



Sir P. T. Sarvajani College of Science

(Autonomous, Affiliated with VNSGU, Surat)

Re-Accredited 'A+' with CGPA 3.35

**PROPOSED
SYLLABUS
FOR
SEM I & II
Program: M.Sc.
Course: Botany**

**From
Academic year
2026-27
(NEP-2020)
(To be effective from June, 2026)**



Acknowledgement

At the outset, I would like to thank Principal Dr. Pruthul R Desai for his guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Botany for the long and arduous work they have put in during the compilation of the restructured syllabus.

Chairperson
Board of Studies in Botany



Board of Studies in Botany

	Name	Designation	Institute/Industry
Head of the Department			
1	Dr. Jayshri D Chaudhari	Assistant Professor	Sir P T Sarvajani College of Science, Surat
Faculty of the specialization			
1	Dr Vibhavari K Vyas	Adhyapak Sahayak	Sir P T Sarvajani College of Science, Surat
2	Dr. Jagruti S Rana	Adhyapak Sahayak	Sir P T Sarvajani College of Science, Surat
Subject Expert nominated by Vice-Chancellor Subject experts			
1	Dr Meghna Adhwaryu	Head of the Department	Govt Arts, Commerce & Science College, Limbayat, Surat
Representative from Industry/corporate sector/allied area			
1	Ms. Prabhuta Patel	Director – Vision & Robotics	At Po. Ambach, F. Vaghshar, Ta. Pardi, Dist. Valsad, Gujarat
Meritorious Alumnus			
1	Dr Minoo Parabia	Start-up	Retired professor VNSGU 12/1768 A, Vakil Street, Shahpore, Surat
Three experts from outside the parent University			
1	Dr Lolly M. Jain	Associate Professor	K. J. Somaiya College of Science and Commerce, Mumbai
2	Prof. Bandu Konde	Professor	Wilson College (Autonomous), Mumbai
3	Dr. Bhupendrasinh A. Jadeja	Associate Professor	M. D. Science College, Porbandar



Program Specific Outcomes (PSOs)	
After the successful completion of the Botany program, the students are expected to	
PSO1	Develop conceptual understanding of science and technology to foster the traditional and modern techniques for solving complex problems in Plant conservation.
PSO2	Be concerned about biodiversity conservation and environmental protection in the context of public health, safety, and cultural and societal development.
PSO3	Design and execute experiments using appropriate techniques, plant resources, and modern ICT tools to conserve natural resources.
PSO4	Apply ethical principles and social responsibilities, along with socioeconomic development, to understand the importance of the plant kingdom.
PSO5	Develop contextual knowledge in plant science research and communicate effectively with stakeholders and the society at large to enhance quality of life.

Program Outcomes (POs)	
On successful completion of the M. Sc. Botany program	
PO1	Apply the knowledge of Botany to find solutions to routine problems in life.
PO2	Ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany.
PO3	Develop scientific problem-solving through experimentation, research projects, and the Analysis and interpretation of data.
PO4	Exploration of diverse plant life forms and the nurturing of biodiversity conservation.
PO5	Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings
PO6	Design and standardize protocols for public health and safety, and cultural, Societal, and environmental considerations.
PO7	Apply appropriate techniques, resources, and modern ICT tools the sustainable utilization of Plant resources.
PO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.



PO9	Follow the concept of professional ethics and bioethics norms for practicing the value of the plant wealth.
PO10	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively.



Course Content

Sr. No	Semester	Course Type	Course Code	Course Name
1.	I	Core Course-I	BOTMSC-S1P1-4CR26	Diversity of Microorganisms
2.		Core Course-II	BOTMSC-S1P2-4CR26	Algae and Lichen
3.		Core Course-III	BOTMSC-S1P3-4CR26	Fungi and Plant Pathology
4.		Indian Knowledge System(IKS)	BOTMSC-S1IKS1-2CR26	Ancient Botanical Wisdom
5.		Skill Enhancement Course (SEC)-1	BOTMSC-S1SEC1PR-2CR26	Biofertilizers and Bio pesticides (Practical)
6.		Practical CC-I	BOTMSC- S1PR1-2CR26	Practical -Diversity of Microorganisms
7.		Practical CC-II	BOTMSC- S1PR2-2CR26	Practical- Algae and Lichen
8.		Practical CC-III	BOTMSC- S1PR3-2CR26	Practical - Fungi and Plant Pathology
1.	II	Core Course-IV	BOTMSC-S2P4-4CR26	Bryophytes and Pteridophytes
2.		Core Course-V	BOTMSC-S2P5-4CR26	Gymnosperms and Paleobotany
3.		Core Course-VI	BOTMSC-S2P6-4CR26	Plant Anatomy and Embryology
4.		Practical CC-IV	BOTMSC- S2PR4-2CR26	Practical- Bryophytes and Pteridophytes
5.		Practical CC-V	BOTMSC-S2PR5-2CR26	Practical Gymnosperms and Paleobotany
6.		Practical CC-VI	BOTMSC-S2PR6-2CR26	Practical- Plant Anatomy and Embryology
7.		VOCATIONAL COURSE-I	BOTMSC-S2VOC1-2CR26	Biostatistics and Instrumentation
			BOTMSC-S2VOC1PR-2CR26	Practical - Vocational course

Credit Framework of M.Sc. (Botany) Semester- I & II Syllabus

Semester	Core Course	IKS	SEC	VOC	Total Credit
I	18	2	2	-	22
II	18	-	-	4	22
Total					44



Distribution of Credit M.Sc. Botany Syllabus
M.Sc. Syllabus with effect from the Academic year 2026-27

Course types	Course Name	Course Code	Credits	Hour	Module	Lectures per module (1 Hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER I									
THEORY									
CC-I	Diversity of Microorganism	BOTMSC-S1P1-4CR26	4	60	4	15	50	50	100
CC-II	Algae and Lichen	BOTMSC-S1P2-4CR26	4	60	4	15	50	50	100
CC-III	Fungi and Plant Pathology	BOTMSC-S1P3-4CR26	4	60	4	15	50	50	100
IKS-1	Ancient Botanical Wisdom	BOTMSC-S1IKS1-2CR26	2	30	2	15	25	25	50
PRACTICAL									
SEC-1	Bio fertilizers and Bio pesticides (Practical)	BOTMSC-S1SEC1PR1-2CR26	2	60	-	-	25	25	50
PCC1	Practical -Diversity of Microorganism	BOTMSC-S1PR1-2CR26	2	60	-	-	25	25	50
PCC2	Practical-Algae and Lichen	BOTMSC-S1PR2-2CR26	2	60	-	-	25	25	50
PCC3	Practical- Fungi and Plant Pathology	BOTMSC-S1PR3-2CR26	2	60	-	-	25	25	50
Total			22						550



SEMESTER II									
THEORY									
CC-IV	Bryophytes and Pteridophytes	BOTMSC-S2P4- 4CR26	4	60	4	15	50	50	100
CC- V	Gymnosperms and Paleobotany	BOTMSC- S2P5- 4CR26	4	60	4	15	50	50	100
CC-VI	Plant Anatomy and Embryology	BOTMSC- S2P6- 4CR26	4	60	4	15	50	50	100
VOC 1	Biostatistics and Instrumentation	BOTMSC-S2VOC1- 2CR26	2	30	2	15	25	25	50
PRACTICAL									
PCC IV	Practical - Bryophytes and Pteridophytes	BOTMSC-S2PR4- 2CR26	2	60	2	15	20	30	50
PCCV	Practical - Gymnosperms and Paleobotany	BOTMSC-S2PR5- 2CR26	2	60	-	-	25	25	50
PCCVI	Practical - Plant Anatomy and Embryology	BOTMSC-S2PR6- 2CR26	2	60	-	-	25	25	50
PVOC1	Practical- Biostatistics and Instrumentation	BOTMSC-S2VOC1PR- 2CR26	2	60	-	-	25	25	50
Total			22						550



M. Sc. (BOTANY) SEMESTER I

CORE COURSE-I

COURSE NAME: DIVERSITY OF MICROORGANISMS

COURSE CODE: **BOTMSC-S1P1-4CR26**

[CREDITS - 04]

Course learning outcome		
After the successful completion of the Botany Course, the learner will be able to:		
• Grasp the history of the classification of microbes and plant development in plant pathology. • Illustrate the disease cycle of pathogens of plants. • Learn the processes of reproduction, adaptation, survival, and interaction of microorganisms with their associated hosts and environment. • Understand the theoretical basis of the tools, technologies and methods commonly used in microbiology and plant pathology. • Develop practical skills in the use of microbiological methodologies, tools and techniques. • Understand the role of microorganisms in human life.		
Module 1	History of virology, classification of viruses	[15L]
Learning objectives:		
The module is intended to:		
• Learn the characteristics of a virus and its classification. • Acquire knowledge of the morphology of the common Viruses. • Gain knowledge about Virus pathology and host interaction.		
Learning outcomes		
After the successful completion of the module, the learner will be able to		
1. Understand the characteristics of viruses, their classification and morphology. 2. Understand the different types of bacteria present in an environment. 3. Characterize and culture Viruses present in different substrates using appropriate techniques. 4. Understand the Economic and Industrial importance of the virus.		



