GURU JAMBHESHWAR UNIVERSITY, MORADABAD
Department of Botany

Master of Science
Botany
(CBCS) NEP-2020
Effective from 2025

PG PROGRAMME CURRICULUM

GURU JAMBHESHWAR UNIVERSITY, MORADABAD
M.Sc. Botany CBCS
PROGRAMME STRUCTURE

1. Introduction:

The M.Sc. Botany program is meticulously crafted to provide students with comprehensive knowledge and technical expertise for studying plant life in an integrated and holistic manner. It offers a unique blend of foundational, advanced, and applied concepts in plant sciences, enriched through fieldwork, hands-on laboratory training, research exposure, digital tools, and professional internships. This multifaceted approach prepares students to become industry-ready professionals equipped for careers in academia, research, and various bio-industries, while also fostering self-employability and entrepreneurial capabilities.

In alignment with the National Education Policy (NEP) 2020 and the UGC Guidelines for Postgraduate Programs (2022–23 onwards), the curriculum is designed to be flexible, outcome-oriented, and relevant to current industry demands.

2. Program Rationale:

The M.Sc. Botany program is designed to provide students with a deep and holistic understanding of plant sciences, integrating classical botanical knowledge with modern scientific advancements. As plants form the foundation of life on Earth, their study is essential for addressing global challenges such as food security, climate change, biodiversity loss, and sustainable resource management.

This program emphasizes the ecological, physiological, biochemical, and molecular aspects of plant life, preparing students to contribute meaningfully to research, conservation, and industry. It fosters analytical thinking, field-based learning, and laboratory skills, enabling graduates to pursue careers in academia, environmental consultancy, agriculture, forestry, biotechnology, and policy-making.

Key highlights of the program include:

- Comprehensive Knowledge of Plant Diversity: Students explore taxonomy, evolution, and the ecological roles of plants across ecosystems.
- Understanding of Plant Physiology and Adaptations: The curriculum covers how plants respond to environmental stresses and adapt to diverse habitats.
- Integration of Modern Tools and Techniques: Training in molecular biology, plant tissue culture, bioinformatics, and phytochemistry equips students for advanced research and innovation.
- Application of Botany in Real-World: Contexts Learners apply ecological and botanical principles to solve problems in agriculture, conservation, and climate resilience.
- Skill Development for Self-Employment and Entrepreneurship: Modules on microbial applications, ethnobotany, biochemistry and sustainable practices encourage innovation and self-driven career paths.
- Promotion of Environmental Stewardship: The program instills values of biodiversity conservation and sustainable development through fieldwork and community engagement.

3. Alignment with NEP 2020 Framework

NEP Guideline	Program Implementation
Multiple Entry and Exit	Exit after 1year with PG Diploma (40 credits); re-entry permitted through ABC.
Credit Framework	86 credits over 4 semesters.
Academic Bank of Credits (ABC)	Full compliance with UGC (Establishment and Operation of ABC) Regulations, 2021.
Choice Based Credit System (CBCS)	Core, Elective, Open, and Skill Enhancement courses offered.
Experiential Learning	40–45% credits earned through internships, labs, and projects.
Interdisciplinary Exposure	Offers Skill Development Course, Discipline Specific Electives
Skill Development	Embedded labs on software, analytics, and communication.
Digital Learning	One course via SWAYAM/NPTEL (4 credits)
Holistic and Continuous Evaluation	Continuous internal assessment (50%) and end-semester evaluation (50%).

4. Programme Objectives:

M.Sc. in Botany is a comprehensive programme crafted to provide students with in-depth knowledge and practical expertise in plant sciences. It offers a balanced blend of core and elective courses, enriched with interdisciplinary perspectives, to ensure a holistic understanding of plant biology. Through exposure to state-of-the-art technologies and methodologies, students will explore plant evolution, ecological interactions, and the latest advancements in botanical research. The curriculum also emphasizes the vital role of plants in environmental sustainability and their impact on both national and global economic development.

5. Programme Specific Outcomes (PSOs):

i. The current syllabus integrates a diverse range of theoretical and practical components, including project work, field studies, and seminar presentations. This comprehensive approach is designed to deepen students' understanding of advanced concepts in Botany and equip them with hands-on experience in the field.

ii. Students will gain insights into the origins and historical development of various cultivated plants, exploring their economic significance and practical applications. The curriculum also emphasizes the sustainable use and conservation of natural resources, along with a comprehensive understanding of both renewable and non-renewable energy sources and their sustainable management.

iii. Graduates of the programme are equipped with advanced analytical techniques in plant biology and gain practical expertise in utilizing plants as industrial resources and as vital components of human livelihood. They are well-prepared to engage in both basic and applied research, contributing meaningfully to innovations and solutions in plant science.

