

INDIRA GANDHI UNIVERSITY, MEERPUR-REWARI, HARYANA-122502

**(A State University Established under Haryana Act No.29 of 2013)
(Recognized u/s 12(B) & 2(f) of UGC Act, 1956)**

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Scheme of Examination for Botany in Under Graduate Programmes

as per NEP 2020

**Curriculum and Credit Framework for Undergraduate Programmes
(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF)**

With effect from the session 2026-27 (in phased manner)

**Department of Botany
Indira Gandhi University
Meerpur-Rewari (122502)
Haryana, India**

Details of Approvals

Council/ Board	Date	Remark
Staff Council		
Board of Studies		
Faculty Board		
Academic Council		
Year of implementation		

Chairperson
(Signature with Stamp)

VISION AND MISSION OF THE UNIVERSITY

VISION

To be a globally renowned university, recognized for excellence in teaching, innovative research, and welfare of the society, imbibing the spirit of "*Vasudhaiv kutumbkam*".

MISSION

- To introduce and implement innovation in teaching and learning process matching up the global standards to strengthen academic delivery through curriculum design, teaching pedagogy and usage of ICT.
- To develop a mechanism that attracts talented, qualified and experienced faculty from across the globe for pursuing their academic and research careers at the University.
- To offer academic programs at UG, PG, doctoral, Post-Doctoral levels which are learner- centric, industry focused, and adhere to outcome based international models.
- To create an ambiance that is conducive for undertaking sponsored research, innovation and consultancy services to a wide spectrum of societal and industrial requirements while encouraging interdisciplinary approach of learning, team work and research.
- To establish state of art centres of excellence in frontier areas of research and design innovation through industry collaboration to innovate and incubate the products and services.
- To establish smart campus and promote e-governance activities in the university for the digitally empowered society and knowledge economy.
- To provide a hygienic, modern, environment friendly and vivacious campus attuned to the urgent needs of Green Technology.
- To consider and implement norms, metrics, standards, procedures and benchmarks for assessing and improving the quality in every aspect of University system and achieve quality certifications by National and International bodies.
- To make society self-reliant by organizing various programmes including literacy, gender sensitization, health awareness and dissemination of information about livelihood generation.

VISION AND MISSION OF THE DEPARTMENT

VISION

To develop scientifically competent, research-oriented and environmentally responsible graduates with a comprehensive understanding of plant sciences who contribute to biodiversity conservation, sustainable development and societal well-being.

MISSION

- To provide quality education in Botany through a strong foundation in plant diversity, structure, function, genetics, biotechnology, ecology and applied plant sciences.
- To develop scientific and research skills through practical training, field studies, experimentation, data interpretation and exposure to contemporary tools and technologies in plant sciences.
- To promote biodiversity conservation and environmental sustainability by fostering awareness of plant resources, ecosystem functioning, climate change and sustainable use of natural resources.
- To encourage innovation and entrepreneurship through skill-based learning in areas such as horticulture, nursery management, mushroom cultivation, organic farming, plant biotechnology and other plant-based enterprises.
- To nurture ethical, socially responsible and lifelong learners capable of applying botanical knowledge to address emerging environmental, agricultural and societal challenges.
- To promote interdisciplinary learning and community engagement through field visits, outreach activities, collaborative projects and application of botanical knowledge for sustainable development.

ABOUT THE PROGRAMME

Name of the Degree Programme: B.Sc. Life-Science / B.Sc. Botany (Honours) / B.Sc. Botany (Honours with Research) in Botany (according to the scheme)

Discipline Core: Botany

Total Credits: 132 (Scheme A); 136 (Scheme B); 136 (Scheme C)

Starting Year of Implementation: 2026-27 (in phase manner)

The **B.Sc. Botany Programme** provides comprehensive knowledge and practical skills in plant sciences through the study of plant diversity, structure, function, genetics, ecology, evolution, biotechnology and applied Botany. The programme integrates core, elective, vocational and interdisciplinary components with classroom teaching, laboratory work, field studies, educational visits, projects and experiential learning.

The curriculum introduces students to modern techniques and emerging areas of plant sciences while highlighting the ecological, economic and societal importance of plants. Emphasis is placed on biodiversity conservation, environmental sustainability, climate change, research skills, innovation and entrepreneurship.

The programme aims to develop scientific thinking, critical analysis, communication and practical competencies, preparing students for higher education, research, competitive examinations and careers in areas such as Botany, biotechnology, ecology, conservation, horticulture, agriculture, environmental science and plant-based enterprises.

INTAKE IN THE PROGRAMME

MINIMUM ELIGIBILITY CRITERIA

ELIGIBILITY FOR EXAMINATION

DURATION FOR PASSING THE PROGRAMME

PASSING CRITERIA

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Build a strong foundation in classical and modern Botany for higher studies, teaching and research.
PEO 2	Apply botanical knowledge in biodiversity conservation, environmental sustainability and plant resource management.
PEO 3	Develop scientific, analytical and experimental skills required for laboratory, field and research-based careers.
PEO 4	Use modern tools and interdisciplinary approaches in plant science, biotechnology and related areas.

PROGRAMME OUTCOMES (POs)

PO1	Knowledge	Demonstrate fundamental knowledge of plant sciences including plant diversity, structure, function, reproduction, genetics, ecology, evolution and applied aspects of botany.
PO2	Research Aptitude	Apply scientific methods including observation, experimentation, data collection and interpretation to investigate biological phenomena and plant-related problems.
PO3	Communication	Communicate botanical concepts, scientific information and experimental findings effectively through oral presentations, written reports and digital platforms.
PO4	Problem-Solving	Identify and analyze biological and environmental issues using logical reasoning, scientific principles and interdisciplinary approaches.
PO5	Individual and Team Work	Work effectively and responsibly as an individual and as a member of a team in laboratory, field and project-based activities.
PO6	Investigation of Problems	Use appropriate techniques and analytical approaches to conduct experiments, interpret results and draw scientific conclusions.
PO7	Modern Tool Usage	Use microscopy, laboratory instruments, computational resources and other modern scientific tools relevant to botanical studies.
PO8	Scientific temperament	Develop scientific temper, ethical values, environmental awareness and social responsibility for biodiversity conservation and sustainable development.

PROGRAMME SPECIFIC OUTCOMES (PSOs) (If applicable)

PSO 1	Understand the diversity, classification, morphology, anatomy, reproduction and evolution of plants, fungi and related microbial groups using classical and modern approaches.
PSO 2	Apply knowledge of plant physiology, genetics, ecology, embryology, biotechnology and environmental sciences in laboratory, field and applied biological studies.
PSO 3	Develop practical, analytical and observational skills through laboratory experimentation, field studies, data interpretation and use of scientific tools.
PSO 4	Demonstrate scientific temperament, environmental awareness and professional competence for higher education, entrepreneurship, employment and sustainable utilization of plant resources.

Indira Gandhi University, Meerpur, Rewari**Scheme of Examination for the Botany Subject in Under Graduate Programmes**

as per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes

(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)**Semester-1**

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-1 MCC-1	A, B & C	26L4.5-BOT-101	Microbial Diversity and Thallophytes	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-2	C	26L4.5-BOT-102	Applied Phycology and Plant Pathology	4	3	1	3		2	5	25	05	50	20	100	3	2
*CC-M1	A, B & D	26L4.5-BOT-103	Diversity of Microbes, Lower Plants and Seed Plants	2	1	1	1		2	3	05	05	20	20	50	2	2
CC-M1	C	From Available CC-1/MCC-1 of 4 credits as per NEP															
MDC-1	A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.															
AEC-1	A, B & C	From Available pool of Ability Enhancement Courses as per NEP															
SEC-1	A, B & C	From Available pool of Skill Enhancement Courses as per NEP															
VAC-1	A, B & C	From Available pool of Value Added Courses as per NEP															

*** For students who opt Botany as a minor subject**

Indira Gandhi University, Meerpur, Rewari**Scheme of Examination for the Botany Subject in Under Graduate Programmes**

as per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes

(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)**Semester-2**

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-2 MCC-3	A, B & C	26L4.5-BOT-201	Pteridophytes, Fossils and Gymnosperms	4	3	1	3		2	5	25	05	50	20	100	3	2
DSEC-1	C	26L4.5-BOT-202	Palaeobotany and Phytogeography	4	3	1	3		2	5	25	05	50	20	100	3	2
*CC-M2	A, B & D	26L4.5-BOT-203	Plants, People and Resources	2	1	1	1		2	3	05	05	20	20	50	2	2
CC-M2	C	From Available CC-2/MCC-3 of 4 credits as per NEP															
MDC-2	A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.															
AEC-2	A, B & C	From Available pool of Ability Enhancement Courses as per NEP															
SEC-2	A, B & C	From Available pool of Skill Enhancement Courses as per NEP															
VAC-2	A, B & C	From Available pool of Value Added Courses as per NEP															
Internship	A, B & C	26L4.5-BOT-204	Internship of 4 Credits of 4-6 weeks duration after 2 nd Semester (Mandatory in case of exit)												100		

*** For students who opt Botany as a minor subject**

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(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)**Semester-3**

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-3 MCC-4	A, B & C	26L5.0-BOT-301	Cell Biology, Genetics and Introductory Biotechnology	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-5	B & C	26L5.0-BOT-302	Plant Molecular Biology	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-2	B	26L4.5-BOT-102	Applied Phycology and Plant Pathology	4	3	1	3		2	5	25	05	50	20	100	3	2
CC-M3	A & C	From Available CC-3/MCC-4 of 4 credits as per NEP															
CC-M3(V)	B	From Available pool of Minor (Vocational) Courses VOC-1															
MDC-3	A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.															
AEC-3	A, B & C	From Available pool of Ability Enhancement Courses as per NEP															
SEC-3	A, B & C	From Available pool of Skill Enhancement Courses as per NEP															
VAC-3	C	From Available pool of Value Added Courses as per NEP															

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Scheme of Examination for the Botany Subject in Under Graduate Programmes

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(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)

Semester-4

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-4 MCC-6	A, B & C	26L5.0-BOT-401	Plant Taxonomy, Anatomy and Reproduction	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-7	B & C	26L5.0-BOT-402	Palynology and Seed Science	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-8	B & C	26L5.0-BOT-403	Plant Biotechnology and Genetic Engineering	4	3	1	3		2	5	25	05	50	20	100	3	2
DSE-1	B & C	26L5.0-BOT-404	Applied Plant Propagation and Tissue Culture	4	3	1	3		2	5	25	05	50	20	100	3	2
		OR															
		26L5.0-BOT-405	Plant Breeding and Crop Improvement	4	3	1	3		2	5	25	05	50	20	100	3	2
CC-M4(V)	A, B & C	From Available pool of Minor (Vocational) Courses VOC-2															
AEC-4	A, B & C	From Available pool of Ability Enhancement Courses as per NEP															
VAC-3	A & B	From Available pool of Skill Enhancement Courses as per NEP															
VAC-4	C	From Available pool of Value Added Courses as per NEP															
Internship	A, B & C	26L5.0-BOT-406	Internship of 4 Credits of 4-6 weeks duration after 4 th Semester (Mandatory in case of exit if not done after 2 nd Semester)												100		

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(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)**Semester-5**

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-5 MCC-9	A, B & C	26L5.5-BOT-501	Plant Physiology and Biochemistry	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-10	B & C	26L5.5-BOT-502	Biomolecules and Metabolism	4	3	1	3		2	5	25	05	50	20	100	3	2
DSE-2	B & C	26L5.5-BOT-503	Plant Bioengineering and Synthetic Biology	4	3	1	3		2	5	25	05	50	20	100	3	2
		OR															
		26L5.5-BOT-504	Plant-Based Food Processing and Post-Harvest Technology	4	3	1	3		2	5	25	05	50	20	100	3	2
DSE-3	B & C	26L5.5-BOT-505	Plant-Based Products and Bioprospecting	4	3	1	3		2	5	25	05	50	20	100	3	2
		OR															
		26L5.5-BOT-506	Phytochemistry and Natural Products	4	3	1	3		2	5	25	05	50	20	100	3	2
CC-M5(V)	A & C	From Available pool of Minor (Vocational) Courses VOC-1															
Internship	A, B & C	26L5.0-BOT-406	Internship of 4 Credits of 4-6 weeks duration after 4 th Semester												100		

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(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2026-27 (in a phased manner)**Semester-6**

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-6 MCC-11	A, B & C	26L5.5-BOT-601	Ecology and Economic Botany	4	3	1	3		2	5	25	05	50	20	100	3	2
MCC-12	B & C	26L5.5-BOT-602	Dendrology, Pomology and Arboriculture	4	3	1	3		2	5	25	05	50	20	100	3	2
DSE-4	B & C	26L5.5-BOT-603	Marine Flora and Coastal Ecology	4	3	1	3		2	5	25	05	50	20	100	3	2
		OR															
		26L5.5-BOT-604	Aquatic Botany and Wetland Management	4	3	1	3		2	5	25	05	50	20	100	3	2
DSE-5	B & C	26L5.5-BOT-605	Field Botany and Plant Resource Entrepreneurship	4	3	1	3		2	5	25	05	50	20	100	3	2
		OR															
		26L5.5-BOT-606	Laboratory Techniques and Biostatistics	4	3	1	3		2	5	25	05	50	20	100	3	2
CC-M6	A	From Available CC-6/MCC-11 of 4 credits as per NEP															
CC-M5(V)	B	From Available pool of Minor (Vocational) Courses VOC-3															
CC-M6(V)	C																
CC-M7(V)	A																
SEC-4	C	From Available pool of Skill Enhancement Courses as per NEP															

Semester-7 (Honours / Honours with Research)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-H1	B & C	26L6.0-BOT-701	Cyanobacteria, Phycology and Bryology	4	4		4			4	30		70		100	3	
CC-H2	B & C	26L6.0-BOT-702	Pteridophytes, Palaeobotany and Gymnosperms	4	4		4			4	30		70		100	3	
CC-H3	B & C	26L6.0-BOT-703	Microbiology and Mycology	4	4		4			4	30		70		100	3	
DSE-6	B & C	26L6.0-BOT-704	Cell and Inheritance Biology	4	4		4			4	30		70		100	3	
		OR															
		26L6.0-BOT-705	AI, Machine Learning and Computational Biology	4	4		4			4	30		70		100	3	
PC-H1	B & C	26L6.0-BOT-706	Lower Plant Diversity, Cell Biology and Computational Biosciences: Practical (<i>based on 26L6.0-BOT-701 to 26L6.0-BOT-703 and any one of 26L6.0-BOT-704/705</i>)	4		4			8	8		30		70	100		3
CC-HM1	B & C	From Available Core Courses in Minor Subject of 4 credits as per NEP															

Semester-8 (Honours)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-H4	B & C	26L6.0-BOT-801	Angiosperm Systematics and Economic Botany	4	4		4			4	30		70		100	3	
CC-H5	B & C	26L6.0-BOT-802	Plant Anatomy and Embryology	4	4		4			4	30		70		100	3	
CC-H6	B & C	26L6.0-BOT-803	Plant Ecology and Environmental Biology	4	4		4			4	30		70		100	3	
DSE-7	B & C	26L6.0-BOT-804	Molecular and Evolutionary Biology	4	4		4			4	30		70		100	3	
		OR															
		26L6.0-BOT-805	Plant Immunity and Defence Systems	4	4		4			4	30		70		100	3	
PC-H1	B & C	26L6.0-BOT-806	Plant Taxonomy, Structure, Function and Molecular Sciences: Practical (<i>based on 26L6.0-BOT-801 to 26L6.0-BOT-803 and any one of 26L6.0-BOT-804/ 805</i>)	4		4			8	8		30		70	100		3
CC-HM2	B & C	From Available Core Courses in Minor Subject of 4 credits as per NEP															