1.1	➤ Pathological History and Timeline of Virology. ➤ Classification of viruses. ➤ Methods of transmission of viruses, properties of virus symptoms of viral infection on plants.	[4L]
1.2	➤ Bacteriophage. ➤ Behavior of viruses in plants, including infection, replication and movement. ➤ Histopathological changes induced by viruses in plants, including inclusion bodies.	[6L]
1.3	• Transmission of viruses: virus - vector relationships. Symptoms expression, viroid and prions. • Application of viruses in biotechnology.	[5L]
Module 2	Biology, reproduction & growth modes of bacteria	[15L]

Learning objectives:

This module is intended to:

- Learn about the various characteristics of bacteria and their classification.
- Acquire knowledge of the morphology of the most common bacteria.
- Gain knowledge about bacterial diseases, their pathogen, and host.

Learning outcome:

After the successful completion of the module, the learner will be able to

1. Grasp the characteristics of bacteria and their classification based on their morphology.
2. Learn to recognize the different types of bacteria present in an environment.
3. Characterize and culture bacteria present in various substrates using appropriate techniques.
4. Comprehend the range and potential of the economic and industrial importance of Bacteria.



2.1	➤ History of Bacteriology. ➤ Detailed study of bacteria with morphology and general classification.	[3L]
2.2	➤ Ultra-Structure of Bacterial cell, cell Wall, flagella and its Motility - Pili (fimbriae), capsules, sheaths, The Cell Wall - Structure and Chemical Composition: cell membrane, nucleoid, ribosomes, and endospore.	[4L]
2.3	➤ Sexual Reproduction-Bacterial conjugation with sex factor. Growth-Normal Growth Cycle (Growth Curve) of Bacteria.	[4L]
2.4	➤ Diseases caused by plant pathogenic bacteria; entry of bacteria into plants; pathogenicity and virulence factors in bacterial diseases; plant response to bacterial infection; diagnosis of bacterial diseases and symptoms. ➤ Industrial importance of Bacteria.	[4L]
Module 3	Methods in Microbiology	[15L]

Learning objectives:

The module is intended to make students:

- Use aseptic techniques for the transfer and handling of microorganisms and instruments.
- Familiarize with appropriate biological media and test systems for microbiology.
- Understand the use of standard biology laboratory equipment correctly.
- Isolate microorganisms from soil, water and air.

Learning outcome:

After the successful completion of the module, the learner will be able to:

1. Understand and recognize the different types of media and their uses.
2. Know of different stains, dyes and culture media for microorganisms present in different substrates using appropriate techniques.
3. Understand the Enumeration of microorganisms in soil, water and air.



3.1	➤ Micro-biological Media. ➤ Types, preparation, and methods of sterilization.	[4L]
3.2	➤ Techniques of pure culture, maintenance and preservation, Stains and dyes. ➤ Types of staining	[4L]
3.3	➤ Isolation of microorganisms from the environment and infected plant tissue.	[3L]
3.4	➤ Enumeration of microorganisms in soil, water, and air.	[4L]
Module 4	Applied microbiology	[15L]

Learning objectives:

The module is intended to:

- Explain the theoretical basis of the tools, technologies and methods commonly used in microbiology and plant pathology.
- Develop practical skills in the use of microbiological methodologies, tools and techniques.
- To assess the role of microorganisms in the industrial processing of microbial products and as causative agents of plant diseases.
- To formulate methodologies and develop tools and techniques to isolate, characterize and effectively exploit the various microbiological processes for human welfare.

Learning outcome:

After the successful completion of the module, the learner will be able to:

1. Recognize the different types of microorganisms present in a biosphere and their importance.
2. Understand the role of microorganisms in the industrial processing of microbial products.
3. Use the different microbiological processes for human welfare.



4.1	➤ Industrial Microbiology: Fermenters, batch fermentation vs continuous fermentation. ➤ Industrial production of enzymes (cellulase, amylase and protease), amino acids (glutamic acid and L-Lysine) and organic acids (lactic acid and citric acid).	[5L]
4.2	➤ Food microbiology, Fermented foods, Beverages, microbial spoilage of food. ➤ Food preservation, microbiology of milk and milk products.	[3L]
4.3	➤ Microbial interactions –Mutualism, commensalism, antagonism and parasitism; Nitrogen fixation, symbiotic.	[4L]
4.4	➤ Pollution indicator microorganisms, Quantification techniques -MPN and membrane filtration; Role of microorganisms in sewage treatment.	[3L]

References:

- Marilyn J. Roossinck (2016) Virus: An Illustrated Guide to 101 Incredible Microbes. Princeton
- Das, S. and Saha, R. (2020). Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India
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- Morello, J.A., Mizer, H.E., Granato, P.A. (2004). Laboratory Manual and Work Book in Microbiology. McGraw-Hill Education, New York, USA..
- J. Willey, K. Sandman. and D Wood (2022). Prescott's Microbiology. McGraw-Hill Education.
- Rakesh Patel and Kiran Patel (2015) Practical Microbiology Vol.1 and 2. Aditya Publication.



Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Classifies microbes based on morphological characters	X	X				
2	Describes the structure, nutrition and reproduction of bacteria and viruses	X					
3.	Analyze the quality of milk and fermented foods	X	X			X	
4	Explain cultivation and purification of single-cell protein.	X	X			X	
5	Develop the employability skills by learning the structure, reproduction and applied aspects of microbes.	X	X				X

Question Paper Template

M.Sc. (BOTANY) SEMESTER I

COURSE NAME: DIVERSITY OF MICROORGANISMS

COURSE CODE: **BOTMSC-S1P1-4CR26**

[CREDITS - 04]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	8	8	-	-	-	-	16
II	6	6	6	-	-	-	18
III	6	6	6	-	-	-	18
IV	6	6	6	-	-	-	18
Total marks per objectives	26	26	18	-	-	-	70
% Weightage	37.14%	37.14%	25.71%	-	-	-	100%



M. Sc. (BOTANY) SEMESTER I

CORE COURSE-II

COURSE NAME: ALGAE AND LICHEN

COURSE CODE: **BOTMSC-S1P2-4CR26**

[CREDITS - 04]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
Govern the concepts of diversity of algae and lichen.		
Module 1	Classification and character of Algae	[15L]
Learning Objectives:		
This module is intended to provide:		
- Understanding of the basic structure, cell properties and characteristics of algae. - Insight into the relation of Algae with Fungi, Lichen and Bryophytes. - Understand its applications for human beings.		
Learning Outcome:		
After the successful completion of the module, the learner will be able to:		
- Elaborate knowledge about algae and will be using to develop skills for identification, importance, and applications. - Illustrate the microscopic characters of algae and Lichen.		
1.1	- Broad outline of algal classification by Smith - Evolution of chloroplast in algae - Origin and evolution of reproduction in algae.	[6L]
1.2	Distinctive characters of major divisions: Chlorophyta, Euglenophyta, Pyrrophyta, Chrysophyta, Phaeophyta, Cyanophyta, Rhodophyta.	[9L]
Module 2	Applications of Algae	[15L]
Learning Objectives:		
This module is intended to provide:		
- The concept of classification criteria for algae and other characteristics of each class. - Understand the knowledge of different types of culture media and the culture of algae.		



Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Elaborate knowledge about the collection of algae from soil and water.
2. Elaborate knowledge about media preparation and culture of specific algae.

2.1	➤ Applications of algae in different fields. ➤ Cultivation and methods of preservation of algae. ➤ Commercial and economic products of sea weeds (Agar, Algin and Carrageenin). ➤ Ecological importance of algae	[8L]
2.2	➤ Affinities of algae with Fungi ➤ Affinities of algae with Bryophytes. ➤ Algal bloom and toxic algae. ➤ Single cell protein Spirulina.	[7L]
Module 3	Life cycle of Algae-III	[15L]

Learning Objectives:

This module is intended to:

- Students will be able to understand external features and internal peculiarities of algae.