iv. Graduates of the programme develop the ability to identify diverse plant life forms and are trained to design and conduct experiments across a broad spectrum of botanical disciplines. These include Phycology, Bryology, Microbiology, Plant Pathology, Pteridology, Gymnosperms, Paleobotany, Plant Systematics and Resource Utilization, Cell and Molecular Biology, Reproductive Biology, Morphogenesis, Tissue Culture, Plant Morphology, Anatomy, Biodiversity, Ecology, Environmental Science, Plant Physiology, Biochemistry, Genetics, Plant Breeding, Biostatistics, Plant Biotechnology and Intellectual Property Rights (IPR)**.** Students also gain proficiency in using bioinformatics tools and databases, and applying statistical methods to analyse biological research data to provide better solutions in specific manner such as in drug designing.

v. The course curriculum is structured to introduce students to key concepts in stress physiology, complemented by hands-on training in both theoretical and practical aspects of modern instrumentation. Additionally, students gain valuable experience in microbial and plant tissue culture techniques**,** enhancing their experimental and research capabilities in plant science.

vi. Upon completing the course, students are expected to possess practical skills in handling and operating essential laboratory instruments for experimental work. They will also develop foundational knowledge in experimental design, project management, and scientific writing. These competencies will support their ability to prepare project reports and enhance their proficiency in drafting research articles and academic notes for publication in scientific journals.

vii. Upon completing the course, students are equipped to undertake short-term research projects under supervision, applying a range of tools and techniques across core specializations in Plant Sciences. The hands-on experience fosters practical skills and prepares them for future academic or professional research endeavors.

viii. An M.Sc. in Botany paves the way for diverse career opportunities in academia and research, both nationally and internationally. Graduates may pursue roles as scientists, teaching faculty, or scholars, and are also well-prepared for various administrative and leadership positions within academic, governmental, or research institutions.

6. Eligibility Criteria:

Bachelor's Degree in Botany/Biosciences/agriculture or equivalent (10+2+3 system) with minimum 45% marks or as per University norms.

Admissions through **University Admission Process**/CUET-PG (as applicable).

7. Program Duration and Credit Structure:

Award	**Duration**	**Credits**	**Exit Option**
PG Diploma	1 Year (2 Semesters)	44	Exit after 2nd Semester
M.Sc. Botany (PG Degree)	2 Years (4 Semesters)	86	Final award

8. Program Structure (Semester-wise Distribution):

Coding Pattern- GJUBOT XYZ

Abbreviation		Specification
GJU		Guru Jambheshwar University
BOT		Department of Botany
Numeric	X	Year
	Y	0 = Core Course
		2 = Department Electives
		4 = Department Specific Elective
		5 = Laboratory
		6 = Project/Industrial Training
	Z	Semester (ODD/EVEN)

First Semester						
S.No.	**Code**	**Title of Paper**	**L**	**T**	**P**	**Total**
1	GJUBOT101	Phycology, Bryology and Lichens	4	0	0	4
2	GJUBOT103	Microbiology and Plant Pathology	4	0	0	4
3	GJUBOT105	Pteridology, Gymnosperms and Paleobotany	4	0	0	4
4	GJUBOT107	Plant Systematics and Resource Utilization	4	0	0	4
5	GJUBOT151	Lab.	0	0	8	4
6	GJU	Skill Development Based-I (Discipline Specific Elective-I)	2	0	0	2
		Total Credits in First Semester				**22**

Second Semester						
S.No.	**Code**	**Title of Paper**	**L**	**T**	**P**	**Total**
1	GJUBOT102	Cell and Molecular Biology	4	0	0	4
2	GJUBOT104	Plant Morphology, Anatomy and Reproductive Biology	4	0	0	4
3	GJUBOT106	Plant Physiology and Biochemistry	4	0	0	4
4	GJUBOT108/148	Biodiversity, Ecology and Environment	4	0	0	4
5	GJUBOT152	Lab.	0	0	8	4
6	GJU	Skill Development Based-II (Discipline Specific Elective-II)	2	0	0	2
		Total Credits in Second Semester				**22**

Professional Engagement (Industrial Training/Summer Training)
(6-8 weeks): 4 Credits (Will be given after Third Semester Evaluation)

Third Semester						
S.No.	**Code**	**Title of Paper**	**L**	**T**	**P**	**Total**
1	GJUBOT201	Genetics, Plant Breeding and Biostatistics	4	0	0	4
2	GJUBOT203	Plant Biotechnology, Bioinformatics and IPR	4	0	0	4
3	GJUBOT……	Department Elective	4	0	0	4
4	GJUBOT251	Lab.	0	0	8	4
5	GJUBOT261	Professional Engagement (Industrial Training/Summer Training)	0	0	4	4