Semester-8 (Honours with Research)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
CC-H4	B & C	26L6.0-BOT-801	Angiosperm Systematics and Economic Botany	4	4		4			4	30		70		100	3	
CC-H5	B & C	26L6.0-BOT-802	Plant Anatomy and Embryology	4	4		4			4	30		70		100	3	
Research	B & C	26L6.0-BOT-806	Dissertation	12									300		300		
CC-HM2	B & C	From Available Core Courses in Minor Subject of 4 credits as per NEP															

Scheme of MDC, VAC, SEC, AEC and VOC courses
offered in the University Pool
by the
Department of Botany

Scheme of MDC, VAC, SEC and VOC courses

Semester	Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture T: Tutorial P: Practical				Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
					Total	Theory (Th)	Practical (P)	L	T	P	Total	Th	P	Th	P		Th	P
1	MDC-1	A, B, C & D	26L4.5-MDC-BOT-101	Fundamentals of Botany	3	2	1	2		2	4	15	5	35	20	75	2	2
2	MDC-2	A, B, C & D	26L4.5-MDC-BOT-201	Plants for Human Welfare	3	2	1	2		2	4	15	5	35	20	75	2	2
3	MDC-3	A, B, C & D	26L5.0-MDC-BOT-301	Plants for Environmental Sustainability	3	2	1	2		2	4	15	5	35	20	75	2	2
3	VAC-3	C	26L5.0-VAC-BOT-301	Indian Plant Knowledge Systems and Conservation	2	2	0	2		-	2	15	-	35	-	50	2	-
4	VAC-3	A, B & D	26L5.0-VAC-BOT-401	Medicinal Plants, Traditional Healing and Conservation	2	2	0	2		-	2	15	-	35	-	50	2	-
4	VAC-4	C																
2	SEC-2	A, B, C & D	26L4.5-SEC-BOT-201	Biofertilizers and Organic Inputs	3	2	1	2		2	4	15	5	35	20	75	2	2
			OR															
			26L4.5-SEC-BOT-202	Vertical Farming and Soilless Cultivation	3	2	1	2		2	4	15	5	35	20	75	2	2
3	SEC-3	A, B, C & D	26L5.0-SEC-BOT-301	Plant Hybridization	3	2	1	2		2	4	15	5	35	20	75	2	2

				and Breeding Techniques													
6	SEC-4	C	26L5.5-SEC-BOT-601	Olericulture and Vegetable Production	2	1	1	1	2	3	10	05	20	15	50	2	2
3	VOC-1	B	26L5.0-VOC-BOT-301	Organic Farming	4	3	1	3	2	5	20	10	50	20	100	3	2
4	VOC-1	A & C	26L5.0-VOC-BOT-401	Floriculture and Landscape Gardening	4	3	1	3	2	5	20	10	50	20	100	3	2
			OR														
			26L5.0-VOC-BOT-402	Nursery Management and Gardening	4	3	1	3	2	5	20	10	50	20	100	3	2
4	VOC-2	B	26L5.0-VOC-BOT-401	Floriculture and Landscape Gardening	4	3	1	3	2	5	20	10	50	20	100	3	2
			OR														
			26L5.0-VOC-BOT-402	Nursery Management and Gardening	4	3	1	3	2	5	20	10	50	20	100	3	2
5	VOC-2	A & C	26L5.5-VOC-BOT-501	Organic Farming	4	3	1	3	2	5	20	10	50	20	100	3	2
6	VOC-3	A, B & C	26L5.5-VOC-BOT-601	Mushroom Cultivation and Processing	4	3	1	3	2	5	20	10	50	20	100	3	2

Core Course: 4 credits (3+1)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	I		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Microbial Diversity and Thallophytes		
Course Code	26L4.5-BOT-101		
Course Type	CC-1 / MCC-1		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Describe the diversity, structure, reproduction and significance of microorganisms including viruses, bacteria and cyanobacteria and explain their ecological and economic importance.	
	CLO₂	Explain the classification, life histories and economic importance of algae and relate their structural diversity to ecological adaptations.	
	CLO₃	Describe the morphology, anatomy, reproduction, classification and significance of bryophytes, fungi and lichens and evaluate their roles in ecosystems and human welfare.	
	CLO₄	Develop skills in identification, observation, slide preparation, specimen collection and preservation of representative microorganisms, algae, bryophytes, fungi and lichens through laboratory and field studies.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			

Unit	Topics	CLO Attempt	Contact Hours
I	Introduction, discovery and scope of microbiology. Virus: General account, structure and reproduction of TMV and bacteriophage. Bacteria: Structure, types (gram positive and gram negative) and economic importance. Cyanobacteria: General account and importance with special reference to <i>Nostoc</i>.	1	14
II	Algae: General characters, classification (up to class level) and economic importance of algae. Life history of <i>Volvox</i>, <i>Vaucheria</i>, <i>Ectocarpus</i> and <i>Polysiphonia</i>. Fungi: General characters, classification (up to class level), economic importance and life history of <i>Mucor</i>, <i>Penicillium</i>, <i>Colletotrichum</i> and <i>Puccinia</i>.	2	16
III	Bryophytes: General characters, classification (up to class level), ecological and economic importance. Structure and reproduction (excluding development) of <i>Marchantia</i>, <i>Anthoceros</i> and <i>Funaria</i>. Lichens: General account, types, ecological and economic importance of Lichens.	3	15
Practical	Suggested laboratory and field studies of Microbes and Thallophytes - Study of virus models including TMV and bacteriophage; lytic and lysogenic cycles using charts, models or digital resources. - Study of bacterial types, binary fission, conjugation and root nodules through temporary preparations, permanent slides, photographs or recorded demonstrations. - Observation and identification of <i>Nostoc</i>/ <i>Oscillatoria</i> or any other available material and their reproductive structures. - Study of vegetative and reproductive structures of <i>Volvox</i>/ <i>Vaucheria</i>/ <i>Oedogonium</i>/ <i>Ectocarpus</i>/ <i>Polysiphonia</i> or any other available material through temporary preparations and permanent slides. - Study of morphology and anatomy of <i>Marchantia</i>/ <i>Anthoceros</i>/ <i>Funaria</i> including thallus, rhizoids, scales, gemma cups, antheridiophores, archegoniophores, sporophytes, capsule, operculum, annulus, peristome and spores from suitable preserved specimens, photographs or departmentally maintained materials. - Study of vegetative and reproductive structures of <i>Mucor</i>/ <i>Penicillium</i>/ <i>Colletotrichum</i>/ <i>Puccinia</i>/ <i>Agaricus</i> through temporary preparations and permanent slides. - Study and identification of crustose, foliose and fruticose lichens through suitable preserved specimens, photographs or departmentally maintained materials. - Collection, preservation and identification of locally available algae, bryophytes, fungi and lichens. - Field visits and biodiversity surveys for thallophytes (depending upon seasonal availability and institutional resources).	1, 2, 3, 4	30
Total Contact Hours			75
Evaluation Methods			

Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources

Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)

- Sharma, O. P. (2017). Algae (3rd ed.). McGraw Hill Education. [396 pp.]
- Sharma, O. P. (2019). Bryophyta (4th ed.). McGraw Hill Education. [452 pp.]
- Sharma, P. D. (2022). Microbiology (3rd ed.). Rastogi Publications. [640 pp.]
- Singh, V., Pande, P. C., & Jain, D. K. (2021). A Textbook of Botany: Algae, Fungi, Bryophyta and Microbiology. Rastogi Publications. [720 pp.]
- Alexopoulos, C. J., Mims, C. W., & Blackwell, M. (2007). Introductory Mycology (4th ed.). Wiley India. [880 pp.]
- Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2014). Microbiology (5th ed.). McGraw-Hill Education. [896 pp.]
- Pandey, B. P. (2020). College Botany, Volume I. S. Chand Publishing. [736 pp.]
- Kumar, H. D. (2018). Introductory Phycology. Affiliated East-West Press. [420 pp.]
- Parihar, N. S. (2018). An Introduction to Embryophyta: Bryophyta. Central Book Depot. [412 pp.]
- Webster, J., & Weber, R. (2016). Introduction to Fungi (3rd ed.). Cambridge University Press. [856 pp.]
- <https://www.algaebase.org/>
- <https://www.indexfungorum.org/>
- <https://www.britannica.com/plant/bryophyte>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	PO₈	PSO₁	PSO₂	PSO₃	PSO₄
CLO ₁	3	2	1	2	1	2	1	2	3	2	1	1
CLO ₂	3	2	1	2	1	2	1	2	3	2	1	1
CLO ₃	3	2	1	2	1	2	1	3	3	2	1	2
CLO ₄	2	2	2	2	3	3	3	2	2	3	3	2

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	8
Entrepreneurship	4
Skill Enhancement	40
Communication Development	4
Indian Knowledge System	5
Environmental Awareness	10

Current Issues and Social Awareness	4
Gender issues	
Public policies	
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved or departmentally maintained specimens/ materials may be used wherever necessary. Field visits/ excursions, specimen collection, preservation, identification, preparation of herbarium/ collection records and submission of reports with photographs related to the course may be undertaken depending upon seasonal availability and institutional resources.
- Teachers are encouraged to supplement classroom teaching with recent scientific developments, discoveries, case studies, research publications, digital resources, virtual laboratory exercises, educational videos, documentaries and information from relevant national and international institutions, databases and websites to enhance student learning, scientific curiosity and interdisciplinary understanding.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	I		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Applied Phycology and Plant Pathology		
Course Code	26L4.5-BOT-102		
Course Type	MCC-2		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the applications of algae in biotechnology, bioenergy, industry, environmental management and human welfare and evaluate their economic importance.	
	CLO₂	Describe the causes, symptoms, spread and management of major plant diseases and explain the role of phytoplasmas and other plant pathogens in disease development.	
	CLO₃	Explain genetic exchange mechanisms in fungi and evaluate the applications of fungi in agriculture, environmental management, medicine and industry.	
	CLO₄	Develop practical skills in identification, analysis and documentation of algae, plant diseases and fungi through laboratory studies, field observations and project-based learning.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			

Unit	Topics	CLO Attempt	Contact Hours			
I	Algae in Daily Needs and Industry: Scope and applications of phycology; economic importance of algae in food, feed, biotechnology, bioenergy and environmental management. Role of Algae in Environment: Algae as pollution indicators; algae in wastewater treatment and wasteland reclamation; algal blooms and red tides.	1	14			
II	Introduction to Plant Pathology: History and scope of plant pathology; causal agents, classification and major groups of plant pathogens including fungi and phytoplasmas. Plant Diseases: Causal organisms, symptoms and management of yellow vein mosaic of bhindi, red rot of sugarcane, black rust of wheat, white rust of crucifers, smut of bajra, downy mildew of cucurbits and late blight of potato.	2	15			
III	Genetic Exchange in Fungi: Heterokaryosis, heterothallism, parasexuality and sex hormones. Applied Mycology: Mycoremediation, mycorrhizae and mycotoxins; applications of fungi in food industry including fermentation, production of organic acids, enzymes, medicines and other industrial products.	3	16			
Practical	Suggested laboratory and field studies of Applied Phycology and Plant Pathology - Isolation, observation and identification of algal species from polluted and non-polluted water sources through temporary preparations, permanent slides or photographs. - Nutritional analysis of <i>Spirulina/ Chlorella</i> and study of commercial algal products in food, feed, cosmetics, pharmaceuticals, nutraceuticals, biofuels and phycoremediation applications from locally available materials, commercial products or digital resources. - Demonstration of extraction and applications of phycocolloids including agar, alginates and carrageenan using charts, models, digital resources or recorded demonstrations. - Isolation of plant pathogens from infected plant materials and preparation of Potato Dextrose Agar (PDA) medium or recorded demonstrations. - Study and identification of symptoms and causal organisms associated with yellow vein mosaic of bhindi/ red rot of sugarcane/ black rust of wheat/ white rust of crucifers/ smut of bajra/ downy mildew and late blight diseases using fresh specimens, herbarium materials, preserved samples, temporary mounts or photographs. - Study of herbarium specimens, preserved materials and photographic records of common bacterial and fungal plant diseases. - Project work, field survey or institutional/ industrial visit related to applied phycology, mycology or plant pathology and preparation of a report with photographs (depending upon seasonal availability and institutional resources).	1, 2, 3, 4	30			
Total Contact Hours			75			
Evaluation Methods						
Internal Assessment:30		Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:		05	0	Lab record	NA	05

Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources

Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)

- Lee, R. E. (2018). Phycology (5th ed.). Cambridge University Press. [560 pp.]
- Barsanti, L., & Gualtieri, P. (2014). Algae: Anatomy, Biochemistry and Biotechnology (2nd ed.). CRC Press. [320 pp.]
- Kumar, H. D. (2018). Introductory Phycology. Affiliated East-West Press. [420 pp.]
- Agrios, G. N. (2005). Plant Pathology (5th ed.). Academic Press. [952 pp.]
- Mehrotra, R. S., & Aggarwal, A. (2017). Plant Pathology (3rd ed.). McGraw Hill Education. [960 pp.]
- Alexopoulos, C. J., Mims, C. W., & Blackwell, M. (2007). Introductory Mycology (4th ed.). Wiley India. [880 pp.]
- Webster, J., & Weber, R. (2016). Introduction to Fungi (3rd ed.). Cambridge University Press. [856 pp.]
- Sharma, O. P. (2017). Algae (3rd ed.). McGraw Hill Education. [396 pp.]
- Sharma, P. D. (2022). Plant Pathology. Rastogi Publications. [560 pp.]
- Singh, V., Pande, P. C., & Jain, D. K. (2021). A Textbook of Botany: Algae, Fungi and Plant Pathology. Rastogi Publications. [780 pp.]
- <https://www.apsnet.org/Pages/default.aspx>
- <https://www.algaebase.org/>
- <https://www.indexfungorum.org/>
- <https://www.cabi.org/products-and-services/about-cabi-books/open-resources/plant-pathology-and-plant-diseases/>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	1	2	1	2	2	3	1	2
CLO ₂	3	2	1	3	1	2	1	2	2	3	1	2
CLO ₃	3	2	1	2	1	2	1	2	2	3	1	2
CLO ₄	2	2	2	2	3	3	3	2	2	3	3	2

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	10
Entrepreneurship	2
Skill Enhancement	40
Communication Development	4
Indian Knowledge System	2

Environmental Awareness	12
Current Issues and Social Awareness	5
Gender issues	
Public policies	
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved or departmentally maintained specimens/ materials may be used wherever necessary. Field visits/ excursions, specimen collection, preservation, identification, preparation of herbarium/ collection records and submission of reports with photographs related to algae, fungi and plant diseases may be undertaken depending upon seasonal availability and institutional resources.
- Teachers are encouraged to supplement classroom teaching with recent scientific developments, discoveries, case studies, research publications, digital resources, virtual laboratory exercises, educational videos, documentaries and information from relevant national and international institutions, databases and websites to enhance student learning, scientific curiosity and interdisciplinary understanding.