Students will be able to understand the reproduction of life cycle of Ulothrix, Euglena, Dinastridion, Botrydium, Spirulina, Batrachospermum.

Learning Outcome:

After the successful completion of the module, the learner will be able to

1. Enhance detailed knowledge about algal taxa.
2. Identification and application of algae in life.
3. Learn about the morphology, internal structure, reproduction and life cycle of algae.
4. Understand the fundamentals of economic importance a biomedical application of selected species of algae.



3.1	➤ Morphology, cell structure, reproduction and life cycle of following types: Chlorophyta: Ulothrix Euglenophyta: Euglena Pyrrophyta: Dinastridion Chrysophyta: Botrydium Phaeophyta: Ectocarpus Cyanophyta: Spirulina Rhodophyta: Batrachospermum	[15L]
Module 4	Lichen	[15L]
Learning Objectives: This module is intended to: - Familiarize with this unique biological class. - Understand about general characters, habit and habitat of Lichen, external and internal features of lichen, reproduction mode of lichen and types of lichen. - Remember ecological significance and economic importance of lichen.		
Learning Outcome: After the successful completion of the module, the learner will be able to: - Elaborate knowledge about industrial and ecological applications. - Learn about the morphology, structure, reproduction and life cycle of Lichen. - Understand the fundamentals of economic importance and biomedical applications of selected species of lichen.		
4.1	➤ Introduction of Lichen. ➤ General characteristics of Lichen. ➤ Occurrence of lichen.	[5L]
4.2	➤ Classification of Lichen. ➤ Thallus Structure of lichen. ➤ Reproduction in Lichen. ➤ Economic and Ecological Importance of Lichen.	[6L]
4.3	➤ Usnea: Classification, Morphology, Internal Structure, and Reproduction.	[4L]



References:

- Bhattia, A.(2004).Treatise on Algae. S. Chand & Company ,New Delhi
- Bilgarmi, K. S and Saha, L.C.(1996)..A text book of Algae. CBS Publishers, New Delhi
- Bold, H.C.& Wynne,M.J.(1995)..Introduction to Algae. Prentice Hall of India, New Delhi.
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- Sharma, P.D.(2003).A Text book of Botany-Lower plants. Rastogi Publications, Meerut.
- Smith, G.M.(1976). Cryptogamic Botany Vol.1.Tata McGraw Hill Publ. Comp. Ltd. New Delhi.
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Question Paper Template

M.Sc. (BOTANY) SEMESTER I

COURSE NAME: ALGAE AND LICHEN

COURSE CODE: BOTMSC-S1P2-4CR26

[CREDITS - 04]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	8	8	-	-	-	-	16
II	6	6	6	-	-	-	18
III	6	6	6	-	-	-	18
IV	6	6	6	-	-	-	18
Total marks per objectives	26	26	18	-	-	-	70
% Weightage	37.14%	37.14%	25.71%	-	-	-	100%

Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Classifies algae based on morphological characters	X	X				
2	Describes the structure and reproduction of algae	X					
3.	Illustrate the structure and reproduction in lichens	X	X			X	
4	Understand the fundamentals of economic importance and biomedical applications of selected species of Algae and Lichen	X	X			X	
5	Familiarize the use of microscope for identification selected algae and lichen		X			X	



M. Sc. (BOTANY) SEMESTER I

CORE COURSE-III

COURSE NAME: FUNGI AND PLANT PATHOLOGY

COURSE CODE: **BOTMSC-S1P3-4CR26**

[CREDITS – 04]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
• Become self-sustaining by gaining knowledge of Fungi and plant pathogens. • Start their start-ups and be an entrepreneur. • Prepare products from fungi and utilize them in medicine and in other areas.		
Module 1	Classification and character of fungi	[15L]
Learning Objectives:		
This module is intended to:		
• Introduce to the scope, importance, uses, and market demand of Fungi. • Understanding Plant diseases, types, and prevention. • Elaborate knowledge about fungi to be used to develop industrial applications.		
Learning Outcome:		
After the successful completion of the module, the learner will be able to:		
1. Start their start-ups and be an entrepreneur. 2. Prepare products from fungi and utilize them in medicine and other applications.		
1.1	➤ Fungi-General characters (Ultra-structure of thallus and reproduction) ➤ Unicellular and multicellular organization. ➤ Cell wall composition and nutrition. ➤ Classification of Fungi (Ainsworth).	[6L]
1.2	➤ Para sexuality in Fungi. (Mechanism of Parasexual cycle and application of Para sexuality). ➤ Edible Fungi: Mushrooms and their cultivation, Economic importance of Fungi.	[6L]
1.3	➤ Useful activities and Harmful activities of Fungi. ➤ Heterothallism.	[3L]



Module 2	Life history of fungi	[15L]
Learning Objectives: This module is intended to: • Help in learning thallus Structure, cell structure, nutrition and life cycle of the Fungi. • Provide Knowledge about nutrition and the life cycle of different fungi in the syllabus.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Identify the given fungi in the syllabus. 2. Importance of serendipity (by chance discovery) and keen observation leading to the discovery of Penicillin.		
2.1	➤ Occurrence, classification, thallus structure, cell structure, nutrition and life cycle of the following: • Phytophthora • Rhizopus • Penicillium • Claviceps • Ustilago • Colletotrichum	[15L]
Module 3	Advanced Concept in Plant Pathology	[15L]
Learning Objectives: This module is intended to: • Develop and understanding of plant-microbe interactions and their significance in plant health and disease. • Explain the mechanisms of host-pathogen interaction and the process of disease development. • Analyze the factors influencing plant disease epidemiology and disease spread.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Explain the nature and significance of plant-microbe interaction in plant health and disease. 2. Analyze the mechanisms involved in host-pathogen interactions and disease development. 3. Evaluate the factors affecting plant disease epidemiology and disease progression		



3.1	➤ Introduction to plant-microbe interactions ➤ Beneficial and harmful plant-microbe interactions ➤ Rhizosphere, phyllosphere and endophytic microorganisms ➤ Role of plant microbiome in plant health and diseases suppression	[3L]
3.2	➤ Host-Pathogen Interaction: Disease cycle, infection process, host specificity, host-pathogen relationship	[4L]
3.3	➤ Plant Disease Epidemiology: Factors affecting disease development, disease forecasting, disease assessment and disease progress curves	[4L]
3.4	➤ Recent Advances in Plant Pathology - Molecular techniques in plant disease diagnosis (PCR, ELISA) - Biosensors and nanotechnology in plant detection - Remote sensing and artificial intelligence(AI) in plant disease diagnosis - Future prospects of plant pathology	[4L]
Module 4	Plant Diseases	15L

Learning Objectives:

This module is intended to

- Knowledge of plant pathogens.
- Learning value: Plant diseases and prevention.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Learn fungal, bacterial, viral and phytoplasma diseases.

4.1	➤ Fungal diseases of plants: Wheat (Rust, Smut, Bunt)Wilt of cotton, Early blight of potato, Powdery mildew of pea	[4L]
4.2	➤ Bacterial diseases of plants: Citrus canker, Bacterial blight of paddy, Bacterial wilt of tomato, Fire blight of apple, Soft rot of potato	[4L]



4.3	➤ Viral diseases of plants: TMV, Bhindi (Yellow vein mosaic virus), Papaya ring spot virus, Rice tungro disease	[3L]
4.4	➤ Phytoplasma diseases of plants: Little leaf of brinjal, Grassy shoot of sugarcane, Sesame phyllody	[4L]

References:

- Alexopoulos, C. J., Mims, C.W. and Blackwel, M., Introductory Mycology, John Wiley & Sons Inc.
- Mandahar, C.L. Introduction to Plant Viruses. Chand & Co. Ltd., Delhi.
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Question Paper Template

M.Sc. (BOTANY) SEMESTER I

COURSE NAME: FUNGI AND PLANT PATHOLOGY

COURSE CODE: BOTMSC-S1P3-4CR26

[CREDITS - 04]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	8	8	-	-	-	-	16
II	6	6	6	-	-	-	18
III	6	6	6	-	-	-	18
IV	6	6	6	-	-	-	18
Total marks per objectives	26	26	18	-	-	-	70
% Weightage	37.14%	37.14%	25.71%	-	-	-	100%