6	GJU	Skill Development Based-III (Discipline Specific Elective-III)	2	0	0	2
					Total Credits in Third Semester	**22**

Department Electives (Any one of the followings):**

Third Semester					
Code	**Title of Paper**	**Credits in each open elective**			
		Theory	**Practical**	**Tutorial**	**Credits**
GJUBOT221	Plant Cell and Tissue Culture	4	0	0	4
GJUBOT223	Advanced Microbiology/ Microbial Technology	4	0	0	4
	Phyto techniques				
	Nanotechnology				

**** Offered to the students of Department of Botany**

Open Elective/Discipline Specific Elective Courses* (One to be selected out of the following offered):**

Third Semester					
Code	**Title of Paper**	**Credits in each open elective**			
		Theory	**Practical**	**Tutorial**	**Credits**
GJUBOT241	Climate Change and Ecosystem Function	4	0	0	4
GJUBOT243	Plant Curios – Fascinating Plants	4	0	0	4
GJUBOT245	Plants for Human Welfare	4	0	0	4
GJUBOT247	Plants, People and World History	4	0	0	4
GJUBOT249	Sustainable Development	4	0	0	4

*** Offered to the students from outside the Department of Botany**

Fourth Semester						
S.No.	**Code**	**Title of Paper**	**L**	**T**	**P**	**Total**
1	GJUMBOT262	Industrial Training/Project	0	0	16	16
2		MOOCs Online Mode Course	4	0	0	4
					Total Credits in Fourth Semester	**20**

9. Internship and Professional Practice:

- Professional Engagement (Industrial Training/Summer Training/Short Internship): After Semester II (6–8 weeks, 4 credits; Evaluated in 3rd Semester).
- Industrial Training/Project/Dissertation: Semester IV (16 credits).
- Each internship governed by a Learning Agreement signed by the student, industry mentor, and faculty supervisor.
- Evaluation (Joint): Industry (40%) + Faculty (40%) + Viva (20%)

10. Assessment and Evaluation:

Component	**Weightage**
Continuous Internal Assessment (Assignments, Seminars, Written Test)	50 %
End Semester Examination/Viva	50 %

Internship/Project Evaluation	As per joint assessment policy
Minimum Passing Grade	40% Marks in each paper 45% aggregate per Semester

- English shall be the medium of instruction and examination.
- Duration of Theory examination of each paper shall be 3 hours and of Practical examination shall be 4 hours.
- Each paper will be of 100 marks of which, 50 marks shall be allocated for end-semester theory examination, 50 marks for internal assessment and 100 marks for end-semester practical examination (50 Marks internal+50 Marks External).

Internal Assessment of students' performance shall consist of:

Component	Marks
Assignments/Seminars	10
Quiz (2)	5+5
Written tests (2)	10+10
Attendance	10

Thus, Internal assessment is evaluated for a maximum score of 50 marks in each paper. Of this, students are evaluated for 40 marks through assignments/seminars presentations, Quiz, written examinations. Percent attendance in theory and practical classes is used to award students a maximum of 10 marks based on the table given below:

Attendance	Marks
<50%	0
50 – 54.9%	1
55 – 59.9%	2
60 – 64.9%	3
65 – 69.9%	4
70 – 74.9%	5
75 – 79.9%	6
80 – 84.9%	7
85 – 89.9%	8
90 – 94.9%	9
95% and above	10

Attendance Requirement:

Attendance records are maintained by every faculty member separately for theory and practical classes in their paper/s. These are consolidated at the end of the semester to determine the percent attendance and allocation of marks as given above.

No student shall be considered to have pursued a regular course of study unless he/she is certified by the Head of the Department of Botany, Guru Jambheshwar University, Moradabad to have attended 75% of the total number of lectures/practicals and seminars conducted in each semester, during his/her course of study. Provided that he/she fulfills other conditions, the Head, Department of Botany, may permit a student to the next Semester who falls short of the required percentage of attendance by not more than 10% of the lectures/practicals and seminars conducted during the Semester.

11. Pedagogical Approach:

i. Experiential Learning: Field visits, case studies, simulation labs.
ii. Industry Integration: Guest lectures by Eminent Botanist and scientist.
iii. Research-Linked Learning: Mini-projects and dissertations.
iv. ICT-enabled Classes: Blended mode using LMS and SWAYAM MOOCs.

Skill Labs: Practical sessions in accounting, analytics, communication, and entrepreneurship.