Minor: 2 credits (1+1)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	I		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Diversity of Microbes, Lower Plants and Seed Plants		
Course Code	26L4.5-BOT-103		
Course Type	CC-M1		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Describe the general characteristics, morphology, diversity and economic or ecological importance of microbes, fungi, lichens and major plant groups.	
	CLO₂	Identify common representatives of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms using diagnostic morphological characters and suitable practical resources.	
	Theory	Practical	Total
Credits	1	1	2
Teaching Hours per week	1	2	3
Internal Assessment Marks	05	05	10
End Term Exam Marks	20	20	40
Max. Marks	25	25	50
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 4 questions from unit 01 with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 6 short answer type questions carrying one mark each (total 06 marks). The remaining questions will be carrying 07 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 02 questions from other 03 questions.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		Contact Hours
I	Diversity of Microbes and Mycology: General characteristics, morphology and economic importance of viruses, bacteria, fungi and lichens. Algae, Bryophytes and Pteridophytes: General characteristics, morphology and importance of algae, bryophytes and pteridophytes. Gymnosperms: General characteristics, morphology and economic or ecological importance of gymnosperms.		15

	Angiosperms: General characteristics, morphology and economic importance of angiosperms.				
Practical	Suggested laboratory and field studies of Microbes, Lower Plants and Seed Plants • Identification of some common algae and fungi using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Study of viruses, bacteria and lichens using charts, models or digital resources. • Morphological study of some common bryophytes using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Morphological study of some common pteridophytes using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Morphological study of some common gymnosperms using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Morphological study of some common angiosperms using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Preparation and observation of temporary mounts of suitable algal, fungal or plant materials where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Preparation of labelled diagrams, observation sheets and practical records based on studied specimens, photographs, charts, models or digital resources.	1, 2	30		
Total Contact Hours			45		
Evaluation Methods					
Internal Assessment:10	Th-05	P-05	End Term Examination: 40	Th-20	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	NA	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	20	NA
Mid-Term Exam:	NA	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)					
• Mehrotra, R. S., & Aneja, K. R. (2005). An Introduction to Mycology. New Age International Pvt. Ltd. • Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2001). Microbiology (5th ed.). Tata McGraw-Hill. • Lee, R. E. (2018). Phycology (5th ed.). Cambridge University Press. • Singh, V., Pande, P. C., & Jain, D. K. (2017). Biodiversity: Microbiology, Fungi, Algae, Archegoniate: Bryophyta, Pteridophyta and Gymnosperms. Rastogi Publications. • Ahluwalia A. S. (2020). Phycology: Principles, Processes and Applications. Daya Publishing House. • Dube, H. C. (2012). An Introduction to Fungi (4th ed.). Vikas Publishing House.					

- Sethi, I. K., & Walia, S. K. (2011). Text Book of Fungi and Their Allies. MacMillan Publishers.
- Kumar, A., Vashishta, B. R., & Sinha, A. K. (2012). Bryophyta. S. Chand Publishing.
- Bendre, A. M., & Kumar, A. (2010). A Textbook of Practical Botany 1. Rastogi Publications.
- Bendre, A. M., & Kumar, A. (2010). A Textbook of Practical Botany 2. Rastogi Publications.
- Pandey, B. P. (2021). Modern Practical Botany Volume I and Volume II.. S. Chand Publishing.
- Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology and Biotechnology (5th ed.). New Age International.
- Sharma, O. P. (2011). Algae. Tata McGraw-Hill Education.
- Vashishta, P. C., Sinha, A. K., & Kumar, A. (2010). Gymnosperms. S. Chand Publishing.
- Parihar, N. S. (1996). The Biology and Morphology of Pteridophytes. Central Book Depot.
- <https://www.algaebase.org/>
- <https://www.indexfungorum.org/>
- <https://www.britannica.com/plant/bryophyte>
- <https://asm.org/>
- <https://www.britannica.com/plant/angiosperm>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	1	1	1	1	1	1	2	3	2	1	2
CLO ₂	3	2	2	2	3	3	2	2	3	2	3	2

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	5
Entrepreneurship	4
Skill Enhancement	12
Communication Development	4
Indian Knowledge System	5
Environmental Awareness	8
Current Issues and Social Awareness	3
Gender issues	
Public policies	
Any Other (Biodiversity Appreciation and Natural History Orientation)	4

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved, herbarium-based or departmentally maintained materials may be used wherever necessary. Suitable charts, models, photographs, digital resources, demonstrations and virtual laboratory exercises may be used depending upon institutional resources.

Core Course: 4 credits (3+1)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	II		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Pteridophytes, Fossils and Gymnosperms		
Course Code	26L4.5-BOT-201		
Course Type	CC-2 / MCC-3		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Describe the classification, morphology, reproduction and evolutionary significance of pteridophytes and evaluate their ecological and economic importance.	
	CLO₂	Explain the process of fossilization, major fossil plant groups and the significance of fossils in understanding plant evolution.	
	CLO₃	Describe the classification, morphology, anatomy, reproduction and evolutionary significance of gymnosperms and evaluate their ecological and economic importance.	
	CLO₄	Develop practical skills in identification, observation, comparison and documentation of representative pteridophytes, fossil plants and gymnosperms through laboratory and field studies.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			

Unit	Topics	CLO Attempt	Contact Hours
I	Pteridophytes: General characters and classification of pteridophytes (up to class level); structure and reproduction (excluding development) of <i>Selaginella</i> , <i>Equisetum</i> and <i>Pteris</i> ; heterospory and origin of seed habit, overview of stelar system, affinities and evolutionary significance of pteridophytes, economic and ecological importance of pteridophytes.	1	14
II	Fossilization and Fossils: Fossilization, importance and types of fossils. Fossil Plants: General account of fossil pteridophytes (<i>Rhynia</i> and <i>Lepidodendron</i>); evolutionary significance of fossil gymnosperms <i>Williamsonia</i> and <i>Lyginopteris</i> .	2	14
III	Gymnosperms: General characteristics, distribution, economic importance and classification of gymnosperms (up to class level); morphology, anatomy and reproduction (excluding development) of representative genera (<i>Cycas</i> , <i>Pinus</i> and <i>Ephedra</i>); affinities and evolutionary significance of gymnosperms.	3	17
Practical	Suggested laboratory and field studies of Pteridophytes, Fossils and Gymnosperms - Study of morphology, anatomy and reproductive structures of <i>Selaginella</i>, <i>Equisetum</i> and <i>Pteris</i> including ligule, stem, strobilus, sporangiophore, spores, sporophyll, rhizome, rachis, prothallus and young sporophyte using temporary preparations, permanent slides, preserved specimens or photographs. - Comparative study of stelar organization in representative pteridophytes using transverse sections, permanent slides, charts or digital resources. - Study of photographs, casts or preserved specimens of representative fossil plants including <i>Rhynia</i>, <i>Lepidodendron</i>, <i>Williamsonia</i> and <i>Lyginopteris</i>. - Study of morphology, anatomy and reproductive structures of <i>Cycas</i>, <i>Pinus</i> and <i>Ephedra</i> including coralloid roots, bulbils, leaves, cones, strobili, ovules, microsporophylls and spores using temporary preparations, permanent slides, preserved specimens or photographs. - Collection, preservation and documentation of locally available pteridophytes and gymnosperms (depending upon seasonal availability and institutional resources). - Comparative study of spores and pollen grains of representative pteridophytes and gymnosperms with reference to morphology, size, aperture and dispersal adaptations using temporary preparations, permanent slides, photomicrographs or digital resources. - Comparative study of life cycles of representative pteridophytes and gymnosperms by identifying the dominant phase, reproductive structures and alternation of generations using charts, models, preserved specimens or digital resources. - Excursion tours, field visits and preparation of reports with photographs related to pteridophytes, gymnosperms and fossil specimens (depending upon seasonal availability and institutional resources).	1, 2, 3, 4	30
Total Contact Hours			75
Evaluation Methods			

Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources

Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)

- Rashid, A. (2017). An Introduction to Pteridophyta (2nd ed.). Vikas Publishing House. [368 pp.]
- Parihar, N. S. (2018). An Introduction to Embryophyta: Pteridophyta. Central Book Depot. [412 pp.]
- Sporne, K. R. (2017). The Morphology of Pteridophytes (2nd ed.). B.I. Publications. [544 pp.]
- Sharma, O. P. (2018). Gymnosperms (2nd ed.). McGraw Hill Education. [520 pp.]
- Vashishta, P. C. (2019). Botany for Degree Students: Gymnosperms. S. Chand Publishing. [320 pp.]
- Biswas, C., & Johri, B. M. (2015). The Gymnosperms. Narosa Publishing House. [792 pp.]
- Stewart, W. N., & Rothwell, G. W. (2010). Paleobotany and the Evolution of Plants (2nd ed.). Cambridge University Press. [498 pp.]
- Taylor, T. N., Taylor, E. L., & Krings, M. (2009). Paleobotany: The Biology and Evolution of Fossil Plants (2nd ed.). Academic Press. [560 pp.]
- Singh, V., Pande, P. C., & Jain, D. K. (2021). A Textbook of Botany: Pteridophytes, Gymnosperms and Paleobotany. Rastogi Publications. [720 pp.]
- Dutta, S. C. (2016). An Introduction to Pteridophyta. Oxford & IBH Publishing. [240 pp.]
- <https://microbenotes.com/pteridophytes/>
- <https://egyankosh.ac.in/bitstream/123456789/69611/1/Unit-9.pdf>
- <https://www.nps.gov/subjects/fossils/how-fossils-form.htm>
- <https://www.majordifferences.com/2014/02/difference-between-pteridophytes-and.html>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	1	2	1	2	3	2	1	2
CLO ₂	3	2	1	2	1	2	1	2	2	2	1	2
CLO ₃	3	2	1	2	1	2	1	2	3	2	1	2
CLO ₄	3	2	2	2	3	3	3	2	2	3	3	2

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	8
Entrepreneurship	4
Skill Enhancement	42
Communication Development	4
Indian Knowledge System	4
Environmental Awareness	10

Current Issues and Social Awareness	3
Gender issues	
Public policies	
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved or departmentally maintained specimens/ materials may be used wherever necessary. Field visits, excursions, collection, preservation, identification and submission of reports with photographs related to pteridophytes, fossils and gymnosperms may be undertaken depending upon seasonal availability and institutional resources.
- Teachers are encouraged to supplement classroom teaching with recent scientific developments, discoveries, case studies, research publications, digital resources, virtual laboratory exercises, educational videos, documentaries and information from relevant national and international institutions, databases and websites to enhance student learning, scientific curiosity and interdisciplinary understanding.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	II		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Paleobotany and Phytogeography		
Course Code	26L4.5-BOT-202		
Course Type	DSEC-1		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the origin, fossil record and evolutionary significance of early land plants and major fossil groups.	
	CLO₂	Describe fossilization, geological time scale, extinction events and the role of fossils in understanding plant evolution and Gondwana history.	
	CLO₃	Explain the principles of phytogeography, continental drift, endemism, vegetation patterns and plant adaptations in different regions and climates.	
	CLO₄	Develop practical skills in fossil observation, map reading, physiographic interpretation, soil profile study and field-based analysis of plant distribution and landforms.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Paleobotany: Colonization and rise of early land plants; introduction to megafossils and microfossils; major extinction events.	1	14

	Fossilization and Time Scale: Fossils, fossilization, taphonomy, geological time scale and significance of plant fossils.					
II	Fossil Plants: General account and significance of <i>Glossopteris</i> and <i>Gangamopteris</i> in palaeoclimate and continental drift. Gondwana Significance: Importance of fossils in studying the Gondwana period and plant evolution.	2	15			
III	Phytogeography: Importance of phytogeography; theory of tolerance; concept, types and examples of endemic plants in India and worldwide. Vegetation and Plant Distribution: Biogeographic zones and vegetation patterns of India with special reference to Haryana.	3	16			
Practical	Suggested laboratory and field studies of • Study of available fossil groups, fossilized plant specimens, fossilization processes, geological time scale and major extinction events using preserved specimens, photographs, casts, charts, models, digital resources or visual presentations. • Study of major geomorphic features, outcrops, physiographic divisions and lithostratigraphic units through topographic sheets, geological maps, physiographic models, charts and digital resources. • Preparation of physiographic description of an area using topographic sheets, maps and available geospatial resources. • Study of soil profiles, rock types and their relationship with vegetation patterns in selected localities using field observations, photographs, preserved samples or digital resources. • Study of biogeographic zones, vegetation patterns of India, endemic plant distribution and major dams of India/ Haryana and their influence on river systems using maps, charts, atlases and digital resources. • Field survey, project work or excursion for observation of fossils, soil types, rock formations, vegetation patterns and related ecological features, followed by preparation of a report with photographs (depending upon seasonal availability and institutional resources).	1, 2, 3, 4	30			
Total Contact Hours			75			
Evaluation Methods						
Internal Assessment:30		Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:		05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:		05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:		NA	05	Written Examination	50	NA
Mid-Term Exam:		15	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources						
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)						
• Stewart, W. N., & Rothwell, G. W. (2010). Paleobotany and the Evolution of Plants (2nd ed.). Cambridge University Press. [498 pp.] • Taylor, T. N., Taylor, E. L., & Krings, M. (2009). Paleobotany: The Biology and Evolution of Fossil Plants (2nd ed.). Academic Press. [560 pp.] • Singh, V.,Pande, P. C., & Jain, D. K. (2021). A Textbook of Botany: Pteridophytes, Gymnosperms and Paleobotany. Rastogi Publications. [720 pp.]						

- Ghosh, A. K. (2018). Paleobotany. New Central Book Agency. [432 pp.]
- Saxena, M. M. (2017). Plant Geography. Pragati Prakashan. [384 pp.]
- Mani, M. S. (2014). Ecology and Biogeography in India. Springer. [620 pp.]
- Cox, C. B., & Moore, P. D. (2018). Biogeography: An Ecological and Evolutionary Approach (9th ed.). Wiley-Blackwell. [496 pp.]
- Sharma, P. D. (2020). Environmental Biology and Biogeography. Rastogi Publications. [512 pp.]
- Pandey, B. P. (2020). College Botany, Volume II. S. Chand Publishing. [640 pp.]
- Vashishta, P. C. (2019). Botany for Degree Students: Palaeobotany and Plant Geography. S. Chand Publishing. [360 pp.]
- <https://egyankosh.ac.in/bitstream/123456789/69611/1/Unit-9.pdf>
- <https://www.nps.gov/subjects/fossils/how-fossils-form.htm>.
- <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/phytogeography>
- <https://www.britannica.com/place/Gondwana-supercontinent>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	1	2	1	2	3	2	1	2
CLO ₂	3	2	1	2	1	2	1	2	2	2	1	2
CLO ₃	3	2	1	2	1	2	1	2	3	2	1	2
CLO ₄	2	2	2	2	3	3	3	2	2	3	3	2

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	8
Entrepreneurship	4
Skill Enhancement	20
Communication Development	4
Indian Knowledge System	3
Environmental Awareness	14
Current Issues and Social Awareness	5
Gender issues	
Public policies	
Any Other (Fossil interpretation, field mapping and physiographic analysis skills)	17

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved or departmentally maintained specimens/ materials may be used wherever necessary. Field visits, excursions, collection, preservation, identification and submission of reports with photographs related to fossils, soil

types, rocks and vegetation may be undertaken depending upon seasonal availability and institutional resources.

- Teachers are encouraged to supplement classroom teaching with recent scientific developments, discoveries, case studies, research publications, digital resources, virtual laboratory exercises, educational videos, documentaries and information from relevant national and international institutions, databases and websites to enhance student learning, scientific curiosity and interdisciplinary understanding.