Mapping of CLOs and PSOs

Identify

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Classify fungi based on their morphology, ultra structure, reproduction, nutrition and taxonomy.	X	X				
2	Explain the life cycle, structure, reproduction and economic importance of representative fungi.	X	X	X			
3.	Analyze plant microbe interactions, host-pathogen relationships, disease epidemiology and recent advances in plant pathology.	X	X	X	X	X	
4	Identify and describe the symptoms, causal organisms and management of major fungal, bacterial, viral and phytoplasma diseases of plants.	X	X	X	X		X
5	Apply mycological and plant pathological knowledge for disease diagnosis, research and sustainable plant disease management.	X	X	X	X	X	X



**M. Sc. (Botany) SEMESTER I
IKS**

COURSE NAME: ANCIENT BOTANICAL WISDOM

COURSE CODE: BOTMSC-S1IKS1-2CR26

[CREDITS - 02]

Course Learning Outcome

After the successful completion of the course, the learner will be able to:

- Understand the significance of Indian Knowledge System (IKS) in the field of botany.
- Explain ancient Indian botanical knowledge described in Vedas, Upanishads, Puranas and Classical texts.
- Recognize the contributions of modern Indian botanists like Birbal Sahni, E.K. Janaki Ammal and M.S. Swaminathan.
- Explain the importance of sacred groves, biodiversity conservation and traditional ecological knowledge.
- Identify important medicinal and economic plants used in Ayurveda and daily life.
- Apply indigenous botanical knowledge for sustainable agriculture, environment conservation and human welfare.

Module 1

Roots of Indian Botanical Wisdom

[15L]

Learning Objectives:

This module is intended to:

- Develop an understanding of the role and importance of plants in ancient Indian civilization and culture.
- Familiarize students with sacred and economically important plants mentioned in Indian traditions.
- Promote appreciation of traditional botanical wisdom and its relevance to sustainability.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Explain the importance of plants in ancient Indian civilization and culture.
2. Identify sacred and economically important plants mentioned in Indian traditions.
3. Appreciate the relevance of traditional botanical knowledge in modern sustainable practices.



1.1	➤ Importance of plants in Indian culture and daily life. Sacred plants used in holy festival	[4L]
1.2	➤ Sacred plants used in Rashi Vatika and their significance,	[3L]
1.3	➤ Sacred plants used in Navgrah Vatika and their spiritual, medicinal and ecological importance.	[4L]
1.4	➤ Ancient Indian Plant Science - Vrikshayurveda: Science of plant life and tree care - Traditional methods of seed treatment, irrigation and soil fertility - Ancient gardening and forest management practices	[4L]
Module 2	Indian Botanists and Modern Relevance	[15L]

Learning Objectives:

This module is intended to:

- Introduce students to the life and scientific contributions of eminent Indian botanists such as Birla Sahni, E.K. Janaki Ammal and M.S. Swaminathan.
- Develop understanding of the role of Indian scientists in Plant taxonomy, Paleobotany, Cytogenetics and agricultural development.
- Explain the concept and importance of traditional ecological knowledge in India.
- Familiarize students with sacred groves as centers of biodiversity conservation.
- Highlight traditional practices such as organic farming, natural manure use, seed preservation and water management.
- Promote awareness about integrating traditional wisdom with modern environmental sustainability.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Identify eminent Indian botanists and describe their major scientific contributions.
2. Explain the role of Indian scientists in the development paleo botany, cytogenetics, taxonomy and agriculture science.
3. Describe the concept and significance of traditional ecological knowledge in India.



4. Explain the importance of sacred groves in biodiversity conservation.
5. Discuss traditional practices such as organic farming, seed preservation and water management.

2.1	➤ Inspiring Indian Botanists - Birbal Sahni- Father of Indian Paleobotany - E.K. Janaki Ammal- plant breeding and cytogenetics - M.S.Swaminathan- Green Revolution in India - Contribution of Indian scientists to plant research	[8L]
2.2	➤ Nature Conservation through Tradition - Sacred groves of India as biodiversity centers - Traditional eco-friendly farming methods - Role of local communities in forest protection	[7L]

References:

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- **Nene, Y.L.** Agricultural Heritage of India (2007), Asian Agri-History Foundation, Secunderabad.
- **Amithalingam, M.** Sacred Groves of India –An Overview (2016), CPR Environmental Education Centre, Chennai.

**Web References:**

- Biodiversity Heritage Library
- Encyclopedia Britannica
- NCERT
- Botanical Survey of India

Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Understand the significance of Indian Knowledge System (IKS) in the field of botany.	X	X				
2	Explain the concept and significance of traditional ecological knowledge in India.	X	X	X			
3.	Apply traditional practices such as organic farming, seed preservation and water management in daily practices	X			X	X	
4	Get knowledge of role of Indian scientists in the development paleo botany, cytogenetics, taxonomy and agriculture science.	X	X			X	



Question Paper Template

M.Sc. (BOTANY) SEMESTER I
COURSE NAME: ANCIENT BOTANICAL WISDOM

COURSE CODE: BOTMSC-S1IKS1-2CR26

[CREDITS - 02]

Module	Remembering / Knowledge	Understan ding	Applying	Analysing	Evaluating	Creating	Total marks
I	3	5	5		-	-	13
II	2	5	5		-	-	12
Total marks per objective	05	10	10				25
% Weightage	20%	40%	40%				100%



M. Sc. (BOTANY) SEMESTER I

Skill Enhancement Course

COURSE NAME: BIOFERTILIZERS AND BIOPESTICIDES

COURSE CODE: **BOTMSC-S1SEC1PR-2CR26** [CREDITS - 02] [30 Hrs]

Course Learning Outcome

After the successful completion of the Course, students will be able to:

- Understand the concept, type and agricultural importance of bio fertilizers in improving soil fertility.
- Demonstrate the preparation and application of bio fertilizers and evaluate their effect on plant growth under treated and normal (control) conditions.
- Identify commonly used bio pesticides and explain their role in eco-friendly pest management.
- Develop practical skills in the preparation of botanical pesticides from plants like *Azadirachta indica* and other natural sources.
- Apply knowledge of biofertilizers and biopesticides in sustainable agriculture and small-scale organic farming practices.
- Record experimental observations, analyze result and prepare a structured practical report.

Module 1	PRACTICAL OF BIOFERTILIZER
1	Study of important biofertilizers and their agricultural importance: • Rhizobium • Azotobacter • Azospirillum
2.	Observation of root nodules in leguminous plants to understand nitrogen fixation.
3.	Study of commercial biofertilizer packets (composition, expiry date, method of application).
4.	Demonstration of seed treatment using biofertilizer.
5.	Study of vermicompost and the role of earthworms in soil fertility.
6.	To prepare biofertilizer using Banana peel and Onion Peel.
7.	To prepare a simple biofertilizer, apply it for seed treatment or plant growth, and compare the growth of treated plants with that of normal (untreated) plants, and record observations to prepare and submit a practical report.



Module 2	PRACTICAL OF BIOPESTICIDES
8.	Study of any two important microbial biopesticides and their uses.
9.	Preparation of neem extract as a botanical pesticide from <i>Azadirachta indica</i> leaves or seeds.
10.	Preparation of natural Chilli and garlic extract for pest control.
11.	Observation and identification of pest damage in plants in college campus.
12.	Preparation of simple biopesticide spray solution and method of application.
- Every candidate shall complete a laboratory course by the regulations issued from time to time by the Academic Council on the recommendation of the Board of Studies. - Every candidate shall record observations directly in the laboratory journal. Every journal shall be signed periodically. - At the end of the semester, candidates shall produce a certified journal during the practical examination	

Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Understand the concept, types and importance of biofertilizers such as Rhizobium and Azotobacter in sustainable agriculture.	X	X				
2	Demonstrate preparation and application of biofertilizers and compare plant growth under treated and normal conditions.	X	X	X			
3.	Identify and apply biopesticides for eco-friendly pest control.	X		X		X	
4	Develop skills in preparation of botanical pesticides from <i>Azadirachta indica</i> and other natural sources.			X	X		
5	Apply knowledge of biofertilizers and biopesticides for sustainable and small-scale agricultural practices.			X	X	X	



M.Sc. (BOTANY) SEMESTER I

COURSE NAME: Practical - Diversity of Microorganisms

(Based on Core Course I)

COURSE CODE: BOTMSC-S1PR1-2CR26

[Credit- 02]

Course Learning Outcome	
After the successful completion of the Course, the learner will be able to:	
1. Demonstrate practical skills. 2. Correlate their Botany theory concepts through practical. 3. Develop an understanding different diversity of plants.	
Biology and diversity of Microorganisms	[60 Hrs]
1	To Study the preparation of Microbiological Culture Media.
2	To study Sterilization Techniques used in Microbiology.
3	To Prepare Agar Slants and Agar Stabs.
4	To study Preparation and pouring of Agar Plates.
5	To Isolate Pure Culture by Streak plate method.
6	To Isolate Pure Culture by Pour Plate Method.
7	Isolation of bacteria, fungi [plate count] from soil and water.
8	Isolation of pathogenic microorganisms from infected plant tissue.
9	Observation of motility of bacteria [hanging drop technique].
10	Staining methods: Preparation of smears for stains, simple staining, negative staining and gram staining.
11	Spoilage of milk by micro-organisms [Methylene blue test].
12	Micrometry for the Bacterial slide.
13	Direct examination of root nodule bacteria under microscope.
14	Study of Viruses by chart or specimen- Potato Virus, Tomato yellow leaf Curl virus, Ralstonia Phage Virus.
15	To study zone & inhibition test (Kirby-Bauer) for antimicrobial activity.