12. Faculty and Infrastructure Requirements:

Category	Requirement
Faculty	Ph.D. Research exposure
Labs	As per the requirements of curriculum; supported with modern tools and software used in Plant Science
Library	Access to e-resources, Plant Science databases, Journals
Facilities	Smart classrooms, seminar halls, and internet-enabled terminals
Industry Partners	MSME units, NGOs, Start-ups, Research Organizations, Central Pollution Control Board (CPCD), Forest Department

13. Quality Assurance & Monitoring:

- Continuous review through Internal Quality Assurance Cell (IQAC).
- Industry-academia board for internship supervision.
- Semester-end feedback from students and mentors.
- Learning Outcome evaluation through OBE framework and CO–PO mapping.
- Adoption of transparent Assessment System
- Monitoring Internship and Project Quality
- Ensuring the Faculty Development
- Timely Accreditation Compliance
- Infrastructure and Resource Audit
- Stakeholder Involvement
- Annual Quality Reports

Quality assurance in the M.Sc. Botany program is a continuous and multi-dimensional process to ensure academic excellence, relevance, and effectiveness in training industry-ready graduates. The key mechanisms include:

Internal Quality Assurance Cell (IQAC): The program undergoes regular review and monitoring through the IQAC, which evaluates curriculum delivery, teaching methodologies, and learning outcomes to maintain high standards.

Industry-Academia Collaboration Board: A dedicated board that fosters partnerships with industries, research institutes, and NGOs to oversee internships, projects, and applicable real-world inputs for curriculum updates.

Continuous Feedback System: Semester-end feedback is obtained from students, alumni, faculty, and industry mentors to assess various aspects of the program such as course content, infrastructure and skill development.

Outcome-Based Education (OBE): The program employs outcome-based evaluation strategies, ensuring that learning objectives, program outcomes, and course outcomes are aligned and achieved.

Assessment Transparency: Multiple evaluation modes, including internal assessments (50%) and end-semester examinations (50%), promote transparency and fairness.

Monitoring Internship and Project Quality: Close supervision of internship and project work is done jointly by faculty and industry mentors to guarantee meaningful experiential learning.

Faculty Development: Regular training sessions and workshops for faculty to keep updated with new research, digital tools, and pedagogical methods.

Accreditation Compliance: The program complies with National Educational standards and accreditation requirements from UGC, NAAC, and NAAC's reference to NEP 2020 guidelines.

Infrastructure and Resource Audit: Regular audits of laboratories, library resources, digital facilities, and teaching aids ensure they meet program needs and technological advancements.

Stakeholder Involvement: Active engagement of all stakeholders in quality assurance decision-making for continuous program improvement.

Annual Quality Reports: Documentation and dissemination of quality reports to university authorities for informed decision-making and accountability.

14. SWOT Analysis:

Strengths:

- Strong applied learning through internships, lab work, and industry projects.
- Curriculum aligned with NEP 2020 and includes digital tools and MOOCs.
- Experienced faculty with research and industry collaboration.

Weaknesses:

- Need for ongoing faculty training in new technologies.
- Limited mentorship capacity in initial years.
- Dependence on external internship partners affecting uniformity.

Opportunities:

- Growing demand for plant science professionals in biotech and agriculture.
- Potential for entrepreneurship and startup incubation in agri-biotech.
- Expansion of interdisciplinary research and digital learning platforms.

Threats:

- Rapid technological changes may outpace curriculum updates.
- Competition from other life science programs.
- Funding challenges impacting labs and research projects

15. Approval and Implementation

- Effective Session: 2025–26
- Offered by: *Department of Botany*, Guru Jambheshwar University, Moradabad

- Mode: Regular/Full-Time
- Intake Capacity: 30 (As approved by Board of Studies)
- Medium of Instruction: English/Hindi (bilingual)
- Credit Registration: Through Academic Bank of Credits (ABC)

16. Annexures (for submission)

I. Detailed Course Outcomes (COs) & CO–PO Matrix
II. Internship Policy Document (Learning Agreement, Evaluation Templates)
III. Industry MOU Samples
IV. Faculty Qualification Data Sheet
V. Model Time Table & Evaluation Scheme

Annexure I

Program Outcomes (POs):

PO1: Equip the students with advanced knowledge of lower plant diversity (algae, fungi, bryophytes, and pteridophytes), their ecological roles, and prepare them for higher-level studies and research in this domain.

PO2: Enable students to gain foundational understanding of microbiological diversity, including viruses, and develop competencies in research methodologies, industrial applications, and pathological techniques.

PO3: Train students to identify angiosperm diversity in natural habitats, develop proficiency in herbarium techniques, recognize medicinal properties of plants, and apply knowledge in sustainable plant resource utilization. Additionally, digital tools and softwares used in modern days will help the students to understand applied aspects in better way.

PO4: Provide students with hands-on experience in various plant science techniques and foster a comprehensive understanding of disciplines such as ecology, cytology, physiology, biochemistry, genetics, molecular biology, recombinant DNA technology, proteomics, and transgenic technology. Additionally, students will be familiar with bioinformatics tools, biological databases, and statistical applications in plant science research. Students will also be able to design and execute botanical experiments effectively.