Minor (2 Credits)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	II		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Plants Resources and Their Uses		
Course Code	26L4.5-BOT-203		
Course Type	CC-M2		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Describe the morphology, botanical features, plant parts used and economic importance of selected food plants, vegetables, fibres, oils, spices, medicinal plants and beverages.	
	CLO₂	Identify economically important plants and plant products using specimens, photographs, commercial samples and field-based documentation.	
	Theory	Practical	Total
Credits	1	1	2
Teaching Hours per week	1	2	3
Internal Assessment Marks	05	05	10
End Term Exam Marks	20	20	40
Max. Marks	25	25	50
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 4 questions from unit 01 with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 6 short answer type questions carrying one mark each (total 06 marks). The remaining questions will be carrying 07 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 02 questions from other 03 questions.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Food Plants and Pulses: Morphology and economic importance of cereals (rice, wheat); pulses (gram, pea). Vegetables, Fibres and Oils: Botanical description, plant parts used, economic importance and basic processing of vegetables (potato, tomato and onion); fibre plant (cotton); oil-yielding plants (mustard and coconut).	1	15

	Spices, Medicinal Plants and Beverages: Morphology, useful plant parts and economic importance of spices (turmeric, coriander, ginger); medicinal plants (opium, cannabis, neem); beverages (tea and coffee).				
Practical	Suggested laboratory and field studies of Plants Resources and Their Uses • Study of economically important cereals such as wheat, rice and maize using fresh specimens, grains, photographs, commercial samples or departmentally maintained materials. • Study of economically important pulses such as gram, pea and arhar using fresh specimens, seeds, photographs, commercial samples or departmentally maintained materials. • Study of economically important spices such as black pepper, ginger and clove using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Study of beverages such as tea and coffee using plant parts, commercial samples, photographs or departmentally maintained materials. • Study of fibre-yielding plant cotton using plant material, fibre samples, photographs, commercial samples or departmentally maintained materials. • Study of oil-yielding plants such as coconut and mustard using fresh materials, seeds, oil samples, photographs or departmentally maintained materials. • Study of different types of wood and timber products using wood samples, photographs, charts, models or digital resources. • Study of useful plant parts and plant products of selected economic plants using commercial samples, photographs, charts, models or digital resources. • Collection and preparation of reports on various crops and economically important plants cultivated or wildy available in the local area depending upon seasonal availability and institutional resources. • Field documentation of locally available economic plants including their local name, habit, plant part used, product obtained and economic importance depending upon seasonal availability and institutional resources. • Preparation of practical records, labelled diagrams, observation sheets and short reports based on economically important plants and plant products.	1, 2	30		
Total Contact Hours			45		
Evaluation Methods					
Internal Assessment:10	Th-05	P-05	End Term Examination: 70	Th-20	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	NA	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	20	NA
Mid-Term Exam:	NA	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources**Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)**

- Singh, V., Pande, P. C., & Jain, D. K. (2018). Economic Botany. Rastogi Publications.
- Kochhar, S. L. (2016). Economic Botany: A Comprehensive Study (5th ed.). Cambridge India.
- Wickens, G. E. (2001). Economic Botany: Principles and Practices. Springer.
- Daubenmire, R. F. (2017). Plants and Environment (2nd ed.). John Wiley & Sons.
- Rajan, S. S. (2007). College Botany Vol. V, Part 1: Taxonomy and Economic Botany. Himalaya Publishing House.
- Mukherjee, S. K. (2004). College Botany Vol. III. New Central Book Agency.
- Simpson, B. B., & Ogorzaly, M. C. (2015). Economic Botany: Plants in Our World (5th ed.). McGraw-Hill Education.
- Hill, A. F. (1952). Economic Botany: A Textbook of Useful Plants and Plant Products (2nd ed.). McGraw-Hill.
- Practical References
- Bendre, A. M., & Kumar, A. (2010). A Textbook of Practical Botany 1. Rastogi Publications.
- Bendre, A. M., & Kumar, A. (2010). A Textbook of Practical Botany 2. Rastogi Publications.
- Pandey, B. P. (2021). Modern Practical Botany Volume II. S. Chand Publishing.
- Sharma, O. P. (2011). Economic Botany. McGraw-Hill Education.
- Sambamurthy, A. V. S. S., & Subrahmanyam, N. S. (2008). A Textbook of Economic Botany. Wiley Eastern.
- Jain, S. K., & Rao, R. R. (1977). A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers.
- <https://ethnobotany.org/home/publications/economic-botany.html>
- <https://botany.org/home/resources/plant-talking-points/what-is-economic-botany.html>
- <https://www.britannica.com/search?query=economic%20botany>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	1	1	2	1	1	1	2	2	2	1	3
CLO ₂	3	2	2	2	3	3	2	2	2	2	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	5
Entrepreneurship	5
Skill Enhancement	16
Communication Development	4
Indian Knowledge System	4
Environmental Awareness	5
Current Issues and Social Awareness	4
Gender issues	

Public policies	2
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved, herbarium-based or departmentally maintained materials may be used wherever necessary. Suitable charts, models, photographs, digital resources, demonstrations and virtual laboratory exercises may be used depending upon institutional resources.

MDC: 3 credits (2+1)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	I		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Fundamentals of Botany		
Course Code	26L4.5-MDC-BOT-101		
Course Type	MDC-1		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Describe the general characteristics, morphology and economic importance of viruses, bacteria, fungi and lichens.	
	CLO₂	Explain the general features, morphology and economic or ecological importance of algae, bryophytes, pteridophytes, gymnosperms and angiosperms.	
	CLO₃	Identify common representatives of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms using diagnostic morphological characters and suitable practical resources.	
	Theory	Practical	Total
Credits	2	1	3
Teaching Hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Diversity of Microbes and Mycology: General characteristics, morphology and economic importance of viruses, bacteria, fungi and lichens.	1	14

	Algae, Bryophytes and Pteridophytes: General characteristics, morphology and economic or ecological importance of algae, bryophytes and pteridophytes.				
II	Gymnosperms: General characteristics, morphology and economic or ecological importance of gymnosperms. Angiosperms: General characteristics, basic morphology and economic importance of angiosperms with reference to common flowering plants and useful plant resources.	2	16		
Practical	Suggested laboratory and field studies of Fundamentals of Botany • Identification of some common algae and fungi using fresh specimens if available; alternatively, suitable preserved specimens, photographs or departmentally maintained materials may be used. • Study of viruses, bacteria and lichens using charts, models or digital resources. • Morphological study of some common bryophytes and pteridophytes using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Morphological study of some common gymnosperms and angiosperms using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Preparation and observation of temporary mounts of suitable algal, fungal or plant materials where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Preparation of labelled diagrams, observation sheets and practical records based on studied specimens, photographs, charts, models or digital resources.	1, 2, 3	30		
Total Contact Hours			60		
Evaluation Methods					
Internal Assessment:20	Th-15	P-05	End Term Examination: 55	Th-35	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	35	NA
Mid-Term Exam:	05	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)					
• Willey, J. M., Sandman, K. M., & Wood, D. H. (2019). Prescott’s Microbiology (11th ed.). McGrawHill Education. [976 pp.] • Lee, R. E. (2018). Phycology (5th ed.). Cambridge University Press. [535 pp.] • Singh, V., Pande, P. C., & Jain, D. K. (2017). Biodiversity: Microbiology, Fungi, Algae, Archegoniate: Bryophyta, Pteridophyta and Gymnosperms. Rastogi Publications. [759 pp.]					

- Ahluwalia, A. S. (2020). Phycology: Principles, Processes and Applications. Daya Publishing House. [502 pp.]
- Dube, H. C. (2013). An Introduction to Fungi (4th ed.). Scientific Publishers. [603 pp.]
- Vashishta, B. R., Sinha, A. K., & Kumar, A. (2010). Botany for Degree Students: Bryophyta. S. Chand Publishing. [517 pp.]
- Lakhanpal, R. N., Maheshwari, H. K., & Awasthi, N. (1976). A Catalogue of Indian Fossil Plants: Covering All Available Records from 1821 to 1970. Birbal Sahni Institute of Palaeobotany. [318 pp.]
- <https://www.algaebase.org/>
- <https://www.indexfungorum.org/>
- <https://www.britannica.com/plant/bryophyte>
- <https://asm.org/>
- <https://www.britannica.com/plant/angiosperm>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	1	1	1	1	1	1	2	2	1	1	2
CLO ₂	3	1	1	2	1	1	1	3	3	2	1	2
CLO ₃	2	2	2	2	3	3	2	2	3	2	3	2

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	4
Entrepreneurship	2
Skill Enhancement	22
Communication Development	5
Indian Knowledge System	2
Environmental Awareness	16
Current Issues and Social Awareness	6
Gender issues	
Public policies	3
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved, herbarium-based or departmentally maintained materials may be used wherever necessary. Suitable charts, models, photographs, digital resources, demonstrations and virtual laboratory exercises may be used depending upon institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	II		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Plants for Human Welfare		
Course Code	26L4.5-MDC-BOT-201		
Course Type	MDC-2		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO ₁	Explain the importance of plant diversity, agrodiversity, agroforestry, ornamental plants and plant resources in relation to human welfare.	
	CLO ₂	Describe the morphology and economic importance of selected cereals, pulses, fruits, nuts, spices, condiments and wood-yielding plants.	
	CLO ₃	Identify selected medicinal plants, ornamental plants, cereals, pulses, spice-yielding plants, wood samples and fruit types using specimens, photographs, commercial samples and field-based resources.	
	Theory	Practical	Total
Credits	2	1	3
Teaching Hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		Contact Hours
I	Understanding Plant Biodiversity: Plant diversity and agrodiversity in India; values of biodiversity and the role of plants in food security, environment and human well-being.		14

	Agroforestry and Ornamental Plants: Economic and ecological importance of agroforestry and social forestry; common ornamental plants of India and their uses.		
II	Crop Plants: Origin of cultivated plants; economic importance of major food plants including cereals (rice, wheat) and pulses (gram, pea). Fruits, Nuts, Spices, Condiments and Wood: Important fruit crops and nuts with their commercial importance; spices and condiments as plant resources; wood, timber and their uses in human welfare.	2	16
Practical	Suggested laboratory and field studies of Plants for Human Welfare • Identification and study of selected medicinal plants such as tulsi, neem, aloe, ashwagandha, mint, turmeric, amla, rauwolfia and vinca using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Identification and study of selected ornamental plants such as rose, marigold, jasmine, hibiscus, bougainvillea, chrysanthemum, croton, money plant and areca palm using fresh specimens if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Identification and study of important cereals such as rice, wheat and maize using seeds, grains, fresh specimens, photographs, commercial samples or departmentally maintained materials. • Identification and study of important pulses such as gram and pea using seeds, pods, fresh specimens, photographs, commercial samples or departmentally maintained materials. • Identification and study of spice-yielding plants and condiments such as turmeric, ginger, coriander, black pepper, clove, cardamom, fennel, cumin and asafoetida using fresh specimens if available; alternatively, suitable commercial samples, photographs or departmentally maintained materials may be used. • Study of different types of wood and timber-yielding plants such as teak, shisham, sal, deodar, pine, eucalyptus and bamboo using wood samples, charts, models, photographs or digital resources. • Study of different fruit types using locally available fruits such as mango, banana, citrus, apple, guava, papaya, pomegranate, coconut, tomato and pea if available; alternatively, suitable preserved specimens, photographs or departmentally maintained materials may be used. • Study of nuts and dry fruits such as almond, cashew nut, walnut, coconut, groundnut and pistachio using commercial samples, photographs, charts or digital resources. • Study of useful plant parts and plant products related to food, medicine, spices, ornaments, timber and household use using commercial samples, charts, models or digital resources. • Field documentation of locally available useful plants including local name, habit, plant part used, product obtained and importance depending upon seasonal availability and institutional resources.	1, 2, 3	30

	Preparation of practical records, labelled diagrams, observation sheets and short reports based on medicinal, ornamental and economically important plants.		
Total Contact Hours			60
Evaluation Methods			
Internal Assessment:20	Th-15	P-05	End Term Examination: 55
Class Participation:	05	0	Lab record
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination
Mid-Term Exam:	05	NA	Write-up and execution of the practical
Part C – Learning Resources			
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)			
- Singh, V., Pande, P. C., & Jain, D. K. (2018). Economic Botany. Rastogi Publications. - Kochhar, S. L. (2016). Economic Botany: A Comprehensive Study (5th ed.). Cambridge University Press. [664 pp.] - Wickens, G. E. (2001). Economic Botany: Principles and Practices. Kluwer Academic Publishers. [535 pp.] - Daubenmire, R. F. (1959). Plants and Environment: A Textbook of Plant Autecology (2nd ed.). John Wiley & Sons. [422 pp.] - Pandey, B. P. (1999). Economic Botany. S. Chand Publishing. [486 pp.] - Simpson, B. B., & Ogorzaly, M. C. (1986). Economic Botany: Plants in Our World. McGraw-Hill. [640 pp.] - Nayar, M. P., Ramamurthy, K., & Agarwal, V. S. (1989-1994). Economic Plants of India Vol. 1 and Vol. 2. Botanical Survey of India. [Vol. 1: pp. 1-159; Vol. 2: pp. 161-258] - Berg, L. R. (1997). Introductory Botany: Plants, People and the Environment. Saunders College Publishing. [466] https://agritech.tnau.ac.in/horticulture/horti_spices%20%282%29.html https://www.researchgate.net/publication/316861607_The_Role_of_Plants_in_Human_Welfare. https://ethnobotany.org/home/publications/economic-botany.html			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	1	1	2	1	1	1	3	2	2	1	3
CLO ₂	3	1	1	2	1	1	1	2	2	2	1	3
CLO ₃	2	2	2	2	3	3	2	2	2	2	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	5
Entrepreneurship	5
Skill Enhancement	18
Communication Development	5

Indian Knowledge System	5
Environmental Awareness	12
Current Issues and Social Awareness	7
Gender issues	
Public policies	3
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved, commercial, herbarium-based or departmentally maintained plant materials may be used wherever necessary. Suitable charts, models, photographs, digital resources, field observations and report submission may be used depending upon institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	III		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Plants for Environmental Sustainability		
Course Code	26L5.0-MDC-BOT-301		
Course Type	MDC-3		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the role of plants in sustaining life, ecosystem services, air purification, carbon sequestration, climate regulation and biodiversity conservation.	
	CLO₂	Describe plant-based sustainable practices such as afforestation, agroforestry, urban gardening, composting, organic farming, phytoremediation, green landscaping and circular bioeconomy.	
	CLO₃	Identify and document selected plants used in indoor gardening, urban greening, soil and water conservation, drought tolerance, biodiversity support and sustainable living.	
	Theory	Practical	Total
Credits	2	1	3
Teaching Hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Plants and Life Support Systems: Importance of plants in ecosystem services and human welfare; role in pollination, soil conservation, nutrient cycling, biodiversity conservation and ecological balance.	1	15