16	Isolation of N ₂ fixing Bacteria <i>Rhizobium</i> .
17	Isolation of N ₂ fixing Bacteria <i>Azotobacter</i> .
18	Isolation and identification of bacteria in soil.



M.Sc. (BOTANY) SEMESTER I
COURSE NAME: Practical - Algae and Lichen
(Based on Core Course II)

COURSE CODE: BOTMSC-S1PR2-2CR26

[Credit- 02]

Course Learning Outcome	
After the successful completion of the Course, the learner will be able to:	
1. Demonstrate practical skills. 2. Correlate their Botany theory concepts through practical. 3. Develop an understanding different diversity of plants.	
Algae and Lichen	[60 Hrs.]
1	A. To study algae Ulothrix . B. To study Permanent slide of Ulothrix .
2	A. To study algae Anabena . B. To study Permanent Slide of Anabena .
3	A. To study algae Euglena . B. To study Permanent Slide of Euglena .
4	A. To study algae Dinastriidion . B. To Study Permanent Slide of Dinastriidion .
5	A. To study algae Botrydium . B. To study Permanent Slide of Botrydium .
6	A. To study algae Ectocarpus . B. To Study Permanent Slide of Ectocarpus .
7	A. To study algae Spirulina . B. To study Permanent Slide of Spirulina .
8	A. To study algae Batrachospermum . B. To study Permanent Slide of Batrachospermum .
9	A. To study lichen Usnea . B. To study Permanent Slide of Usnea .
10	Student should collect and identify common Algae and prepare a field report of collection activities in the journal itself.
11	Isolation of algae from soil.



M.Sc. (BOTANY) SEMESTER I

COURSE NAME: Practical - Fungi and Plant Pathology

(Based on Core Course III)

COURSE CODE: **BOTMSC-S1PR3-2CR26**

[Credit- 02]

Course Learning Outcome	
After the successful completion of the Course, the learner will be able to:	
1. Demonstrate practical skills. 2. Correlate their Botany theory concepts through practical. 3. Develop an understanding different diversity of plants.	
Fungi and Plant Pathology	
[60 Hrs.]	
1	A. To study fungi <i>Phytophthora</i> . B. To study Permanent Slide of T.S. of infected leaf showing sporangia of <i>Phytophthora</i> .
2	A. To study fungi <i>Rhizopus</i> . B. To study Permanent Slide: Sporangia and Zygosporangium of <i>Rhizopus</i> .
3	A. To study fungi <i>Penicillium</i> . B. To study Permanent Slide of mycelium bearing conidia and ascocarp of <i>Penicillium</i> .
4	A. To study fungi <i>Claviceps</i> . B. To study Permanent Slide of Mycelium showing conidiophores, V.S. of stroma, V.S. of ascocarp of <i>Claviceps</i> .
5	A. To study fungi <i>Ustilago</i> . B. To study Permanent Slide of Chlamydospores and Teleutospores of <i>Ustilago</i> .
6	A. To study fungi <i>Colletotrichum</i> . B. To study Permanent Slide of inter and intracellular mycelium, acervulus and conidia of <i>Colletotrichum</i> .
7	Isolation and identification of fungi from soil.



8	To study Causal organism, symptoms and control measures of the following Fungal diseases of plants. A. Wheat (Rust, Smut, Bunt) B. Wilt of Cotton C. Irish blight of Potato D. Blight of Colocasia E. Covered smut of Barley or Oat F. Common smut of maize G. Red rot of sugarcane – lesions on stem and leaf
9	To study Causal organism, symptoms and control measures of the following Bacterial diseases of plants. A. Leaf Spot of Mango B. Bacterial Rot of Crucifers C. Soft Rot of Potato
10	To study Causal organism, symptoms and control measures of the following Viral diseases of plants. A. Leaf Spot of Mango B. Yellow Vein Mosaic of Okra
11	Identify different types of fungi according to morphological characters.
12	Student should collect and identify fungi and prepare a field report of collection activities in the journal.

- Every candidate shall complete laboratory course in accordance with the regulations issued from time to time by Academic Council on the recommendation of the Board of Studies.
- Every candidate shall record observation directly in the laboratory journal. Every journal shall be signed periodically. At the end of the semester candidate shall produce certified journal during the practical examination.



M. Sc. (BOTANY) SEMESTER II

CORE COURSE-IV

COURSE NAME: BRYOPHYTES AND PTERRIDOPHYTES

COURSE CODE: **BOTMSC-S2P4-4CR26** [CREDITS - 04]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
- Govern the concepts of diversity of Bryophytes and Pteridophytes. - Understand the structural level of plant diversity emphasized in ecological, organizational and cultural. - Realized the fundamental values of diversity and the importance of human welfare. - Define and characterize diversity of lower non vascular and vascular plants to understand the significance of diversity.		
Module 1	Classification and characters of Bryophytes	[15L]
Learning Objectives: This module is to designed that - Students will be able to understand the basic structure, cell and tissue properties as characters of bryophytes. - Students will be able to understand the affinities of bryophytes with algae. - Students will be able to understand the applications of Bryophytes and Pteridophytes.		
Learning Outcome: After the successful completion of the module, the learner will be able to - Elaborate knowledge about Bryophytes and will be used to develop skill for identification, importance and applications of bryophytes. - To understanding the ecological, cultural and economic importance of bryophytes.		
1.1	➤ Classification of Bryophytes by Rothmaler and Proskauer ➤ Evolution of sporophytes and gametophytes in Bryophytes ➤ Affinities of Bryophytes.	[7L]
1.2	➤ General and principal characters of following classes (with a note on comparative account) - Hepaticopsida - Anthocerotopsida - Bryopsida	[5L]



1.3	➤ Application of bryophytes in different field.	[3L]
Module 2	Life history of Bryophytes	[15L]
Learning Objectives: This module is intended to: - Students will be able to understand the classification criteria and important characters of each class. - To acquaint students with bryophytes diversity and its ecological and economic importance.		
Learning Outcome: After the successful completion of the module, the learner will be able to - Envisage bryophytes as one of the most successful and diverse group of plants that form the pioneering ecosystem. - Correlate the characters of bryophytes as connecting link between the different groups. - Understand the journey of plants water to land, while still retaining some characters of water plants.		
2.1	➤ Morphology, Internal structure, reproduction and life cycle of following types: - Plageochasma - Porella - Frullania - Anthoceros - Sphagnum - Pogonatum	[15L]
Module 3	Classification and Characters of Pteridophytes	[15L]
Learning Objectives: This module is intended to: Learn about the morphology, structure, reproduction and life cycle of different types of Pteridophytes.		



Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Illustrate diversity among the Pteridophytes. General characters of Pteridophytes. Classify Pteridophytes based on their structure, reproduction and life cycles. Evaluate the ecological, ethnic and economic value of Pteridophytes. Summarize their goods and services to human welfare.		
3.1	➤ Diversity and distribution of pteridophyte in India ➤ Classification of Pteridophytes (Riemers-1954)	[4L]
3.2	➤ Principal characters of following subdivisions with an examples • Psilophytopsida • Psilotopsida • Lycopsidea • Sphenopsida • Pteropsida	[6L]
3.3	➤ Affinities of Pteridophytes ➤ Biotechnology- application in Peridophytes. ➤ Pteridophytes as medicines.	[5L]
Module 4	Evolution and life history of Pteridophytes	[15L]
Learning Objectives: This module is intended to: • Illustrate diversity among the pteridophytes, heterospory and seed habit, telome theory.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Evolution of stellar system of Pteridophytes. 2. Learn about apospory and apogamy.		
4.1	➤ Heterospory and seed Habit ➤ Telome theory, Enation theory	[5L]
4.2	➤ Stelar system and evolution of stele in Pteridophytes ➤ Apospory and Apogamy	[5L]



4.3	➤ Morphology, Internal structure, reproduction and life cycle of following types: • Rhynia • Psilotum • Equisetum • Adiantum	[5L]
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References:

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- Parihar, N.S.: An Introduction to Embryophyta Vol.II Pteridophyta Central Book Depot., Allahabad.
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Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Classified Bryophyte and Pteridophytes based on morphological characters	X	X				
2	Describes the structure, reproduction of Bryophyte	X					
3.	Illustrate the structure and reproduction in Pteridophytes	X	X			X	
4	Understand the fundamentals of economic importance and biomedical applications of selected species of Bryophyte and Pteridophytes	X	X			X	
5	Familiarize the use of microscope for identification selected algae and lichen		X			X	



Question Paper Template

M.Sc. (BOTANY) SEMESTER II

COURSE NAME: BRYOPHYTES AND PTERIDOPHYTES

COURSE CODE: BOTMSC-S2P4-4CR26

[CREDITS - 04]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	8	8			-	-	16
II	6	6	3	3	-	-	18
III	4	4	5	5	-	-	18
IV	4	4	5	5	-	-	18
Total marks per objective	22	22	13	13	-	-	70
% Weightage	31.4%	31.4%	18.6%	18.6%	-	-	100%



M. Sc. (Botany) SEMESTER II

CORE COURSE-V

COURSE NAME: GYMNOSPERMS AND PALEOBOTANY

COURSE CODE: BOTMSC-S2P5-4CR26

[CREDITS - 04]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
• Explain and define the meaning of gymnosperms. • Describe the characteristic features of gymnosperms. • Distinguish and identify the gymnosperms in your surroundings. • Classify the gymnosperms. • Analyze the distribution and economic importance of gymnosperms.		
Module 1	Distribution, Affinities, Origin and Application of Gymnosperms	[15L]
Learning Objectives: This module is intended to: • To prove the evolutionary relationship with prehistoric evidences. • Summarize the general characters, classification, and distribution with reference to gymnosperms.		
Learning Outcome: After the successful completion of the module, the learner will be able to 1. Explain economic importance of gymnosperm. 2. Compare gymnosperm with pteridophytes and angiosperms.		
1.1	➤ Distribution of Gymnosperms in India. ➤ Affinities of Gymnosperm with pteridophytes and angiosperms.	[8L]
1.2	➤ Origin and evolutionary tendencies in Gymnosperm. ➤ Application of Gymnosperm in different fields.	[7L]
Module 2	Orders of gymnosperms	[15L]



Learning Objectives: This module is intended to: - Summarize the distinguishing characters of orders of Gymnosperms. - Classify the gymnosperms to respective orders.		
Learning Outcome: After the successful completion of the module, the learner will be able to Describe the distinguishing characters of orders of gymnosperm.		
2.1	- Distinguishing characters of following Orders of Gymnosperms. - Cycadofilicales - Bennettitales - Cycadales - Cordaitales	[8L]
2.2	- Distinguishing characters of following Orders of Gymnosperms. - Coniferales - Ginkgoales - Gnetales	[7L]
Module 3	Life history of gymnosperms	[15L]
Learning Objectives: This module is intended to: - Alternation of generation in gymnosperms. - Distribution, morphology and reproduction of gymnosperms.		
Learning Outcome: After the successful completion of the module, the learner will be able to: Describe the life cycle of Zamia, Ginkgo, Ephedra and Thuja.		



3.1	➤ Classification, distribution, morphology, anatomy, reproduction and life cycle of following types: • Cycadales: Zamia • Ginkgoales: Ginkgo • Ephedrales: Ephedra • Cupressales: Thuja • Welwitschiales: Welwitschia	[15L]
Module 4	Paleobotany	[15L]
Learning Objectives: This module is intended to: • To consolidate the process of fossilization and principle types of fossils. • Review characters of fossils.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Understand the geological time scale and process of fossilization.		
4.1	➤ Geological Time Scale and Evolution of Gymnosperms ➤ Process of Fossilization and types of Plant Fossils ➤ Types of fossils ➤ Mesozoic Gymnosperm Flora ➤ Important Gymnosperm Fossils in India (Rajmahal Hills, Raniganj Coalfields, Deccan Intrappean Beds)	[15L]
References: • Arnold, C.A. (1948). “Classification of gymnosperms”, Botanical Gazette, Vol.110, pp.2-12. • Bierhorst, D.W. (1971), Morphology of vascular plants, Mac. Millan Co., New York. • Maheshwari, P. and Singh. H. (1960), Economic importance of conifers. J. Univ. Gawhati (Sci), Vol. 11.pp.1-28. • Raizada, M.B. and Sahani, K.C. (1960), Living Indian Gymnosperms, Indian forest records: Botany, Vol.5 (2), Manager of Publications, New		



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- A Text Book of Botany: V.Singh, P.C. Pandey and D.K. Jain (2008).

Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Discuss the salient features of Gymnosperm morphology	X	X				
2	Illustrate the reproductive characters of important genus of gymnosperm.	X	X				
3.	Explain the significance of Important genus of fossil gymnosperm.	X	X				
4	Classify, structure and reproduction of the main classes of gymnosperm.	X	X			X	
5	Develop the Employability skills by learning the application of gymnosperms.						X



Question Paper Template

M.Sc. (BOTANY) SEMESTER II

COURSE NAME: GYMNOSPERMS AND PALEOBOTANY

COURSE CODE: **BOTMSC-S2P5-4CR26**

[CREDITS - 04]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	8	8			-	-	16
II	6	6	3	3	-	-	18
III	4	4	5	5	-	-	18
IV	4	4	5	5	-	-	18
Total marks per objectives	22	22	13	13	-	-	70
% Weightage	31.4%	31.4%	18.6%	18.6%	-	-	100%



M. Sc. (BOTANY) SEMESTER II

CORE COURSE-VI

COURSE NAME: PLANT ANATOMY AND EMBRYOLOGY

COURSE CODE: BOTMSC-S2P6-4CR26

[CREDITS - 04]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
• Explain the structure, development and functional significance of advanced plant anatomical and embryological features. • Analyze anatomical and embryological characteristics for their applications in taxonomy, ecology and plant breeding. • Apply histological and embryological techniques to investigate plant tissues and reproductive structures. • Evaluate recent advances and research in plant anatomy, embryology and reproductive biology.		
Module 1	Advanced Plant Anatomy	[15L]
Learning Objectives:		
This module is intended to:		
• Understand the development and organization of plant tissues and meristems. • Explain normal and anomalous secondary growth in plants. • Analyze the adaptive and functional significance of plant anatomical features.		
Learning Outcome:		
After the successful completion of the module, the learner will be able to:		
1. Explain the development and organization of plant tissues and meristems. 2. Differentiate normal and anomalous secondary growth in plants' 3. Analyze the structural and adaptive significance of plant anatomical features.		
1.1	• Organization and development of apical meristem (Shoot and Root Meristems) • Histogenesis and tissue differentiation • Vascular cambium and secondary growth • Anomalous secondary growth (in stems and roots)	[8L]



	Secretory structures (Laticifers, resin ducts, oil glands, hydathodes, nectaries)	
	- Ecological and adaptive anatomy of hydrophytes, xerophytes, halophytes and epiphytes. - Developmental anatomy of leaf, stem and root. - Applied significance of plant anatomy in taxonomy, ecology, forestry and pharmacognosy.	[7L]
Module 2	Applied Plant anatomy	[15L]
Learning Objectives: This module is intended to: - Develop an understanding of advanced plant anatomical techniques and their applications. - Explain the taxonomic and applied significance of wood, leaf and nodal anatomy. - Evaluate the role of plant anatomy in taxonomy, forestry, pharmacognosy and related fields.		
Learning Outcome: After the successful completion of the module, the learner will be able to: - Explain advanced plant anatomical techniques and histochemical methods. - Analyze the taxonomic significance of wood, leaf and nodal anatomy. - Apply anatomical knowledge in taxonomy, forestry, pharmacognosy and related disciplines.		
2.1	Wood anatomy – Structure of softwood and hardwood, Identification of wood Leaf anatomy – Venation patterns, leaf architecture and taxonomic significance Nodal anatomy – Types of nodes and their systematic importance Histochemistry of plant tissues – Localization of starch,	[15L]



	proteins, lipids, lignin, cellulose, tannins and phenolic compounds. • Plant anatomical techniques – Fixation, sectioning, staining, maceration, clearing and permanent slide preparation. • Applied plant anatomy – Applications in taxonomy, pharmacognosy, forestry, palaeobotany, environmental studies and forensic botany.	
Module 3	Advanced Plant Embryology	[15L]
Learning Objectives: This module is intended to: • Develop an understanding of advanced concepts in seed development. • Explain the development of male and female gametophytes, fertilization and embryogenesis. • Analyze advanced concepts in plant embryology, including apomixes, polyembryony and their significance.		
Learning Outcome: After the successful completion of the module, the learner will be able to: 1. Explain the development of male and female gametophytes and the process of fertilization in angiosperms. 2. Describe the stages of endosperm development and embryogenesis. 3. Analyze the significance of apomixis, polyembryony and related reproductive process in plants		
3.1	• Microsporogenesis and development of female gametophyte (embryo sac) • Megasporogenesis and development of female gametophyte (embryo sac)	[8L]



