M. Sc. II
Semester : III
Course Type : Major (Elective)
Course Code : BOT-611- MJE (B)
Course Title : Advanced Mycology-I
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: Fungi as Organism **(15L)**

1.1 Fungi and their significance **2L**

1.2 Relationship of fungi with plants and animals **2L**

1.3 Milestones in mycological and pathological studies in India. **2L**

1.4 Fungal cell- structure and composition **1L**

1.5 Physiology of fungal growth **2L**

1.6 Fungal Association- Lichen and Mycorrhizae **2L**

1.7 Outline classification of fungi - **2L**

a) Alexopoulos and Mims System (1979)

b) Webster and Weber System (2007)

1.8 Ecological services of fungi- bioremediation and microbiological sensors. **2L**

Credit-II

Unit - II: Allied Fungi, True Fungi, Anamorphic Fungi and Allied Aspects

(With respect to general characters, classification, structure, variation and importance)

2.1 **Allied Fungi:**

a) Myxomycota - Myxomycetes. **1L**

b) Plasmodiophoromycota **1L**

c) Straminipila **1L**

2.4 **True Fungi:** (With respect to general characters, classification, structural variation and pathological importance, if any)

a) Chytridiomycota - Chytridiomycetes **1L**

b) Zygomycota - Zygomycetes **1L**

c) Ascomycota – Plectomycetes and Pyrenomycetes **2L**

d) Basidiomycota – Hymenomycetes **1L**

e) Teliomycetes – Rust and Smut fungi **2L**

2.5 **Anamorphic Fungi and Allied Aspects.**

a) Deuteromycota- Classification, structural variations and importance **2L**

b) Fungi as Human pathogens- Dermatomycosis (Tinea), intermediate and systemic mycosis, its symptoms, clinical aspects and control measures. **3L**

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. Alexopolous C. J. Minms C.W. and Blackwell M., 1999. Introductory Mycology (4th Edition), Willey, New York.
4. Deacon J. W. Fungal Biology (4th Edition) , Blackwell Publishing, ISBN 1405130660
5. Kirk *et al.*, 2001. Dictionary of fungi, 9th edition, Wallingford.
6. Mehrotra R. S. and Aneja K. R., 1990. An Introduction to Mycology, New Age Publication.
7. Miguel U., Richard H., and Samuel A. 2000. Illustrated dictionary of mycology Elvira Aguirre Acosta Publisher.
8. Webster J., and Roland W. 2007. Introduction to fungi (3rd Edition), Cambridge University Press.
9. Dube H. C. 2010. An Introduction to fungi. Vikas Publication.
10. Vashista B. R. and Sinha A. K. 2008. Botany for Degree students- Fungi, S. Chand Publication.
11. Sharma O. P. 2011. Fungi and allied microbes. McGraw Hill Education Private Ltd., New Delhi.

Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Elective Papers – Advanced Mycology-I

Course Code: BOT-611- 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										
CO 2					3					
CO 3	3			3						
CO 4									3	
CO 5					3					
CO 6										3
CO 7										

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:
CO3. Acquire different factor affecting on their growth with respect to physiology.
PO2 Practical, Professional, and Procedural Knowledge:
CO2. Classify different fungi.
PO3 **Specialized Skills, Critical Thinking, and Problem-Solving:**
CO3. Acquire different factor affecting on their growth with respect to physiology.
PO4 Research, Analytical Reasoning, and Ethical Conduct:
CO5. Use the knowledge of industrial and agricultural potential of fungi.
PO5 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO4. Use knowledge of fungal ecology in bioremediation.

Name of the Programme	**:**	**M.Sc. Botany**
Program Code	**:**	**PSBT**
Class	**:**	**M.Sc. II**
Semester	**:**	**III**
Course Type	**:**	**Major Elective (Practical)**
Course Code	**:**	**BOT-612-MJE (A)**
Course Title	**:**	**Practicals based on Advanced Plant Physiology-I**
No. of Credits	**:**	**02**
No. of Teaching Hours	**:**	**30**

A) Course Objectives:

1. To give the knowledge about agricultural improvement.
2. To make aware the students about response of plants to environmental conditions.
3. To give knowledge about different activities take place in plants.
4. To develop the knowledge about physiology of plants.
5. To give the knowledge about different metabolic activities in plants.
6. To study about metabolic events take place in plants.
7. To gain knowledge of different biomolecules.