	Plants and Environmental Regulation: Role of plants in air purification and carbon sequestration, green cover and urban environment, pollution reduction and climate regulation.		
II	Plant-Based Sustainable Practices: Role of plants in indoor and urban gardening, climate-resilient landscaping and afforestation, reforestation, agroforestry and social forestry. Green Technologies and Sustainability: Role of plants in soil and water conservation, phytoremediation, plant-based products, circular bioeconomy and Sustainable Development Goals.	2	15
Practical	Suggested laboratory and field studies of Plants for Environmental Sustainability • Identification and study of environmentally important plants including indoor and air-purifying plants (areca palm, money plant, snake plant, spider plant, peace lily, aloe vera and rubber plant), ornamental and urban greening plants (rose, marigold, hibiscus, bougainvillea, chrysanthemum, croton and ficus) and drought-tolerant or climate-resilient plants (cactus, agave, euphorbia, date palm and millets) using fresh specimens if available; alternatively, suitable photographs or departmentally maintained materials may be used. • Identification and study of native trees and plants used in ecosystem restoration including neem, peepal, banyan, amaltas, jamun, arjun, shisham, khejri, bamboo, vetiver, grasses, eucalyptus, subabul, fruit trees and other locally available species with reference to their ecological role, soil and water conservation, agroforestry and social forestry applications using fresh specimens, herbarium specimens, field observations or suitable photographs depending upon seasonal availability and institutional resources. • Field documentation and assessment of local vegetation including recording plant habit, common name, ecological importance, environmental uses and estimation of green cover or tree diversity in a selected area using simple observation, counting and tabulation methods depending upon seasonal availability and institutional resources. • Study of sustainable urban horticulture and waste management practices including kitchen gardening, terrace gardening, composting, organic waste management, container selection, layout preparation and maintenance practices through practical demonstrations, charts, models, virtual laboratory exercises or digital resources depending upon institutional facilities. • Study of nature-based environmental management approaches including phytoremediation, wastewater treatment using suitable plant species, green buildings, vertical gardens, green roofs, urban landscaping and biodiversity-friendly public spaces using charts, models, photographs or digital resources. • Preparation of a short report on the role of plants in achieving any one Sustainable Development Goal related to climate action, life on land, clean water, sustainable cities or responsible consumption.	1, 2, 3	30

	Educational visit to a botanical garden, nursery, biodiversity park, urban garden, herbal garden, composting unit, wastewater treatment plant, agroforestry site or green building and preparation of a report with photographs depending upon institutional resources and permissions.				
Total Contact Hours			60		
Evaluation Methods					
Internal Assessment:20	Th-15	P-05	End Term Examination: 55	Th-35	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	35	NA
Mid-Term Exam:	05	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)					
- Berg, L. R. (2007). Introductory Botany: Plants, People and the Environment (2nd ed.). Cengage Learning. [648 pp.] - Berg, L. R. (1997). Introductory Botany: Plants, People and the Environment. Saunders College Publishing. [466 pp.] - Sharma, P. D. (2004). Plant Ecology and Environmental Biology. Rastogi Publications. [375 pp.] - Sharma, P. D. (2005). Ecology and Environment (7th ed.). Rastogi Publications. [652 pp.] - Rajagopalan, R. (2016). Environmental Studies: From Crisis to Cure (3rd ed.). Oxford University Press. [424 pp.] - Pandey, B. P. (1999). Economic Botany. S. Chand Publishing. [486 pp.] - Sharma, A. K. (2001). A Handbook of Organic Farming. Agrobios India. [627 pp.] - Capon, B. (2010). Botany for Gardeners (3rd ed.). Timber Press. [288 pp.] - Daubenmire, R. F. (1959). Plants and Environment: A Textbook of Plant Autecology (2nd ed.). John Wiley & Sons. [422 pp.] - Simpson, B. B., & Ogorzaly, M. C. (2015). Economic Botany: Plants in Our World (5th ed.). McGraw-Hill Education. [640 pp.] https://sdgs.un.org/goals https://egyankosh.ac.in/bitstream/123456789/91201/1/Unit-2.pdf https://www.fao.org/sustainable-forest-management/toolbox/en					

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	1	1	2	1	1	1	3	2	2	1	3
CLO ₂	2	2	1	3	1	2	2	3	1	3	2	3
CLO ₃	2	3	3	3	3	3	2	3	2	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	4
Entrepreneurship	5

Skill Enhancement	16
Communication Development	5
Indian Knowledge System	4
Environmental Awareness	18
Current Issues and Social Awareness	6
Gender issues	
Public policies	2
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available, seasonally available, preserved, commercial, field-based or departmentally maintained plant materials may be used wherever necessary. Suitable charts, models, photographs, digital resources, field observations and educational visits may be used depending upon institutional resources

VAC: 2 credits (2+0)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	III		
Nature of Course/ Course Composition	Theory		
Nomenclature of the Course	Indian Plant Knowledge Systems and Conservation		
Course Code	26L5.0-VAC-BOT-301		
Course Type	VAC-3 (for Scheme C)		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the concept, scope, methods and importance of ethnobotany with reference to traditional plant knowledge and local communities.	
	CLO₂	Evaluate the role of ethnobotanical knowledge in medicinal plant use, food and ritual traditions, biodiversity conservation, ethical research, intellectual property rights and benefit sharing.	
	Theory	Practical	Total
Credits	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Duration (in Hours)	2	0	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
Unit	Topics	CLO Attempt	Contact Hours
I	Introduction to Indian Plant Knowledge Systems: Concept, scope and importance of Indian plant knowledge systems; ethnobotany and its role in traditional plant knowledge and plant-people interactions. Ethnobotanical Methods and Traditional Community Plant Knowledge: Traditional, rural, farming and indigenous plant knowledge systems with special reference to Haryana; cultural practices and medicinal, nutritional and agricultural uses of plants.	1	15
II	Traditional Plant Use, Ethnobotanical Applications and Local Plant Resources: Traditional uses of plants in healthcare, food, agriculture and	2	15

cultural practices; ethnobotanically important plants of Haryana and nearby regions. Conservation, Ethics and Policy Framework: Role of traditional plant knowledge in biodiversity conservation and sustainable use of plant resources; ethical documentation, intellectual property rights, access and benefit sharing, traditional knowledge protection and biodiversity governance.			
Total Contact Hours			30
Evaluation Methods			
Internal Assessment: 15	Th-15	End Term Examination: 35	Th-35
Class Participation:	05	Written Examination: 35	
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05		
Mid-Term Exam:	05		
Part C – Learning Resources			
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)			
• Cotton, C. M. (1996). Ethnobotany: Principles and Applications. John Wiley & Sons. [424 pp.] • Martin, G. J. (1995). Ethnobotany: A Methods Manual. Chapman & Hall. [302 pp.] • Alexiades, M. N. (Ed.). (1996). Selected Guidelines for Ethnobotanical Research: A Field Manual. The New York Botanical Garden. [306 pp.] • Schultes, R. E., & von Reis, S. (Eds.). (1995). Ethnobotany: Evolution of a Discipline. Dioscorides Press. [414 pp.] • Sofowora, A. (1993). Medicinal Plants and Traditional Medicine in Africa (2nd ed.). Spectrum Books. [289 pp.] • Jain, S. K. (Ed.). (1981). Glimpses of Indian Ethnobotany. Oxford & IBH Publishing Co. [365 pp.] • Green, J. (2000). The Herbal Medicine-Maker's Handbook: A Home Manual. Crossing Press. [384 pp.] • Foster, S., & Duke, J. A. (2000). A Field Guide to Medicinal Plants and Herbs of Eastern and Central North America (2nd ed.). Houghton Mifflin. [411 pp.] • https://bsi.gov.in/page/en/ethnobotany • https://www.tkdil.res.in/ • https://www.cbd.int/access-benefit-sharing • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7936095/			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	2	2	2	2	1	1	1	3	2	2	1	3
CLO ₂	2	3	2	3	1	2	2	3	1	3	2	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	2
Entrepreneurship	2
Skill Enhancement	5
Communication Development	4

Indian Knowledge System	8
Environmental Awareness	4
Current Issues and Social Awareness	3
Gender issues	
Public policies	2
Any Other	

Any other information

- Relevant case studies, local plant examples, photographs, digital resources, community knowledge examples and official biodiversity or traditional knowledge resources may be used wherever appropriate

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	IV		
Nature of Course/ Course Composition	Theory		
Nomenclature of the Course	Medicinal Plants, Traditional Healing and Conservation		
Course Code	26L5.0-VAC-BOT-401		
Course Type	VAC-3 (for Scheme A, B & D) / VAC-4 (for Scheme C)		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the importance, diversity, traditional uses and healthcare significance of medicinal plants with reference to Indian systems of medicine and local plant resources.	
	CLO₂	Describe major phytochemicals, herbal remedy preparations, important medicinal plants, herbal industry prospects and conservation strategies for sustainable use of medicinal plant resources.	
	Theory	Practical	Total
Credits	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Duration (in Hours)	2	0	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
Unit	Topics	CLO Attempt	Contact Hours
I	Introduction to Medicinal Plants: History and importance of medicinal plants in India and the world; applications in healthcare, traditional medicine, nutrition and herbal industries. Medicinal Plant Diversity and Indian Systems of Medicine: Medicinal plant diversity and traditional healthcare systems; basic concepts of Ayurveda, Siddha, Unani and Homeopathy and household uses of medicinal plants.	1	15
II	Phytochemistry and Herbal Preparations: Overview of bioactive plant compounds and herbal preparations; alkaloids, flavonoids, tannins, terpenoids, glycosides, phenolics, essential oils and basic herbal formulations.	2	15

Important Medicinal Plants and Conservation: Important medicinal plants and their uses; cultivation, sustainable harvesting, conservation and the role of the National Medicinal Plants Board.					
Total Contact Hours					30
Evaluation Methods					
Internal Assessment: 15		Th-15	End Term Examination: 35	Th-35	
Class Participation:		05	Written Examination: 35		
Seminar/ presentation/ assignment/ quiz/ class test etc.:		05			
Mid-Term Exam:		05			
Part C – Learning Resources					
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)					
• Cotton, C. M. (1996). Ethnobotany: Principles and Applications. John Wiley & Sons. [424 pp.] • Martin, G. J. (1995). Ethnobotany: A Methods Manual. Chapman & Hall. [302 pp.] • Alexiades, M. N. (Ed.). (1996). Selected Guidelines for Ethnobotanical Research: A Field Manual. The New York Botanical Garden. [306 pp.] • Schultes, R. E., & von Reis, S. (Eds.). (1995). Ethnobotany: Evolution of a Discipline. Dioscorides Press. [414 pp.] • Sofowora, A. (1993). Medicinal Plants and Traditional Medicine in Africa (2nd ed.). Spectrum Books. [289 pp.] • Jain, S. K. (Ed.). (1981). Glimpses of Indian Ethnobotany. Oxford & IBH Publishing Co. [365 pp.] • Green, J. (2000). The Herbal Medicine-Maker's Handbook: A Home Manual. Crossing Press. [384 pp.] • Foster, S., & Duke, J. A. (2000). A Field Guide to Medicinal Plants and Herbs of Eastern and Central North America (2nd ed.). Houghton Mifflin. [411 pp.] • https://bsi.gov.in/page/en/ethnobotany • https://www.tkdil.res.in/ • https://www.cbd.int/access-benefit-sharing • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7936095/					

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	2	2	2	2	1	1	1	3	2	2	1	3
CLO ₂	2	3	2	3	1	2	2	3	1	3	2	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	2
Entrepreneurship	2
Skill Enhancement	5
Communication Development	4
Indian Knowledge System	8
Environmental Awareness	4

Current Issues and Social Awareness	3
Gender issues	
Public policies	2
Any Other	

Any other information

- Relevant case studies, local plant examples, photographs, digital resources, community knowledge examples and official biodiversity or traditional knowledge resources may be used wherever appropriate

SEC: 3 / 2 credits (2+1 / 1+1)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	II		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Biofertilizers and Organic Inputs		
Course Code	26L4.5-SEC-BOT-201		
Course Type	SEC-2		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the concept, types, role and significance of biofertilizers in sustainable agriculture, soil health and crop productivity.	
	CLO₂	Describe important microbial biofertilizers, mycorrhizal associations, antagonistic microorganisms, organic inputs and waste recycling practices used for plant growth and soil fertility.	
	CLO₃	Develop practical skills in microbial isolation, staining, sterilization, media preparation, compost testing, mycorrhizal observation, VAM production and biofertilizer-based project documentation.	
	Theory	Practical	Total
Credits	2	1	3
Teaching Hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		CLO Attempt Contact Hours

I	General Overview of Biofertilizers: Definition, importance and applications of biofertilizers in sustainable agriculture; role in soil health, nutrient availability and crop productivity. Types and Applications of Biofertilizers: Major biofertilizers including nitrogen-fixing and phosphate-solubilizing microorganisms; isolation, identification, mass multiplication and field application.	1	14		
II	Mycorrhizal and Antagonistic Microorganisms: Beneficial soil microorganisms including vesicular arbuscular mycorrhizae, actinomycetes and antagonistic microbes; role in soil fertility, plant health and sustainable crop management. Organic Inputs and Waste Recycling: Organic nutrient management including green manuring, composting and vermicomposting; recycling of biodegradable wastes and their role in soil health and sustainable agriculture.	2	16		
Practical	Suggested laboratory and field studies of Biofertilizers and Organic Inputs • Study of different types of biofertilizers including <i>Rhizobium</i>, <i>Azotobacter</i>, <i>Azospirillum</i>, <i>phosphate-solubilizing bacteria (PSB)</i>, <i>cyanobacteria</i>, <i>Azolla</i> and vesicular-arbuscular mycorrhiza (VAM) using commercial packets, specimens, photographs, charts, models or digital resources. • Study of basic microbiological techniques including methods of sterilization, media preparation and microbial inoculation where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Study of arbuscular mycorrhizal fungi (AMF) including mycorrhizal association, arbuscules, vesicles and AMF spores from root or rhizospheric soil samples where facilities are available; alternatively, suitable slides, photographs, charts or digital resources may be used. • Study and quality assessment of organic manures and composts including compost, vermicompost, biocompost, green manure and other organic inputs through pH, chloride and organic matter testing where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Preparation of a short project report on any one topic such as <i>Rhizobium</i> technology, AMF technology, organic farming, vermicomposting, biocompost production, <i>Azolla</i> culture, biofertilizer application or sustainable soil fertility management. • Educational visit to a biofertilizer production unit, vermicompost unit, organic farm, Krishi Vigyan Kendra, agricultural research station, microbiology laboratory or composting facility and preparation of a report with photographs depending upon institutional resources and permissions.	1, 2, 3	30		
Total Contact Hours			60		
Evaluation Methods					
Internal Assessment:20	Th-15	P-05	End Term Examination: 55	Th-35	P-20
Class Participation:	05	0	Lab record	NA	05

Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	35	NA
Mid-Term Exam:	05	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources

Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)

- Giri, B., Prasad, R., Wu, Q. S., & Varma, A. (Eds.). (2019). Biofertilizers for Sustainable Agriculture and Environment. Springer. [544 pp.]
- Subba Rao, N. S. (1993). Biofertilizers in Agriculture and Forestry (3rd ed.). Oxford & IBH Publishing Co. Pvt. Ltd. [242 pp.]
- Aneja, K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International. [632 pp.]
- Sylvia, D. M., Fuhrmann, J. J., Hartel, P. G., & Zuberer, D. A. (2005). Principles and Applications of Soil Microbiology (2nd ed.). Pearson Prentice Hall. [640 pp.]
- Alexander, M. (1977). Introduction to Soil Microbiology (2nd ed.). John Wiley & Sons. [467 pp.]
- Sharma, A. K. (2001). A Handbook of Organic Farming. Agrobios India. [627 pp.]
- <https://vikaspedia.in/agriculture/agri-inputs/bio-inputs/bioinputs-for-nutrientmanagement/biofertilizers>
- <https://www.peptechbio.com/blog-biofertilizers/>
- <https://aicrp.icar.gov.in/biofertilizers/>
- <https://icar.org.in/sites/default/files/2022-06/ICAR-technologies-Biofertilizers.pdf>
- https://nconf.dac.gov.in/uploads/quality_control/Green-Book-FCO-2023-Edition.pdf