3.1	• Pollination and pollen – pistil interaction • Double fertilization and endosperm development • Embryogenesis – Development of monocot and dicot embryos • Polyembryony and apomixes – Types, mechanism and significance • Embryological evidence in plant taxonomy and evolution	[7L]
Module 4	Reproductive Development and Application	[15L]
Learning Objectives: This module is intended to: • Develop an understanding of advanced concepts in seed development and reproductive biology. • Explain the application of embryological principles in plant breeding and biotechnology. • Evaluate recent advances in plant embryology and their significance in research and crop improvement.		
Learning Outcome: After the successful completion of the module, the learner will be able to: • Explain the processes of seed development, dormancy and germination. • Analyze the applications of embryological concepts in plant breeding and biotechnology. • Evaluate recent advances in plant reproductive biology and their significance in crop improvement and research.		
4.1	• Seed development, maturation, dormancy and germination • Self-incompatibility and reproductive barriers • Cytoplasmic male sterility (CMS) – Types, mechanism and applications	[15]



	• Embryo rescue and synthetic seed technology • Embryological evidence in plant taxonomy and evolution • Applications of plant embryology in plant breeding and biotechnology • Recent advances in plant reproductive biology and embryology	
References: • Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms – Oxford & IBH, Delhi. • BhojwaniSant Saran, 2014.Current Trends in the Embryology of Angiosperms, Woong-Young Soh, and Springer Netherlands. • Coutler E. G. 1969. Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London. • Dickenson, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA. • Eames A. J. - Morphology of Angiosperms - McGraw Hill, New York. • Esau, K. 1990. Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi • Evert, R.F. (2006) Esau’s Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc • Fahn, A.1992. Plant Anatomy, Pergamon Press, USA • Johri, B.M. 1., 1984.Embryology of Angiosperms, Springer-Verlag, Netherlands.		



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Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Explain advanced concept of plant anatomy and embryology.	X	X				
2	Analyze anatomical and embryological features and their applications in taxonomy, ecology and plant breeding.	X	X	X			
3.	Apply histological and embryological techniques to investigate plant tissues and reproductive structure.	X	X			X	
4	Evaluate recent advances in plant anatomy, embryology and reproductive biology for research and crop improvement.					X	X

Question Paper Template

M.Sc. (BOTANY) SEMESTER II

COURSE NAME: PLANT ANATOMY AND EMBRYOLOGY

COURSE CODE: **BOTMSC-S2P6-4CR26**

[CREDITS - 04]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	6	6	2	2	-	-	16
II	5	5	4	4	-	-	18
III	5	5	4	4	-	-	18
IV	4	4	5	5	-	-	18
Total marks per objective	20	20	15	15	-	-	70
% Weightage	28.6%	28.6%	21.4%	21.4%	-	-	100%



M. Sc. (BOTANY) SEMESTER II

VOCATIONAL COURSE

COURSE NAME: BIOSTATISTICS AND INSTRUMENTATION

COURSE CODE: BOTMSC-S2VOC1-2CR26

[CREDITS - 02]

Course learning outcome		
After the successful completion of the Botany Minor Course, the learner will be able to: • Introduce the various techniques and methods involved in plant science which will enable them to pursue various research activities. • Biostatistics intended to provide the student with a conceptual overview of statistical methods with emphasis on applications commonly used analysis research experiment value. • Topics such as how probability theory explains plant reproduction and how agricultural food is produced will be investigated. • To gain the knowledge about the graphical representation of data, estimation, elementary probability and statistical inference will be covered.		
Module 1	Biostatistics	[15L]
Learning objectives: The module is intended to: • Interpret some common measures of association such as absolute risk, relative risk, and odds ratio. • Demonstrate a good understanding of measures of correlations. • Produce output for multiple linear regression models and interpret their meanings. • Use the statistical tools and apply it to interpret the result.		
Learning outcomes: After the successful completion of the module, the learner will be able to: 1. Understand Biostatistics: introduction, scope and application. 2. Understand types of sampling, variables and its types. 3. Analyze the different type of data using appropriate statistical method. 4. Demonstrate a good understanding of descriptive statistics graphical representation.		
1.1	➤ Biostatistics: Introduction, Scope and Application. ➤ Types of Sampling: Random and Stratified Random Sampling. ➤ Data: Types (Grouped and Ungrouped Data).	[7L]



	Variable: Types	
1.2	➤ Graphical representation of data by Histogram, Bar Charts, Pie Charts. ➤ Measures of central tendency Mean, median and mode ➤ Measure of dispersion: Dispersion: range, variance, SD, and CV. ➤ Common Statistical Tools: Chi-Square, T-Test	[8L]
Module 2	Instrumentation –I	[15L]
Learning objectives: This module is intended to: • Master good laboratories practice and discipline. • To utilize safety measures and equipment. • Impart knowledge of principle, methodology and application of various techniques & instrumentation. • To get knowledge about the process of chromatography. To understand and describe different practical methods for performing paper chromatography		
Learning outcome: After the successful completion of the module, the learner will be able to: 1. Understand the principle, instrumentation and working techniques of like colorimeter, centrifugation and Spectrophotometry used in botanical research. 2. Evaluate research problem and formulate the methodology for carrying out Research/experiment by using instrumental techniques. 3. Understand, define and explain the principle, instrumentation and working of techniques chromatography. 4. Analyze the research problem and formulate the methodology for carrying out Chromatography.		



2.1	➤ Beer Lambert Law- Spectrophotometer (UV-VIS) and Colorimeter. ➤ Centrifugation and Soxhlet apparatus. ➤ Light microscopy (compound microscopy and Phase contrast microscopy). ➤ Fluorescence microscopy. ➤ Transmission and Scanning electron microscopy.	[7L]
2.2	➤ Chromatography: introduction and history. Types of chromatography: • Thin layer chromatography. • Column chromatography. • Ion exchange chromatography. • HPTLC • HPLC • Gas Chromatography	[8L]
References: • Biostatistics by P. Ramakrishna, Saras publication, Kanyakumari • Biostatistics by P. N. Arora and P. K. Malhan, Himalaya Publishing House, Mumbai • Karp, G. (1999). Cell and molecular Biology, Concepts and experiments (John Wiley and Sons Inc) 2nd edition. USA. 2. Bajpai P. K. (2006). • Biological instrumentation and methodology (S. Chand and Company. Ltd. Mumbai. 3. Plummer D.T. (2009). • An Introduction to Practical Biochemistry. 3rd edition. Tata Mc Graw Hill. Education Private Ltd. New Delhi. 4. Ghatak K.L (2011). • Pillai, R.S.N. and Bagavathi, V. S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi. Panse, V.G. and Sukhatme, P.V. 1978. Statistical Methods for Agricultural Workers. ICAR, New Delhi. • Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd. 2. K. Wilson and J. Walker Eds. 2005.		