B) Course Outcome:

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

Practicals based on Advanced Plant Physiology I **(15P)**

1. Testing of seed viability by TTC. **1P**
2. Estimation of total alkaloids. **1P**
3. Effect of various PGRs on seed germination. **2P**
4. Effect of various PGRs on seedling growth / enzymes. **2P**
5. Isolation of starch. **1P**
6. Comparative studies of accumulation of superoxide dismutase (SOD) in normal and salt stressed plants. **2P**
7. Effect of weed extracts on seed germination. **2P**
8. Studies on changes in acidity and TSS during grape/ guava ripening. **1P**
9. Studies on changes in NR activity during leaf senescence. **1P**
10. Estimation of Total flavonoids. **1P**
11. Estimation of soluble proteins in germinating and non-germinating seed by Lowry / Bradford's method. **1P**

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

References :

1. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology.
2. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant
4. Metabolism (Second Edition) Longman, Essex, England.
5. Nobel P.S 1999. Physiochemical and Environmental Plant Physiology (Second Edition) Academic Press, San Diego, USA.
6. Salibury F.B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
7. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
8. Taiz L. and Zeiger E. 1998. Plant Physiology (Sixth Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
9. Thomas B. and Vince-Prue D. 1997. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA.
10. Verma S. K. and Verma Mohit 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.
11. Leninger A. C. 1987. Principles of Biochemistry, CBS Publishers and Distributers (Indian Reprint).
12. Introduction to Plant Physiology (Forth Edition) William G. Hopkins and Norman.

Choice Based Credit System Syllabus (NEP Pattern)

Mapping of Program Outcomes with Course Outcomes

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

Course: Practical – Advanced Plant Physiology - I

Course Code: Practicals based on Advanced Plant Physiology- 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					3					
CO 6	2									
CO 7					2					

Justification for the mapping

PO1 Comprehensive Knowledge and Understanding:

CO3. Students get knowledge of internal activities in plant.

CO6. Students get knowledge of plant cycle.

PO2 Practical, Professional, and Procedural Knowledge:

CO4. Development of expertise in plant physiology.

PO5 Research, Analytical Reasoning, and Ethical Conduct:
CO5. Get knowledge of plant metabolism.
CO7. Students get knowledge of biomolecules.
PO8 Multicultural Competence, Inclusive Spirit, and Empathy:
CO2. Students aware about the plant to response environmental conditions.
PO9 Value Inculcation, Environmental Awareness, and Ethical Practices:
CO1. Use knowledge for improvement of agricultural yield

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Name of Programme	**:**	**M.Sc. Botany**
Programme Code	**:**	**PSBOT**
Class	**:**	**M. Sc. II**
Semester	**:**	**III**
Course Type	**:**	**Major (Elective) (Practical)**
Course Code	**:**	**BOT-612- MJE (B)**
Course Title	**:**	**Practicals based on Advanced Mycology-I**
No. of Credits	**:**	**02**
No. of Teaching Hours	**:**	**30**

A) Course Objectives:

1. To isolation and identification of aquatic fungal flora.
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. Use different isolation techniques and identification of aquatic fungi.
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-611- MJE (B) Advanced Mycology-I **(16P)**

1. Preparation of culture medium for fungi CDA and SDA medium **1P**
2. Isolation of aquatic fungi by baiting method **1P**
3. Isolation of fungi from rhizosphere soil sample. **1P**
4. Isolation of plant pathogenic fungi from roots, stems and fruits **1P**
5. Study of seed borne fungi. **1P**

Study of fungi from the following groups **10P**

6. Myxomycetes- any one example.
7. Chytridiomycetes- any one example.
8. Oomycetes- any one example.
9. Pyrenomycetes- any one example.
10. Loculoascomycetes- any one example.
11. Discomycetes- any one example.

12. Teliomycetes – any one example.
13. Gasteromycetes- any one example.
14. Hymenomycetes- any one example.
15. Deuteromycetes- any one example.
16. Preparation of stains and mounting media for study of fungi **1P**

❖ **Note**

1. **Compulsory visit to Western Ghats for collection and observation of fungi (at least for three days).**
2. **Visit to any one Mycology Institute / Laboratory.**

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:

Name of the Programme	**:**	**M. Sc. Botany**
Program Code	**:**	**PSBOT**
Class	**:**	**M. Sc. II (Semester- III)**
Semester	**:**	**III**
Course Type	**:**	**Research Project - Practical**
Course Code	**:**	**BOT-621-RP**
Course Title	**:**	**Research Project**
No. of Credits	**:**	**04**
No. of Teaching Hours	**:**	**60**

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 of the project.

Credit: 1 **(15L)**

Unit-1

1.1 Identification of problem.
1.2 Experimental design.
1.3 Research proposal development.

Credit: 2 **(15L)**

Unit-2

2.1 Introduction on research project.
2.2 Review of literature
2.3 Materials and method.

Credit: 3 **(15L)**

Unit-3

3.1 Field visit and collection of data.
3.2 Data analysis by using various statistical method.
3.3 Report writing.

Credit: 4 **(15L)**

Unit-4

4.1 Power point presentation based on research project work.
4.2 Submission of dissertation.
4.3 Publication of research project in National and International Conference.
4.4 Publication of any one research paper.

Choice Based Credit System Syllabus (NEP 2020 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M.Sc. (Sem. III) **Subject** : Botany
Course: Research Project – Practical **Course Code** : BOT-621-RP
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										
CO 3				3						
CO 4		3								
CO 5				3						
CO 6						3				
CO 7				3						

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding:
CO2. Set objectives of the project.
PO2: Practical, Professional, and Procedural Knowledge:
CO4. Prepare methodology of the project.
PO4: Specialized Skills, Critical Thinking, and Problem-Solving.
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.
PO6: Communication, Collaboration, and Leadership:
CO6. Write down discussion and references.