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	1	2	2	3	2	3	2	3
CLO ₂	3	3	2	3	1	2	2	3	2	3	2	3
CLO ₃	2	3	3	3	3	3	3	3	1	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	7
Entrepreneurship	8
Skill Enhancement	24
Communication Development	4
Indian Knowledge System	3
Environmental Awareness	8
Current Issues and Social Awareness	4
Gender issues	
Public policies	2
Any Other	

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Any other information

- Any other relevant practical may be conducted. Locally available soil samples, composts, organic inputs, root nodules, rhizospheric soil, biofertilizer packets, laboratory facilities, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	II		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Vertical Farming and Soilless Cultivation		
Course Code	26L4.5-SEC-BOT-202		
Course Type	SEC-2		
Course Level	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO ₁	Explain the concept, types, role and significance of biofertilizers in sustainable agriculture, soil health and crop productivity.	
	CLO ₂	Describe important microbial biofertilizers, mycorrhizal associations, antagonistic microorganisms, organic inputs and waste recycling practices used for plant growth and soil fertility.	
	CLO ₃	Develop practical skills in microbial isolation, staining, sterilization, media preparation, compost testing, mycorrhizal observation, VAM production and biofertilizer-based project documentation.	
	Theory	Practical	Total
Credits	2	1	3
Teaching Hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Concept and Significance: Concept, evolution and importance of vertical farming; role in sustainable agriculture, urban food production and resource use efficiency.	1	14

	Vertical Farm Design and Crop Selection: Components and working principles of vertical farming; growing media, propagation methods and selection of suitable crops for vertical farming.		
II	Soilless Cultivation Systems: Principles, types, applications, advantages and limitations of hydroponics, aeroponics and aquaponics in vertical farming. Sustainability and Economic Aspects: Resource efficiency in water, land and energy use; environmental benefits, waste management and climate-resilient production.	2	16
Practical	Suggested laboratory and field studies of Vertical Farming and Soilless Cultivation • Study of vertical farming systems and infrastructure including vertical farming structures, growing racks, trays, containers, nutrient tanks, pumps, lighting systems, environmental requirements (light, temperature, humidity, aeration, water quality and nutrient solution management) and commonly used growing media and substrates such as cocopeat, perlite, vermiculite, rockwool, clay pellets, sand, gravel and locally available alternatives using available materials, charts, models or digital resources. • Study of crops and soilless cultivation techniques including crops suitable for vertical farming such as lettuce, spinach, coriander, mint, basil, fenugreek, microgreens, tomato, cucumber and strawberry, along with hydroponics, aeroponics, aquaponics, vertical gardens, container farming and rooftop farming using fresh specimens, field observations, charts, models, photographs or digital resources. • Demonstration of hydroponic, aeroponic or aquaponic systems and comparison of plant growth and vigour under nutrient-rich and nutrient-deficient water, mist or fog conditions where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Study of nutrient solution preparation and water quality assessment including measurement of pH, electrical conductivity (EC) and total dissolved solids (TDS), and identification of nutrient deficiency symptoms in soilless-grown plants using available instruments, charts, photographs or digital resources; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Preparation of a simple vertical farming project including layout design for a home, terrace, classroom, laboratory, urban balcony or small commercial unit, maintenance records, growth observation sheets, nutrient comparison records, layout diagrams and a cost-benefit analysis of a small hydroponic, aeroponic, microgreen or vertical gardening unit. • Preparation and monitoring of a small hydroponic or microgreen unit using locally available materials and suitable crops. Record observations on seed germination, plant growth, water consumption and harvesting period where facilities are available; alternatively,	1, 2, 3	30

	demonstration, virtual laboratory exercises or recorded demonstrations may be used. Educational visit to a hydroponic unit, aeroponic unit, aquaponic unit, greenhouse, polyhouse, vertical farm, urban farming centre, nursery, agri-startup or other relevant organization and preparation of a report with photographs depending upon institutional resources and permissions.				
Total Contact Hours				60	
Evaluation Methods					
Internal Assessment:20	Th-15	P-05	End Term Examination: 55	Th-35	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	35	NA
Mid-Term Exam:	05	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)					
- Despommier, D. (2010). The Vertical Farm: Feeding the World in the 21st Century. Thomas Dunne Books/St. Martin's Press. [303 pp.] - Resh, H. M. (2022). Hydroponic Food Production: A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower (8th ed.). CRC Press. [642 pp.] - Misra, S. (2022). Soilless Crop Production. Daya Publishing House. [372 pp.] - Fell, D. (2011). Vertical Gardening: Grow Up, Not Out, for More Vegetables and Flowers in Much Less Space. Rodale Books. [372 pp.] - Jones, J. B. Jr. (2016). Hydroponics: A Practical Guide for the Soilless Grower (2nd ed.). CRC Press [440 pp.] https://epale.ec.europa.eu/system/files/2024-02/URBAN-FARMING-FOR-BEGINNERS.pdf https://www.nal.usda.gov/farms-and-agricultural-production-systems/hydroponics https://www.edengreen.com/blog-collection/what-is-vertical-farming https://www.jains.com/JainGreenhouse/Vertical%20Farming.html					

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	2	2	1	2	1	2	2	2	1	3	2	3
CLO ₂	2	3	2	3	1	2	3	3	1	3	2	3
CLO ₃	2	3	3	3	3	3	3	3	1	3	2	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	7
Entrepreneurship	10
Skill Enhancement	22
Communication Development	4

Indian Knowledge System	1
Environmental Awareness	7
Current Issues and Social Awareness	6
Gender issues	
Public policies	3
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available crops, substrates, soilless cultivation materials, hydroponic or aeroponic units, laboratory facilities, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	III		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Plant Hybridization and Breeding Techniques		
Course Code	26L5.0-SEC-BOT-301		
Course Type	SEC-3		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO ₁	Explain the objectives, genetic basis and importance of plant breeding, self-incompatibility, male sterility, heterosis and hybrid vigour.	
	CLO ₂	Describe hybridization techniques, parent selection, emasculation, pollination, F1 seed harvesting, wide hybridization and breeding methods used in crop improvement.	
	CLO ₃	Develop practical skills in floral biology, emasculation, pollination, pollen viability testing, male sterility observation, breeding designs and hybridization record preparation.	
	Theory	Practical	Total
Credits	2	1	3
Teaching Hours per week	2	2	4
Internal Assessment Marks	15	05	20
End Term Exam Marks	35	20	55
Max. Marks	50	25	75
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 7 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Objectives and Genetic Basis of Plant Breeding: General objectives, importance and scope of plant breeding in crop improvement; role of genetic variation, selection and reproductive systems in breeding programmes.	1	14

	Self-Incompatibility, Male Sterility and Heterosis: Concept and utilization of self-incompatibility and male sterility in hybrid seed production; concept, effects, estimation and genetic basis of heterosis and hybrid vigour.		
II	Hybridization Techniques: Hybridization programmes and parent selection; floral biology, emasculation, bagging, pollination, tagging and F₁ seed production; wide hybridization and methods to overcome incompatibility. Breeding Methods and Evaluation: Breeding methods in self- and cross-pollinated crops; pure line, mass, pedigree, bulk and recurrent selection; evaluation and application in crop improvement.	2	16
Practical	Suggested laboratory and field studies of Plant Hybridization and Breeding Techniques • Study of floral biology including floral structure, anthesis, anther dehiscence, stigma receptivity and pollination behaviour in selected self-pollinated and cross-pollinated crops using fresh flowers if available; alternatively, suitable herbarium specimens, photographs or departmentally maintained materials may be used. • Demonstration of plant breeding techniques including emasculation, bagging, tagging, controlled pollination and F₁ seed harvesting where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Study of different emasculation methods including hand, hot water, cold water, alcohol, suction and chemical emasculation using demonstrations, charts, models, photographs or digital resources depending upon institutional facilities. • Study of pollen fertility and breeding barriers including testing of pollen viability or pollen incompatibility and observation of male sterility or self-incompatibility systems in suitable plant materials where facilities are available; alternatively, suitable slides, photographs, charts, models or digital resources may be used. • Study of experimental designs and breeding records including crossing plans, pedigree records, field layouts, selection records and hybridization data sheets using charts, models, sample formats or digital resources. • Study of hybrid seed production and breeding methods including heterosis, recurrent selection, wide hybridization and breeding methods used in self-pollinated and cross-pollinated crops through case studies, charts, models, photographs, crop examples or digital resources. • Study of seed processing and seed quality evaluation including seed cleaning, grading, moisture determination, seed purity, germination testing and seed certification standards using seed samples, charts, models or digital resources; alternatively, demonstration or recorded demonstrations may be used. • Study of important crop varieties and plant breeding achievements by comparing improved varieties, hybrids and traditional cultivars of selected crops with reference to distinguishing morphological characters, yield attributes, disease resistance and stress tolerance	1, 2, 3	30

	using fresh specimens, seed samples, photographs, charts or digital resources. - Preparation of practical records and a short project report including labelled floral diagrams, emasculation and pollination notes, pollen viability sheets, crossing plans, hybridization records and a report on any selected crop-breeding or hybridization technique. - Educational visit to a plant breeding research station, seed production farm, agricultural university, Krishi Vigyan Kendra, crop improvement laboratory, seed testing laboratory or hybrid seed production field and preparation of a report with photographs depending upon institutional resources and permissions.		
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Total Contact Hours

60

Evaluation Methods

Internal Assessment:20	Th-15	P-05	End Term Examination: 55	Th-35	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	35	NA
Mid-Term Exam:	05	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources**Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)**

- Acquaah, G. (2012). Principles of Plant Genetics and Breeding (2nd ed.). Wiley-Blackwell. [756 pp]
- Sleper, D. A., & Poehlman, J. M. (2006). Breeding Field Crops (5th ed.). Blackwell Publishing. [424 pp.]
- Allard, R. W. (1999). Principles of Plant Breeding (2nd ed.). John Wiley & Sons. [264 pp.]
- Chaudhari, H. K. (1971). Elementary Principles of Plant Breeding (2nd ed.). Oxford & IBH Publishing Co. [327 pp.]
- Sharma, J. R. (1994). Principles and Practice of Plant Breeding. Tata McGraw-Hill. [599 pp.]
- Welsh, J. R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley & Sons. [290 pp.]
- Singh, B. D. (2006). Plant Breeding: Principles and Methods (7th ed.). Kalyani Publishers. [1000 pp.]
- <https://www.britannica.com/science/plant-breeding/Hybrid-varieties>
- <https://pubmed.ncbi.nlm.nih.gov/33862960/>
- <https://pbea.agron.iastate.edu/files/2021/12/Basic-Principles-of-Plant-Breeding.pdf>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	PO₈	PSO₁	PSO₂	PSO₃	PSO₄
CLO ₁	3	2	1	2	1	2	1	2	2	3	2	3
CLO ₂	3	3	2	3	1	2	2	2	1	3	1	3
CLO ₃	2	3	3	3	3	3	3	2	1	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	7
Entrepreneurship	5

Skill Enhancement	25
Communication Development	4
Indian Knowledge System	2
Environmental Awareness	4
Current Issues and Social Awareness	7
Gender issues	
Public policies	6
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available crop flowers, field materials, breeding tools, charts, models, digital resources, demonstrations, recorded practicals and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	VI		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Olericulture and Vegetable Production		
Course Code	26L5.5-SEC-BOT-601		
Course Type	SEC-4		
Course Level	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Describe the importance, challenges and cultivation practices of selected vegetable crops with reference to morphology, sowing, manuring, irrigation, harvesting and plant protection.	
	CLO₂	Develop practical skills in vegetable seed testing, seedling raising, crop identification, nursery-bed preparation, transplanting, fertilizer application, irrigation practices and pest or disease observation.	
	Theory	Practical	Total
Credits	1	1	2
Teaching Hours per week	1	2	3
Internal Assessment Marks	05	05	10
End Term Exam Marks	20	20	40
Max. Marks	25	25	50
Examination Duration (in Hours)	2	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u>			
The paper setter shall prepare 4 questions from unit 01 with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 6 short answer type questions carrying one mark each (total 06 marks). The remaining questions will be carrying 07 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 02 questions from other 03 questions.			
<u>Instructions for Practical Examiner</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours
I	Importance and Scope of Vegetable Cultivation: Importance of vegetable cultivation in India and Haryana; nutritional, economic and livelihood value of vegetables; export and import potential of vegetables; major constraints in vegetable production and basic remedies. Cultivation of Selected Vegetable Crops: Basic morphology, important varieties, climate, seed and sowing, manuring, irrigation, harvesting and	1	15

	common disease management of vegetable crops (brinjal, tomato), leafy vegetables (coriander, spinach), root vegetables (carrot, beetroot) and legumes (mung bean, chickpea).				
Practical	Suggested laboratory and field studies of Olericulture and Vegetable Production • Study of seed germination and seed viability tests for selected vegetable seeds where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. • Identification of vegetable seeds and vegetable crops at different growth stages using fresh specimens if available; alternatively, suitable photographs, commercial samples or departmentally maintained materials may be used. • Study of nursery management including nursery-bed preparation, raising of seedlings in nursery beds or protrays and transplantation of vegetable seedlings depending upon seasonal availability and institutional resources. • Study of cultivation practices of vegetable crops including land preparation, sowing, transplanting, fertilizer application and irrigation practices depending upon seasonal availability and institutional resources. • Study of selected vegetable crops including brinjal, tomato, coriander, spinach, carrot, beetroot, mung bean and chickpea with reference to morphology, useful part, cultivation practices and economic importance using fresh specimens if available; alternatively, suitable photographs, charts, models or digital resources may be used. • Study of major diseases and insect pests of vegetable crops using infected materials if available; alternatively, suitable photographs, preserved specimens, charts or digital resources may be used. • Preparation of practical records including seed-testing observations, nursery notes, vegetable crop descriptions, pest and disease notes and field observation reports. • Educational visit to a vegetable farm, nursery, horticulture farm, Krishi Vigyan Kendra, farmers' field, vegetable market, seed production unit or other relevant organization and preparation of a report with photographs depending upon institutional resources and permissions.	1, 2	30		
Total Contact Hours			45		
Evaluation Methods					
Internal Assessment: 10	Th-05	P-05	End Term Examination: 40	Th-20	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	NA	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	20	NA
Mid-Term Exam:	NA	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					

Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)

- Bose, T. K., & Som, M. G. (Eds.). (1986). Vegetable Crops in India. Naya Prokash. [775 pp.]
- Chadha, K. L. (Ed.). (2001). Handbook of Horticulture. Indian Council of Agricultural Research. [1031 pp.]
- Rubatzky, V. E., & Yamaguchi, M. (1997). World Vegetables: Principles, Production and Nutritive Values (2nd ed.). Chapman & Hall. [843 pp.]
- Nonnecke, I. L. (1989). Vegetable Production. Springer. [658 pp.]
- Bose, T. K., Kabir, J., & Maity, T. K. (2003). Vegetable Crops Vol. 2 (3rd ed.). Naya Prokash. [485 pp.]
- Decoteau, D. R. (2000). Vegetable Crops. Prentice Hall. [464 pp.]
- Singh, H. P., Singh, N. P., & Deka, B. C. (2004). Vegetable Production Technology. Westville Publishing House. [380 pp.]
- <https://www.britannica.com/science/horticulture>
- <https://www.gardeningknowhow.com/edible/vegetables/vgen/science-of-vegetable-growing.htm>
- https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Compilation_techniques_organic_agriculture_rev.pdf
- <http://eagri.org/eagri50/HORT281/pdf/lec01.pdf>