PO5. To equip the students with diverse career opportunities, enabling them to pursue research, enter the teaching profession, secure employment across various industries, or explore alternative professional pathways.

PO6: Foster critical thinking and creativity in students through active engagement in presentations, assignments, scientific writing, and project-based learning.

PO7: Support students in preparing for a wide range of competitive examinations, including Civil Services, ARS-NET, CSIR-NET, GATE, SET, and UGC-NET, by equipping them with relevant knowledge and skills.

SEMESTER: I

Course Outcomes (COs):

Course Code	Course Title	Course Outcomes (COs)	Mapped POs
	Phycology, Bryology and Lichens	CO1: Gain understanding of algae and bryophyte, lichen diversity, structure, reproduction, ecology, and their roles in the biosphere. CO2: Develop identification and classification skills for various phycological and bryological groups. CO3: Explore their significance in biotechnology, agriculture, and environmental sustainability.	PO1, PO5, PO6, PO7
	Microbiology and Plant Pathology	CO1: Learning about microorganisms affecting plant health and disease. CO2: Skills to apply microbial technologies in agriculture, environment, industry, and self-employment. CO3: Understand mechanisms of plant-pathogen interactions and disease management techniques. CO4: Develop practical skills in diagnosing and preventing plant diseases affecting crop yield.	PO2, PO4, PO5, PO7
	Pteridology, Gymnosperms and Paleobotany	CO1: Acquire knowledge about morphology, anatomy, and life cycles of pteridophytes and gymnosperms. CO2: Learning these plant groups builds ecological awareness and fosters biodiversity conservation efforts. CO3: Understand fossil plants and their evolutionary significance. CO4: Analyse plant diversity across geological epochs and recognize paleobotanical evidence.	PO1, PO4, PO5, PO7
	Plant Systematics and Resource Utilization	CO1: Gain expertise in identifying, classifying, and naming flowering plants. CO2: Understand principles of plant taxonomy and use modern tools for classification. CO3: Explore economically important plants and their role in human societies. CO4: Explore traditional plant uses and their relevance in modern medicine and biodiversity documentation.	PO3, PO5, PO6, PO7
	Lab.	CO1: Develop hands-on laboratory skills relevant to all above subjects. CO2: Practice experimental techniques and scientific report-writing.	PO4, PO5
	Skill Development Based-I	CO1: Enhance essential professional skills such as scientific communication, data collection and analysis, teamwork, and problem-solving. CO2: Apply botany knowledge for skill-based tasks and real-world applications.	PO3, PO5, PO6

Upon completion of the first semester, students will:

- Demonstrate advanced theoretical and practical knowledge in core botanical disciplines including phycology, bryology, lichenology, microbiology, plant pathology, pteridology, paleobotany, taxonomy, economic botany and ethnobotany.
- Integrate lab-based skills and professional competencies for effective scientific research, problem-solving, and communication in plant sciences.
- Develop critical thinking and technical expertise for sustainable management, biodiversity conservation, and future research or employability in botanically relevant sectors.

COURSE	**PO Alignment**	**Justification**	**Suggested Practical Activities**
CO1: Phycology, Bryology and Lichens	PO1, PO5, PO6, PO7	Students learn foundational knowledge of lower plant groups (PO1); Practical assignments/identification promote career skills (PO5); Classify, identify, and apply critical thinking (PO6); Knowledge will help to prepare for competitive exams (PO7)	Herbarium preparation, algal culture technique, microscopic studies, field tour reports
CO2: Microbiology and Plant Pathology	PO2, PO4, PO5, PO7	Theoretical understanding of plant pathogens (PO2); Lab diagnosis and analytical skills in microbiology (PO4); Use of microbial techniques prepares for employment/entrepreneurship (PO5); Knowledge will help to prepare for competitive exams (PO7)	Pathogen isolation, plant disease diagnosis and management, sterilization techniques, fermentation labs., Microbial culture, Mushroom Culture. Biomass production.
CO3: Pteridology, Gymnosperms and Paleobotany	PO1, PO4, PO5, PO7	Ecology/biodiversity theory applied (PO1); Fossil and anatomical analytical skills (PO4); Assignments connect degree to advanced research and jobs (PO5); Knowledge will help to prepare for competitive exams (PO7)	Fossil study, gymnosperm/pteridophyte slide preparation, diversity survey, Ornamental exploration, botanical tour
CO4: Plant Systematics and Resource Utilization	PO3, PO5, PO6, PO7	Theoretical and practical taxonomy concepts with economic importance (PO3); Case studies boost career readiness in botany/agriculture sectors (PO5); Plant identification develops analytical and research skills (PO6); Knowledge will help to prepare for competitive exams (PO7)	Taxonomy key use, economic plant review, field documentation, digital herbarium software, Ethnobotany