Mapping of CLOs and PSOs

Sr. No.	Course Learning Outcomes	Programme Outcomes					
		1	2	3	4	5	6
1	Obtain an in-depth knowledge on types of spectrophotometer and techniques in chromatography and electrophoresis.	X	X				
2	Understand the importance of aseptic maintenance in laboratory and culturing techniques in microbes and plants.	X	X				
3.	Calculate the mean, median, mode, standard deviation.	X		X		X	
4	Know the latest version using in statistical tools and apply the tools to interpret the results.	X	X			X	
5	Develop the Employability skills by understanding the ultra-structure of plant organelles, collection and interpretation of data and applications of biostatistics and instrument					X	X

Question Paper Template

M.Sc. (BOTANY) SEMESTER II

COURSE NAME: BIOSTATISTICS AND INSTRUMENTATION

COURSE CODE: BOTMSC-S2VOC1-2CR26

[CREDITS - 02]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	7	5	5		-	-	17
II	8	5	5		-	-	18
Total marks per objective	15	10	10				35
% Weightage	42.8%	28.5%	28.5%				100%



M.Sc. (BOTANY) SEMESTER II (Practical)

COURSE NAME: Practical - Bryophytes and Pteridophytes

(Based on Core paper IV)

COURSE CODE: BOTMSC-S2PR4-2CR26

[Credit- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Demonstrate practical skills.
2. Correlate their Botany theory concepts through practical.
3. Develop an understanding different diversity of plants

Bryophytes and Pteridophytes

[60hr]

1	A. Study of morphology, classification, reproduction using preserved specimen of <i>Plagiochasma</i> . B. To study permanent slides of <i>Plagiochasma</i> .
2	A. Study of morphology, classification, reproduction using preserved specimen of <i>Porella</i> . B. To study permanent slides of <i>Porella</i> .
3	A. Study of morphology, classification, reproduction using preserved specimen of <i>Frullinia</i> . B. To study permanent slides of <i>Frullinia</i> .
4	A. Study of morphology, classification, reproduction using preserved specimen of <i>Anthoceros</i> . B. To study permanent slides of <i>Anthoceros</i> .
5	A. Study of morphology, classification, reproduction using preserved specimen of <i>Sphagnum</i> . B. To study permanent slides of <i>Sphagnum</i> .
7	A. Study of morphology, classification, reproduction using preserved specimen of <i>Pogonatum</i> . B. To study permanent slides of <i>Pogonatum</i> .
8	A. Study of morphology, classification, reproduction using preserved specimen of <i>Psilotum</i> . B. To study permanent slides of <i>Psilotum</i> .



9	A. Study of morphology, classification, reproduction using preserved specimen of <i>Lycopodium</i> . B. To study permanent slides of <i>Lycopodium</i> .
10	A. Study of morphology, classification, reproduction using preserved specimen of <i>Equisetum</i> . B. To study permanent slides of <i>Equisetum</i> .
11	A. Study of morphology, classification, reproduction using preserved specimen of <i>Adiantum</i> . B. To study the permanent slides of <i>Adiantum</i> .
12	Collection and identification of Bryophytes and Pteridophytes and prepare field report of collection activities in the journal.



M.Sc. (BOTANY) SEMESTER II (Practical)

COURSE NAME: Practical - Gymnosperms and Paleobotany

(Based on Core Paper V)

COURSE CODE: BOTMSC-S2PR5-2CR26

[Credit- 02]

Course Learning Outcome	
After the successful completion of the Course, the learner will be able to:	
1. Demonstrate practical skills. 2. Correlate their Botany theory concepts through practical. 3. Develop an understanding different diversity of plants.	
Gymnosperm and Paleobotany [60hr]	
1	A. Study of classification and morphology of preserve/fresh material of <i>Zamia</i>. B. To study the anatomical structure of root, stem and leaf using hand sections/Permanent slides/charts of <i>Zamia</i>. C. Study of reproduction using preserves/fresh material of <i>Zamia</i>. D. Study of Permanent slides of <i>Zamia</i>.
2	A. Study of classification and morphology of preserve/fresh material of <i>Ginkgo</i>. B. To study the anatomical structure of root, stem and leaf using hand sections/Permanent slides/charts of <i>Ginkgo</i>. C. Study of reproduction using preserves/fresh material of <i>Ginkgo</i>. D. .Study of permanent slides of <i>Ginkgo</i>.
3	A. Study of classification and morphology of preserve/fresh material of <i>Ephedra</i>. B. To study the anatomical structure of root, stem and leaf using hand sections/Permanent slides/charts of <i>Ephedra</i>. C. Study of reproduction using preserves/fresh material of <i>Ephedra</i>. D. Study of permanent slides of <i>Ephedra</i>.
4	A. Study of classification and morphology of preserve/fresh material of <i>Thuja</i>.



	B. To study the anatomical structure of root, stem and leaf using hand sections/Permanent slides/charts of <i>Thuja</i>. C. Study of reproduction using preserves/fresh material of <i>Thuja</i>. D. Study of permanent slides of <i>Thuja</i>.
6	Collection, Identification and herbarium preparation of locally available gymnosperms.
7	Maceration of gymnosperm wood and study of tracheids and resin canals.
8	Study of following fossils as per availability: 1. Rhynia 2. Calamites 3. Sphenophyllum 4. Lyginopteris 5. Stigmaraia 6. Pterophyllum
9	Study of fossil impressions, casts, compression, petrification and coal balls (specimens/models/photographs).



M.Sc. (BOTANY) SEMESTER II (Practical)

COURSE NAME: Practical Plant Anatomy and Embryology

(Based on Core paper VI)

COURSE CODE: BOTMSC-S2PR6-2CR26

[Credit- 02]

Course Learning Outcome	
After the successful completion of the Course, the learner will be able to:	
1. Demonstrate practical skills. 2. Correlate their Botany theory concepts through practical. 3. Develop an understanding different diversity of plants.	
Plant Anatomy and Embryology [60 hr]	
1	Preparation of temporary and permanent slides of shoot apex, root apex, stem, root and leaf. (Shoot apex- <i>Coleus</i> , Root apex – <i>Allium</i> , Stem – <i>Helianthus</i> , Root- <i>Zea mays</i> , Leaf- <i>Nerium</i>)
2	Study of normal and anomalous secondary growth using fresh specimens and permanent slides (Normal- <i>Helianthus</i> , anomalous- <i>Boerhaavia</i> , <i>Achyranthus</i> and <i>Dracaena</i>)
3	Study of secretory structure (Laticifer - <i>Calotropis</i> , Resin ducts - <i>Cycas</i> , Oil gland- <i>Citrus limon</i> , Hydathodes - <i>Colocasia</i> , Nectaries- <i>Hibiscus rosa-sinensis</i>)
4	Histochemical localization of starch (<i>Solanum tuberosum</i>), Cellulose (<i>Zea mays</i>), Lignin (<i>Tectona grandis</i>), Protein (<i>Cicer arietinum</i>), Lipids (<i>Ricinus communis</i>) and Tannis (<i>Camellia sinensis</i>)
5	Comparative study of wood anatomy and leaf anatomy (Wood - <i>Azadirachta indica</i> and <i>Mangifera indica</i> , Leaves- <i>Ficus religiosa</i> and <i>Colocasia esculenta</i>)
6	Pollen viability test using suitable staining methods.
7	In vitro pollen germination using sucros medium and measurement of pollen tube growth.
8	Study different stages of microsporogenesis and megasporogenesis using permanent slides.
9	Study of embryo sac, endosperm and embryo development using permanent



	slides.	
10	Comparative study of monocot and dicot ebbryos.	
11	Study of polyembryony and apomixis using slides/ photographs or models.	
12	Micrometry of plant tissues and reproductive structures using ocular and stage micrometers (Pollen grains and xylem vessels)	



M.Sc. (BOTANY) SEMESTER – II

COURSE NAME: PRACTICAL VOCATIONAL COURSE

COURSE CODE: BOTMSC –S2VOC1PR-2CR26

[CREDITS- 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
1. Understanding the processes that shape the distribution and abundance of organisms. 2. Modern tools and techniques and their appropriate use to conduct research.		
Sr . No	PRACTICALS	30hrs.
1.	Calculate and interpret Standard Deviation for given data.	
2.	Calculate and interpret t test for given data.	
3.	Calculate and interpret Chi-Square test for given data.	
4.	Prepare Bar graph for given data.	
5.	Construct Pia Chart for given example	
6.	Extraction of given plant sample by Soxhlet appratur.	
7.	Estimation of tannin of given plant sample by spectrophotometry method	
8.	Estimation of phenol of given plant sample by spectrophotometry method	
9.	Separation of chlorophyll by paper chromatography.	
10.	Separation of Alkaloid by thin layer chromatography.	
11.	Separation of Flavonoid by thin layer chromatography.	
12.	Perform separation of plant pigment by Colum chromatography.	
13.	Demonstration experiment on Gas chromatography	
14.	Demonstration instrument HPLC	
15.	Demonstration instrument HPTLC.	
● Every candidate shall complete a laboratory course by the regulations issued from time to time by the Academic Council on the recommendation of the Board of Studies. ● Every candidate shall record observations directly in the laboratory journal. Every journal shall be signed periodically.		