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	1	2	1	2	1	3	2	3
CLO ₂	2	3	3	3	3	3	3	2	1	3	2	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	5
Entrepreneurship	7
Skill Enhancement	18
Communication Development	3
Indian Knowledge System	2
Environmental Awareness	4
Current Issues and Social Awareness	4
Gender issues	
Public policies	2
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available vegetable seeds, seedlings, crop plants, field sites, nursery materials, commercial samples, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

VOC: 4 credits (3+1)

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	III		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Organic Farming		
Course Code	26L5.0-VOC-BOT-301		
Course Type	VOC-1 (for Scheme B)		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the principles, scope, importance, certification and management practices of organic farming.	
	CLO₂	Describe soil health management, organic nutrient sources, biofertilizers, composting, vermicomposting and crop management practices in organic farming.	
	CLO₃	Evaluate organic approaches for pest, disease, weed, water, waste and resource management with reference to sustainable agriculture.	
	CLO₄	Develop practical skills in composting, vermicomposting, organic input preparation, nutrient comparison, pest-control assessment, field observation and organic farm documentation.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO Attempt	Contact Hours

I	Organic Farming Basics: History, concept and importance of organic farming; principles, advantages, limitations and present status in India; organic farming as a sustainable alternative to chemical-based agriculture. Organic Certification and Standards: Organic certification process, record keeping and traceability; India Organic, PGS, IFOAM and USDA Organic standards; branding, labelling and consumer trust.	1	16
II	Soil Health and Organic Nutrient Management: Soil health and fertility management; organic matter, soil microorganisms, organic manures, compost, vermicompost, green manure, mulching and biofertilizers. Organic Crop Management: Selection of crops and planting material for organic farming; crop rotation, mixed cropping, intercropping, harvesting and organic agri-horticulture in urban and semi-urban areas.	2	14
III	Pest, Disease and Weed Management: Organic pest, disease and weed management; seed, seedling and soil treatment, biological control, botanical pesticides, cover crops, mulches and cultural or mechanical weed control. Sustainable and Socio-Economic Aspects: Water management through drip and sprinkler irrigation and rainwater harvesting; farm waste recycling, value addition, marketing, branding and labelling; role of organic farming in rural livelihoods, food security and social well-being.	3	15
Practical	Suggested laboratory and field studies of Organic Farming • Preparation and study of organic manures including compost and vermicompost using locally available biodegradable waste and study of farmyard manure, green manure and oil cakes using available samples or digital resources. • Study of biofertilizers and their applications including <i>Rhizobium</i>, <i>Azotobacter</i>, <i>Azospirillum</i>, phosphate-solubilizing bacteria and mycorrhiza using commercial products, charts, models or digital resources. • Study of organic nutrient management including comparison of organic and inorganic fertilizers through plant growth observations and estimation of nitrogen and phosphorus content using suitable laboratory methods where facilities are available; alternatively, demonstration or digital resources may be used. • Study of organic crop-management practices including mulching, green manuring, cover cropping, crop rotation, seed treatment, seedling treatment and soil treatment using field observations, demonstrations, charts or digital resources. • Study and demonstration of organic pest-management practices including neem extract, botanical pesticides, pheromone traps, sticky traps and biological control agents using available materials, demonstrations or digital resources. • Study of soil health under organic farming including observation or assessment of soil texture, pH, organic matter and moisture using available field or laboratory methods, demonstrations or digital resources. • Study of organic produce and post-harvest practices including harvesting, grading, storage, packaging and quality assessment of	1, 2, 3, 4	30

	organically grown crops using fresh produce, commercial samples, charts or digital resources. - Preparation of a brief project report on an organic farm, kitchen garden, terrace garden, nursery, vermicompost or composting unit or local organic-product enterprise. - Educational visit to an organic farm, vermicompost unit, biofertilizer unit, nursery, Krishi Vigyan Kendra, agricultural research station, farmers' field, organic market or relevant organization and preparation of a report with photographs depending upon institutional resources and permissions.		
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Total Contact Hours

75

Evaluation Methods

Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources**Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)**

- Chandran, S., Unni, M. R., Thomas, S., & Meena, D. K. (Eds.). (2023). Organic Farming: Global Perspectives and Methods (2nd ed.). Woodhead Publishing, Elsevier. [625 pp.]
- Somasundaram, E., Udhaya Nandhini, D., & Meyyappan, M. (2022). Principles of Organic Farming. CRC Press. [412 pp.]
- Chandran, S., Thomas, S., & Unni, M. R. (Eds.). (2019). Organic Farming: New Advances Towards Sustainable Agricultural Systems. Springer. [139 pp.]
- Sharma, A. K. (2001). A Handbook of Organic Farming. Agrobios India. [627 pp.]
- Hermery, H. (2007). Working with Nature: Shifting Paradigms. Gaia College Inc. [43 pp.]
- Lampkin, N. (1990). Organic Farming. Farming Press. [715 pp.]
- Subba Rao, N. S. (2017). Biofertilizers in Agriculture and Forestry (4th ed.). MedTech Publishers. [242 pp.]
- Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology and Biotechnology (5th ed.). New Age International. [632 pp.]
- Palaniappan, S. P., & Annadurai, K. (2022). Organic Farming: Theory and Practice (2nd ed.). Scientific Publishers. [321 pp.]
- Sharma, A. K. (2001). A Handbook of Organic Farming. Agrobios India. [627 pp.]
- <https://nconf.dac.gov.in/>
- <https://apeda.gov.in/OrganicProducts>
- https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Compilation_techniques_organic_agriculture_rev.pdf

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	PO₈	PSO₁	PSO₂	PSO₃	PSO₄
CLO ₁	2	2	1	2	1	1	1	3	1	3	1	3

CLO ₂	3	2	1	2	1	2	2	3	1	3	2	3
CLO ₃	2	3	2	3	2	2	2	3	1	3	2	3
CLO ₄	2	3	3	3	3	3	3	3	1	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	8
Entrepreneurship	10
Skill Enhancement	20
Communication Development	5
Indian Knowledge System	5
Environmental Awareness	14
Current Issues and Social Awareness	8
Gender issues	
Public policies	5
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available organic inputs, farm materials, composting materials, field sites, commercial samples, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	IV		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Floriculture and Landscape Gardening		
Course Code	26L5.0-VOC-BOT-401		
Course Type	VOC-1 (for Scheme A & C) / VOC-2 (for Scheme B)		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO ₁	Explain the scope, importance, nursery management, propagation methods and routine cultural operations used in floriculture.	
	CLO ₂	Describe the cultivation, maintenance and special techniques used for ornamental plants, indoor plants, potted plants, bonsai and selected landscape plants.	
	CLO ₃	Evaluate garden design principles, landscape styles, commercial floriculture practices, post-harvest handling and pest or disease management of ornamental plants.	
	CLO ₄	Develop practical skills in plant propagation, vase-life assessment, hydroponics, floral arrangements, flower study, disease identification and floriculture-based field documentation.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		CLO Attempt Contact Hours

I	Introduction to Floriculture: History, importance, scope and current status of floriculture in India; economic significance of the floriculture industry; basic concept of landscape gardening and ornamental plant use. Nursery Management and Propagation: Establishment and management of ornamental nurseries; seed sowing, cutting, grafting, layering, pricking, planting and transplanting; soil sterilization, nursery hygiene and routine nursery operations.	1	16
II	Ornamental Plants, Indoor Gardening and Special Techniques: Cultivation and maintenance of ornamental flowering plants, trees, climbers, foliage plants, ferns, cacti and succulents; pot and container gardening, indoor plant care and bonsai techniques. Garden Design and Landscape Styles: Principles of garden design; features of English, Italian, French, Persian, Mughal and Japanese gardens; major garden components including lawns, hedges, flower beds, shrubbery and water features.	2	14
III	Commercial Floriculture Practices: Factors affecting flower production; cultivation, post-harvest handling and vase-life extension of important cut and loose flowers; principles of colour harmony and flower arrangement. Landscaping and Plant Protection: Landscaping of highways, parks, educational institutions and public spaces; sustainable landscaping and integrated management of common pests and diseases of ornamental plants.	3	15
Practical	Suggested laboratory and field studies of Floriculture and Landscape Gardening • Study of vegetative propagation methods including stem cutting, grafting and air-layering in suitable ornamental and nursery plants using fresh materials, demonstrations or digital resources. • Study of ornamental nursery practices including seed sowing, pricking, potting, repotting, transplanting, nursery tools, containers, potting mixtures, shade-net requirements and nursery sanitation. • Identification and study of ornamental plants including flowering annuals, herbaceous perennials, foliage plants, climbers, palms, cycads, ferns, cacti, succulents and indoor plants with reference to habit, propagation and maintenance requirements. • Study of garden design and landscape components including hedges, edges, lawns, flower beds, shrubbery, rock gardens and water gardens and preparation of a simple landscape layout for a home, institution, park or roadside. • Study of bonsai and soilless cultivation including bonsai styles, training, pruning and maintenance and demonstration of a laboratory-scale hydroponic setup where facilities are available; alternatively, charts, models or digital resources may be used. • Study of floral biology and post-harvest management including morpho-anatomical features of flowers, flower preservatives, vase-life assessment, packaging, grading and post-harvest handling of cut flowers.	1, 2, 3, 4	30

	- Preparation of floral arrangements using fresh flowers or suitable artificial materials and documentation through photographs, labelled diagrams or digital resources. - Study of ornamental plant health and nursery documentation including common diseases and pests, propagation records, vase-life observations and nursery or landscape records using available materials, photographs, charts or digital resources. - Educational visit to a nursery, botanical garden, floriculture farm, landscape garden, flower market, polyhouse, greenhouse, tissue culture laboratory or ornamental plant enterprise and preparation of a report with photographs depending upon institutional resources and permissions.		
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Total Contact Hours 75

Evaluation Methods

Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources

Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)

- Arora, J. S. (2007). Introductory Ornamental Horticulture (6th ed.). Kalyani Publishers. [203 pp.]
- Jain, S. M., & Ochatt, S. J. (Eds.). (2010). Protocols for In Vitro Propagation of Ornamental Plants (Methods in Molecular Biology, Vol. 589). Humana Press. [XIV + 400 pp.]
- Prasad, S., Singh, D., & Kumar, U. (2022). Commercial Floriculture (2nd ed.). Agrobios India. [494 pp.]
- Laurie, A., & Ries, V. H. (2001). Floriculture: Fundamentals and Practices (2nd ed.). Agrobios India. [534 pp.]
- Larson, R. A. (1980). Introduction to Floriculture. Academic Press. [628 pp.]
- Nowak, J., & Rudnicki, R. M. (1990). Postharvest Handling and Storage of Cut Flowers, Florist Greens and Potted Plants. Timber Press. [210 pp.]
- <https://flower-crop.web.app>
- <https://apeda.gov.in/Floriculture>
- <https://www.india.gov.in/topics/agriculture/floriculture>
- https://www.apeda.gov.in/apedawebsite/six_head_product/floriculture.htm

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	PO₈	PSO₁	PSO₂	PSO₃	PSO₄
CLO ₁	2	2	1	2	1	2	2	2	1	3	2	3
CLO ₂	3	2	1	2	1	2	2	2	2	3	2	3
CLO ₃	2	3	2	3	2	2	2	3	1	3	2	3
CLO ₄	2	3	3	3	3	3	3	2	1	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	10
Entrepreneurship	12
Skill Enhancement	25
Communication Development	6
Indian Knowledge System	5
Environmental Awareness	8
Current Issues and Social Awareness	6
Gender issues	
Public policies	3
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available ornamental plants, flowers, nursery materials, garden tools, commercial samples, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	IV		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Nursery Management and Gardening		
Course Code	26L5.0-VOC-BOT-402		
Course Type	VOC-1 (for Scheme A & C) / VOC-2 (for Scheme B)		
Course Level	200-299		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the scope, infrastructure, seed technology and basic planning required for nursery management and gardening.	
	CLO₂	Describe seed propagation, vegetative propagation, hardening, acclimatization and routine garden management practices.	
	CLO₃	Evaluate cultivation practices of selected vegetables and flowers along with storage, marketing and sustainable nursery practices.	
	CLO₄	Develop practical skills in seed treatment, germination studies, nursery-bed preparation, seedling raising, transplantation, pruning, vegetative propagation and nursery documentation.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		CLO Attempt Contact Hours

I	Nursery and Gardening Basics: Scope and importance of nursery management in horticulture, agriculture and gardening; types of nurseries and gardens including home gardens, public gardens and landscape gardens. Nursery Infrastructure and Seed Technology: Nursery planning and infrastructure; greenhouse, mist chamber, shade house and glasshouse; nursery practices, seed storage, testing and certification.	1	16
II	Propagation Techniques: Cutting, air layering, grafting and budding; selection and treatment of cuttings, rooting media and planting techniques; hardening and acclimatization of nursery plants. Gardening Operations: Elements and principles of garden design; soil preparation, manuring, watering, sowing, seedling raising, transplanting, pruning, pinching and basic pest and disease management.	2	14
III	Cultivation of Vegetables and Flowers: Nursery and cultivation practices of important vegetable and flower crops with suitable examples. Technology and Market Integration: Storage, grading, packaging and marketing of nursery and gardening products; sustainable nursery management, efficient water use, waste recycling and entrepreneurship.	3	15
Practical	Suggested laboratory and field studies of Nursery Management and Gardening • Study of nursery tools, infrastructure and layout including nursery beds, potting areas, propagation areas, shade houses, mist chambers, greenhouses and glasshouses using available materials, charts, models or digital resources. • Study of seeds and seed germination including seed structure, seed types, seed quality, dormancy-breaking methods such as scarification and stratification and the effect of environmental conditions on germination where facilities are available; alternatively, demonstration or digital resources may be used. • Preparation of nursery growing media and beds including rooting media, potting mixtures, containers and seedling beds using locally available materials depending upon seasonal availability and institutional resources. • Study of nursery seedling production including seed sowing, raising, transplanting, hardening and acclimatization of nursery plants depending upon seasonal availability and institutional resources. • Study of vegetative propagation techniques including stem cutting, air-layering, grafting and budding in suitable nursery or ornamental plants using fresh materials, demonstrations or digital resources. • Study of pruning and training practices including topping, thinning and pinching and their effects on plant growth, branching and flowering depending upon seasonal availability and institutional resources. • Identification and study of selected vegetable and flower crops including cabbage, brinjal, okra, onion, tomato, carrot, marigold, liliun, rose, gerbera, gladiolus, chrysanthemum and carnation using fresh specimens, photographs, herbarium specimens or digital resources. • Study of nursery plant health and management records including common pests and diseases, seed source, sowing date, germination	1, 2, 3, 4	30

	percentage, transplanting date, propagation method, survival percentage, plant sale and marketing details.				
	Preparation of a nursery business plan and educational visit including plant selection, infrastructure, inputs, propagation methods, costing, pricing and marketing strategy followed by a visit to a nursery, botanical garden, horticulture farm, greenhouse, polyhouse, seed production unit, garden centre, vegetable farm or flower farm and preparation of a report with photographs.				
Total Contact Hours			75		
Evaluation Methods					
Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10
Part C – Learning Resources					
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)					
- Singh, A. K., & Kumar, A. (2021). Plant Propagation and Nursery Management (1st ed., Reprint 2023). Bhavya Books. [250 pp.] - Ray, P. K. (2024). Essentials of Plant Nursery Management (2nd ed.). Scientific Publishers. [419 pp.] - Ray, P. K. (2012). Plant Nursery Management: How to Start and Operate a Plant Nursery. Scientific Publishers. [407 pp.] - Mason, J. (2004). Nursery Management (2nd ed.). Landlinks Press. [320 pp.] - Sinha, N. K., & Hui, Y. H. (Eds.). (2011). Handbook of Vegetables and Vegetable Processing. Wiley-Blackwell. [776 pp.] - Hopkins, W. G., & Hüner, N. P. A. (2008). Introduction to Plant Physiology (4th ed.). John Wiley & Sons. [528 pp.] - Jain, S. M., & Ochatt, S. J. (Eds.). (2010). Protocols for In Vitro Propagation of Ornamental Plants (Methods in Molecular Biology, Vol. 589). Humana Press. [400 pp.] - Hartmann, H. T., Kester, D. E., Davies, F. T., & Geneve, R. L. (2011). Plant Propagation: Principles and Practices (8th ed.). Prentice Hall. [915 pp.] https://cazri.res.in/publications/PRathaKrishnan.pdf http://www.agritech.tnau.ac.in/horticulture/horti_Landscaping_nursery%20management.html https://egyankosh.ac.in/bitstream/123456789/73071/1/Unit-1.pdf https://rlbcau.ac.in/wp-content/uploads/2024/09/GBT-212-seed-technology-and-nursery-management-1.pdf					