Skill Dev-I: Communication, teamwork, data analysis	PO3, PO5, PO6	Data analysis skill (PO3), Group tasks embed essential team and leadership skills (PO5); Writing and presenting develop communication and analytical thinking (PO6)	Group discussion, poster making, seminar presentation, assignment/project reports

SEMESTER: II

Course Outcomes (Cos):

Course Code	Course Title	Course Outcomes (COs)	Mapped POs
	Cell and Molecular Biology	CO1: Explain the structure, functions, and dynamics of cells and biomolecules in plants. CO2: Covers current understanding of plant cell architecture, from cell wall to chromatin, and their dynamic roles in cellular function. CO2: Apply molecular biology techniques for plant genetics, genomics, and biochemistry research. CO3: Interpret molecular mechanisms regulating plant development and responses.	PO4, PO5, PO6, PO7
	Plant Morphology, Anatomy and Reproductive biology	CO1: Describe reproductive organs, morphogenesis, and embryogenesis. CO2: learn key morphological traits of angiosperms that aid in their classification and identification. CO3: Utilize microscopy and histological techniques to interpret plant anatomy in relation to function and environment. CO4: Synthesize anatomical data for evolutionary and ecological insights into plant form and function.	PO3, PO4, PO5, PO6, PO7
	Plant Physiology and Biochemistry	CO1: Explain plant metabolic processes, regulatory mechanisms, and biochemical pathways fundamental to plant life. CO2: Assess physiological responses to environmental stimuli and stress, using experimental approaches. CO3: Apply advanced biochemical techniques to investigate molecular functions and interactions in plants.	PO4, PO5, PO6, PO7
	Biodiversity, Ecology and Environment	CO1: Evaluate the diversity, distribution, and conservation of plant species in natural ecosystems. CO2: Apply ecological principles to analyse interactions among plants, environment, and human influences. CO3: Address environmental challenges to develop strategies for sustainable practices and environmental stewardship.	PO1, PO4, PO5, PO6, PO7
	Lab.	CO1: Conduct practical experiments in molecular biology, tissue culture, anatomy, and ecology as per theoretical	PO4, PO5

		courses. CO2: Develop observation, measurement, and data analysis skills essential for botanical science.	
	Skill Development Based Elective II	CO1: Strengthen abilities in scientific writing, technical communication, and research presentation in life sciences. CO2: Prepare professional reports, participate in seminars, and engage in group discussions relevant to botany.	PO5, PO6

Upon completion of semester two, students will:

- Gain advanced expertise in molecular biology, reproductive plant biology, tissue culture techniques, ecological principles, and biodiversity assessment.
- Apply experimental, analytical, and professional skills necessary for botanical research, biotechnology, and ecosystem management.
- Demonstrate scientific communication and teamwork abilities to prepare for careers in research, academia, or industry.

COURSE	**PO Alignment**	**Justification**	**Suggested Practical Activities**
CO1: Cell and Molecular Biology	PO4, PO5, PO6, PO7	Cellular/Molecular study through practicals (PO4); Real-world applications and industry-ready hands-on tasks (PO5); Analytical exercises fuel research & problem-solving ability (PO6); Knowledge will help to prepare for competitive exams (PO7)	DNA isolation, molecular assay, microscopy, chromosome staining, genomics exercises, Protein synthesis, Molecular diagnosis
CO2: Plant Morphology, Anatomy and Reproductive biology	PO3, PO4, PO5, PO6, PO7	Field-based learning integrates morphological and anatomical concepts (PO3, PO4); Practical field/lab work supports research and employment (PO5); Analytical experiments and project work promote creativity and critical thinking (PO6); Knowledge will help to prepare for competitive exams (PO7)	Section cutting, plant part identification, anatomical slide preparation, Permanent Slide preparation
CO1: Plant physiology and biochemistry	PO4, PO5, PO6, PO7	Experimental lab skills build understanding of plant function under different conditions (PO4); Techniques like enzyme assay are job-relevant (PO5); Hypothesis testing builds analytical thinking (PO6); Knowledge will help to prepare for competitive exams (PO7)	Biochemical analysis, Enzyme assays, stress physiology experiment, data analysis, lab report writing
CO4: Biodiversity, Ecology and Environment	PO1, PO4, PO5, PO6, PO7	Environmental studies and biodiversity conservation theory/practice (PO1, PO4); Survey assignments enhance career opportunities (PO5); Research-driven field activity (PO6); Knowledge will help to prepare for competitive exams (PO7)	Biodiversity indexing, ecological survey, field work, research-based environmental projects