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	2	2	1	2	1	2	2	2	1	3	2	3
CLO ₂	3	2	1	2	1	2	2	2	2	3	2	3
CLO ₃	2	3	2	3	2	2	2	3	1	3	2	3

CLO ₄	2	3	3	3	3	3	3	2	1	3	3	3
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Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	10
Entrepreneurship	12
Skill Enhancement	25
Communication Development	5
Indian Knowledge System	3
Environmental Awareness	8
Current Issues and Social Awareness	7
Gender issues	
Public policies	5
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available nursery plants, seeds, gardening tools, field sites, nursery materials, commercial samples, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	V		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Organic Farming		
Course Code	26L5.5-VOC-BOT-501		
Course Type	VOC-2 (for Scheme A & C)		
Course Level	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO ₁	Explain the principles, scope, importance, certification and management practices of organic farming.	
	CLO ₂	Describe soil health management, organic nutrient sources, biofertilizers, composting, vermicomposting and crop management practices in organic farming.	
	CLO ₃	Evaluate organic approaches for pest, disease, weed, water, waste and resource management with reference to sustainable agriculture.	
	CLO ₄	Develop practical skills in composting, vermicomposting, organic input preparation, nutrient comparison, pest-control assessment, field observation and organic farm documentation.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		Contact Hours
		CLO Attempt	

I	Organic Farming Basics: History, concept and importance of organic farming; principles, advantages, limitations and present status in India; organic farming as a sustainable alternative to chemical-based agriculture. Organic Certification and Standards: Organic certification process, record keeping and traceability; India Organic, PGS, IFOAM and USDA Organic standards; branding, labelling and consumer trust.	1	16
II	Soil Health and Organic Nutrient Management: Soil health and fertility management; organic matter, soil microorganisms, organic manures, compost, vermicompost, green manure, mulching and biofertilizers. Organic Crop Management: Selection of crops and planting material for organic farming; crop rotation, mixed cropping, intercropping, harvesting and organic agri-horticulture in urban and semi-urban areas.	2	14
III	Pest, Disease and Weed Management: Organic pest, disease and weed management; seed, seedling and soil treatment, biological control, botanical pesticides, cover crops, mulches and cultural or mechanical weed control. Sustainable and Socio-Economic Aspects: Water management through drip and sprinkler irrigation and rainwater harvesting; farm waste recycling, value addition, marketing, branding and labelling; role of organic farming in rural livelihoods, food security and social well-being.	3	15
Practical	Suggested laboratory and field studies of Organic Farming • Preparation and study of organic manures including compost and vermicompost using locally available biodegradable waste and study of farmyard manure, green manure and oil cakes using available samples or digital resources. • Study of biofertilizers and their applications including <i>Rhizobium</i>, <i>Azotobacter</i>, <i>Azospirillum</i>, phosphate-solubilizing bacteria and mycorrhiza using commercial products, charts, models or digital resources. • Study of organic nutrient management including comparison of organic and inorganic fertilizers through plant growth observations and estimation of nitrogen and phosphorus content using suitable laboratory methods where facilities are available; alternatively, demonstration or digital resources may be used. • Study of organic crop-management practices including mulching, green manuring, cover cropping, crop rotation, seed treatment, seedling treatment and soil treatment using field observations, demonstrations, charts or digital resources. • Study and demonstration of organic pest-management practices including neem extract, botanical pesticides, pheromone traps, sticky traps and biological control agents using available materials, demonstrations or digital resources. • Study of soil health under organic farming including observation or assessment of soil texture, pH, organic matter and moisture using available field or laboratory methods, demonstrations or digital resources. • Study of organic produce and post-harvest practices including harvesting, grading, storage, packaging and quality assessment of	1, 2, 3, 4	30

	organically grown crops using fresh produce, commercial samples, charts or digital resources. - Preparation of a brief project report on an organic farm, kitchen garden, terrace garden, nursery, vermicompost or composting unit or local organic-product enterprise. - Educational visit to an organic farm, vermicompost unit, biofertilizer unit, nursery, Krishi Vigyan Kendra, agricultural research station, farmers' field, organic market or relevant organization and preparation of a report with photographs depending upon institutional resources and permissions.		
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Total Contact Hours

75

Evaluation Methods

Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50	P-20
Class Participation:	05	0	Lab record	NA	05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA	05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50	NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA	10

Part C – Learning Resources**Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)**

- Chandran, S., Unni, M. R., Thomas, S., & Meena, D. K. (Eds.). (2023). Organic Farming: Global Perspectives and Methods (2nd ed.). Woodhead Publishing, Elsevier. [625 pp.]
- Somasundaram, E., Udhaya Nandhini, D., & Meyyappan, M. (2022). Principles of Organic Farming. CRC Press. [412 pp.]
- Chandran, S., Thomas, S., & Unni, M. R. (Eds.). (2019). Organic Farming: New Advances Towards Sustainable Agricultural Systems. Springer. [139 pp.]
- Sharma, A. K. (2001). A Handbook of Organic Farming. Agrobios India. [627 pp.]
- Hermery, H. (2007). Working with Nature: Shifting Paradigms. Gaia College Inc. [43 pp.]
- Lampkin, N. (1990). Organic Farming. Farming Press. [715 pp.]
- Subba Rao, N. S. (2017). Biofertilizers in Agriculture and Forestry (4th ed.). MedTech Publishers. [242 pp.]
- Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology and Biotechnology (5th ed.). New Age International. [632 pp.]
- Palaniappan, S. P., & Annadurai, K. (2022). Organic Farming: Theory and Practice (2nd ed.). Scientific Publishers. [321 pp.]
- Sharma, A. K. (2001). A Handbook of Organic Farming. Agrobios India. [627 pp.]
- <https://nconf.dac.gov.in/>
- <https://apeda.gov.in/OrganicProducts>
- https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Compilation_techniques_organic_agriculture_rev.pdf

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	PO₈	PSO₁	PSO₂	PSO₃	PSO₄
CLO ₁	2	2	1	2	1	1	1	3	1	3	1	3

CLO ₂	3	2	1	2	1	2	2	3	1	3	2	3
CLO ₃	2	3	2	3	2	2	2	3	1	3	2	3
CLO ₄	2	3	3	3	3	3	3	3	1	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	8
Entrepreneurship	10
Skill Enhancement	20
Communication Development	5
Indian Knowledge System	5
Environmental Awareness	14
Current Issues and Social Awareness	8
Gender issues	
Public policies	5
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available organic inputs, farm materials, composting materials, field sites, commercial samples, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.

Part A – Introduction			
Name of Programme	B.Sc. Life-Science		
Semester	VI		
Nature of Course/ Course Composition	Theory (Theory + Practical)		
Nomenclature of the Course	Mushroom Cultivation and Processing		
Course Code	26L5.5-VOC-BOT-601		
Course Type	VOC-3 (for Scheme A, B & C)		
Course Level	300-399		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs): After completing this course, the learner will be able to:	CLO₁	Explain the importance, types, nutritional value and basic requirements of edible mushroom cultivation.	
	CLO₂	Describe infrastructure, substrates, pure culture techniques, spawn preparation and bed preparation used in mushroom production.	
	CLO₃	Evaluate cultivation methods, harvesting, storage, pest and disease management, processing, marketing and enterprise potential of mushrooms.	
	CLO₄	Develop practical skills in media sterilization, spawn preparation, mushroom-bed preparation, cultivation, nutrient evaluation, mushroom processing and visit-based documentation.	
	Theory	Practical	Total
Credits	3	1	4
Teaching Hours per week	3	2	5
Internal Assessment Marks	25	05	30
End Term Exam Marks	50	20	70
Max. Marks	75	25	100
Examination Duration (in Hours)	3	2	
Part B – Contents of the Course			
<u>Instructions for Theory Paper-Setter</u> The paper setter shall prepare 7 questions selecting two questions from each of the three units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 4 short answer type questions carrying two marks each (total 08 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt four questions: the compulsory question no. 1 and 1 question from the each of the three units.			
<u>Instructions for Practical Examiner</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics		Contact Hours
		CLO Attempt	

I	Introduction to Mushroom Cultivation: History, importance and scope of mushroom cultivation; nutritional and medicinal value of edible mushrooms; major cultivated and poisonous mushrooms. Infrastructure and Spawn Production: Basic requirements for mushroom cultivation; preparation of culture medium, sterilization, pure culture maintenance and spawn preparation.	1	16
II	Mushroom Bed Preparation: Utilization of locally available agricultural wastes as mushroom substrates; substrate treatment, composting, moisture management and low-cost bed preparation. Cultivation Techniques: Mushroom cultivation methods including bed, bag and tray systems; spawning, incubation, cropping, watering, ventilation, humidity management and harvesting.	2	14
III	Nutritional Value and Post-Harvest Handling: Nutritional composition and food value of mushrooms; food preparations and post-harvest management including harvesting, cleaning, grading, packaging and storage. Pest, Disease and Enterprise Management: Common pests, diseases and contaminants of mushrooms; hygiene, preventive measures and basic management; cost-benefit analysis, marketing, value addition and entrepreneurship opportunities.	3	15
Practical	Suggested laboratory and field studies of Organic Farming - Study of edible and poisonous mushrooms including <i>Volvariella volvacea</i>, <i>Pleurotus citrinopileatus</i> and <i>Agaricus bisporus</i> with reference to identification, nutritional importance and mushroom safety using fresh or preserved specimens, photographs, charts or digital resources. - Study of mushroom cultivation infrastructure and substrates including thatched houses, racks, trays, bags, vessels, water sprayers, inoculation and sterilization tools and locally available substrates such as paddy straw, wheat straw, sugarcane trash, maize straw and banana leaves. - Preparation of mushroom culture and spawn including sterilization of media, preparation of culture medium, spawn preparation and spawn multiplication where facilities are available; alternatively, demonstration, virtual laboratory exercises or recorded demonstrations may be used. - Preparation and management of mushroom beds using suitable agricultural substrates and study of spawning, incubation, pinhead formation, fruiting body development and harvesting stages using live cultures, photographs or recorded demonstrations. - Study of mushroom nutrition and processing including estimation of total soluble sugars and protein content and preparation of dried mushroom powder with basic nutritional evaluation where facilities are available; alternatively, demonstration or digital resources may be used. - Study of mushroom value addition and quality management including dried mushrooms, mushroom powder, pickles, soup mixes and ready-to-cook products and identification of common pests, diseases and contaminants using commercial samples, photographs, charts or digital resources.	1, 2, 3, 4	30

- Preparation of a small-scale mushroom enterprise plan including cultivation records, substrate comparison, processing records, cost-benefit analysis and basic marketing strategy. - Educational visit to a mushroom cultivation unit, spawn production laboratory, Krishi Vigyan Kendra, agricultural research station, food-processing unit, farmers' production unit or mushroom enterprise and preparation of a report with photographs depending upon institutional resources and permissions.				
Total Contact Hours				75
Evaluation Methods				
Internal Assessment:30	Th-25	P-05	End Term Examination: 70	Th-50 P-20
Class Participation:	05	0	Lab record	NA 05
Seminar/ presentation/ assignment/ quiz/ class test etc.:	05	NA	Viva-Voce	NA 05
Seminar/ Demonstration/ Viva-voce/ Lab records etc.:	NA	05	Written Examination	50 NA
Mid-Term Exam:	15	NA	Write-up and execution of the practical	NA 10
Part C – Learning Resources				
Recommended Books/ Journals/ e-resources/ Learning Management Systems (LMS)				
- Bray, R. (2019). Mushroom Cultivation: 12 Ways to Become the MacGyver of Mushrooms. Independently Published. [146 pp.] - Kumaresan, V. (2018). Mushroom Cultivation. Saras Publication. [324 pp.] - Russell, S. (2014). The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane and Maitake Mushrooms at Home. Storey Publishing. [232 pp.] - Pathak, V. N., Yadav, N., & Gaur, M. (2010). Mushroom Production and Processing Technology. Agrobios India. [190 pp.] - Powell, M. (2015). Medicinal Mushrooms: A Clinical Guide. Mycology Press. [152 pp.] - Stamets, P., & Chilton, J. S. (1983). The Mushroom Cultivator: A Practical Guide to Growing Mushrooms at Home. Agarikon Press. [415 pp.] - Bahl, N. (2000). Handbook on Mushrooms. Oxford & IBH Publishing Co. Pvt. Ltd. [165 pp.] - Chang, S. T., & Miles, P. G. (2004). Mushrooms: Cultivation, Nutritional Value, Medicinal Effect and Environmental Impact (2nd ed.). CRC Press. [480 pp.] - Rai, R. D., Upadhyay, R. C., & Sharma, S. R. (Eds.). (2005). Frontiers in Mushroom Biotechnology. National Research Centre for Mushroom. [430 pp.] https://www.iihr.res.in/mushroom https://icar.org.in/node/5830 https://dmrsolan.icar.gov.in https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Mushroom_button_mushroom.html				

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	2	2	1	2	1	1	1	2	2	3	1	3
CLO ₂	3	2	1	2	1	2	2	2	2	3	2	3

CLO ₃	2	3	2	3	2	2	2	3	1	3	2	3
CLO ₄	2	3	3	3	3	3	3	2	1	3	3	3

Content Mapping with NEP thrust areas

Field	Designated Hrs.
Employability	10
Entrepreneurship	15
Skill Enhancement	25
Communication Development	5
Indian Knowledge System	3
Environmental Awareness	6
Current Issues and Social Awareness	7
Gender issues	
Public policies	4
Any Other	

Any other information

- Any other relevant practical may be conducted. Locally available substrates, edible mushrooms, cultivation materials, laboratory facilities, commercial samples, charts, models, digital resources, demonstrations and educational visits may be used depending upon seasonal availability and institutional resources.