SEMESTER: III

Course Outcomes (COs):

Course Code	Course Title	Course Outcomes (COs)	Mapped POs
	Department Elective: Plant Cell and Tissue Culture	CO1: Master cell and tissue culture technique, media preparation and sterilization. CO2: Apply micropropagation and *in vitro* culture techniques for plant improvement like virus resistance. CO3: *in vitro* production of medicinally important compounds. CO4: Clonal propagation through tissue culture technique	PO4, PO5, PO6, PO7
	Department Elective: Advanced Microbiology	CO1: Explain advanced microbial diversity, genetics, and physiology CO2: Employ microbiological techniques for plant health, environmental and industrial role.	PO2, PO4, PO5
	Genetics, Plant Breeding and Biostatistics	CO1: Interpret principles of classical and modern genetics as they pertain to plant improvement and breeding. CO2: Employ statistical tools for genetic data analysis and decision-making in plant breeding experiments. CO3: Design and evaluate breeding protocols to enhance plant traits and yield.	PO4, PO5, PO6, PO7
	Plant Biotechnology, Bioinformatics and IPR	CO1: Analyse biotechnological methods such as genetic engineering, molecular cloning in the context of crop improvement and research. CO2: Utilize bioinformatics databases and tools for gene, genome, and protein analysis relevant to plant sciences. CO3: Demonstrate an understanding of intellectual property rights (IPR) in biotechnology and promote ethical research practices.	PO4, PO5, PO6, PO7
	Lab.	CO1: Execute experiments in physiology, biochemistry, genetics, biotechnology, and bioinformatics, reinforcing theoretical concepts with practical skill development. CO2: Collect, interpret, and communicate scientific data following standard lab protocols.	PO4, PO5
	Skill Based Elective III	CO1: Enhance scientific presentation, documentation, and communication skills for professional and academic contexts.	PO5, PO6

		CO2: Prepare for competitive exams, interviews, and continued learning in botanical and life sciences.	

Upon successful completion of semester three, students will:

- Demonstrate comprehensive understanding of advanced genetics, microbiology, breeding, biostatistics, biotechnology, and applied bioinformatics.
- Apply laboratory methods and practical approaches to reinforce concepts in plant cell culture, molecular biology, and biotechnology.
- Acquire expertise in genetics, plant breeding techniques, and biostatistics for scientific analysis and data-driven investigations
- Develop advanced skills in plant biotechnology, bioinformatics, and intellectual property rights to support research and innovation in plant sciences
- Demonstrate professional engagement through hands-on training, teamwork, and effective scientific communication in academic and industry settings
- Strengthen abilities in experimental planning, data collection, statistical interpretation, and the preparation of professional reports and presentations suitable for careers in research, teaching, and biotechnology sectors

COURSE	**PO Alignment**	**Justification**	**Suggested Practical Activities**
CO1: Department Elective: Plant Cell and Tissue Culture	PO4, PO5, PO6, PO7	Students learn hands-on in vitro techniques, mastering media preparation, sterilization, and plant regeneration vital for research and applied biotechnology (PO4); The practical skills gained create career opportunities in plant biotech industries, nurseries, and research institutions (PO5); Analytical experiments and project work promote creativity and critical thinking in solving plant propagation challenges (PO6); Students are well-prepared for competitive exams and interviews in plant tissue culture and biotechnology fields (PO7).	Media preparation, explant sterilization, micropropagation, tissue culture, organogenesis, somatic embryogenesis
Department Elective: Advanced Microbiology	PO2, PO4, PO5	The course provides a strong theoretical foundation in advanced microbial diversity, virology, and plant-microbe interactions (PO2); Students attain practical laboratory skills for isolating and analyzing microbes, mycorrhizae, and plant pathogens (PO4); Career-focused skills are developed, supporting roles in	Career-focused skills are developed, supporting roles in agriculture, microbiology, and biotechnology sectors.

		agriculture, microbiology, and biotechnology sectors (PO5)	
CO2: Genetics, Plant breeding and Biostatistics	PO4, PO5, PO6, PO7	Genetic crosses, statistical analysis sharpen analytical and research methods (PO4, PO6); Data analysis using biostatistical tools help in industry and higher research (PO5); Knowledge will help to prepare for competitive exams (PO7)	Cross-breeding simulation, genetic data analysis, Genetical disease, breeding project, biostatistics lab
CO3: Plant Biotechnology, Bioinformatics, IPR	PO4, PO5, PO6, PO7	Genetic engineering/bioinformatics labs promote technical/IT skills (PO4, PO6); Practical and Legal/ethical practice link degree to jobs/entrepreneurship (PO5); Knowledge will help to prepare for competitive exams	Genetic engineering, Recombinant DNA Technology, Bioinformatics practicals, GM crop case study, IPR seminar, molecular marker data analysis
Project Engagement/Summer Training	PO5, PO6	Industrial/professional training familiarizes students with workplace skills (PO5); Professional documentation/research project boosts analytical and research preparation (PO6)	Internship (industry/lab), analytical documentation, Preparation of reports, seminars
Skill Dev-III: Scientific writing, research presentation	PO5, PO6	Scientific communication practice for academic and job readiness (PO5); Academic writing/seminar increase analytical/research thinking (PO6)	Scientific article preparation, group seminar, peer review

Open Elective/Discipline Specific Elective Courses (Course Outcomes):

1. Climate Change and Ecosystem Function-

- Explain the fundamental concepts of climate science and global climate systems.
- Assess how climate change influences different ecosystem components and processes.
- Evaluate the socio-economic and ecological consequences of altered climate patterns.
- Examine adaptation and mitigation approaches for climate-related challenges.
- Interpret data and case studies related to ecosystem responses to climate change.
- Critically discuss the role of policy and community action in climate resilience.

2. Plant Curios – Fascinating Plants-

- Identify and describe a wide variety of unusual and rare plant species worldwide.
- Explore unique adaptations and survival strategies of fascinating plants.
- Analyse the ecological functions and evolutionary significance of these plants.

- Explain the use and symbolism of remarkable plants in various cultures.
- Discuss conservation issues concerning unique and rare plant species.
- Collect and present case studies of notable fascinating plants.

3. Plants for Human Welfare-

- Illustrate the role of plants in providing food, shelter, medicine, and clothing.
- Examine plants with significant pharmacological and nutraceutical value.
- Assess traditional and modern uses of plants in different societies.
- Evaluate sustainable practices in the utilization of plant resources for welfare.
- Discuss the socio-economic impacts of plants on community health and development.
- Critically reflect on challenges related to plant bioprospecting and intellectual property

4. Plants, People and World History-

- Trace the historical significance of plants in shaping civilizations and economies.
- Analyse the impact of key plant species on global trade, migration, and colonization.
- Examine botanical influences in art, literature, and technological advances.
- Explore the development of agriculture and domestication of plants over time.
- Discuss case studies where plants influenced social and political change.
- Interpret primary sources and artifacts to connect botanical history with human development

5. Sustainable Development-

- Define and describe the core principles and objectives of sustainable development.
- Analyse the interactions between ecological integrity, economic growth, and social equity.
- Identify challenges and barriers to sustainable resource management at local, national, and global levels.
- Evaluate case studies on sustainable agriculture, urban development, or water management.
- Propose integrative strategies for balancing conservation with development needs.
- Explain the role of policy, education, and community participation in achieving sustainability.
- Critically discuss the impact of global agreements (e.g., SDGs, COP) on environmental management.
- Assess innovative technologies and traditional practices that promote sustainability

CO PO Mapping Matrix (Aggregate)

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7

Annexure II:

Internship & Professional Practice Policy
Program: Master of Science (M.Sc.) Botany
University: Guru Jambheshwar University, Moradabad
Duration: 2 Years (4 Semesters)
Faculty: Faculty of Pure Sciences

1. Introduction:

The Internship & Professional Practice Policy for M.Sc. Botany integrates academic learning with practical botanical, environmental and Industrial experience. It aims to provide hands-on exposure to plant sciences, research methodologies, environmental management, biotechnology, agriculture and related fields. This policy aligns with the National Education Policy (NEP) 2020 to enhance employability, research acumen, innovation, and sustainability competence among students.

2. Objectives of Internship:

- Provide practical exposure to botanical research labs, greenhouses, field studies, and industry settings.
- Apply theoretical knowledge in real-world plant science and environmental contexts.
- Develop professional, analytical, and scientific communication skills.
- Build awareness of ethical, sustainable, and ecological responsibilities.
- Enhance employability in agriculture, biotechnology, environmental consulting, and academia.
- Strengthen collaboration between academia, research institutions, and industry.

3. Structure of Internship and Professional Practice:

Semester	Course Title	Type	Duration	Credits	Evaluation
Semester II	Summer Internship	Full-time	6–8 weeks	4	Joint Internal & External
Semester IV	Major Industry Internship/Dissertation	Full-time	12–16 weeks	16	Industry + University Viva

4. Internship Framework:

4.1 Pre-Internship Phase

- Orientation sessions on internship objectives, ethics, and communication.
- Training on laboratory safety, fieldwork protocols, data collection, and reporting skills.
- Signing of Learning Agreement among student, faculty mentor, and industry/research supervisor.
- Assignment of Faculty Mentor and Industry/Research Supervisor.

4.2 During Internship

- Maintain a Daily Work Logbook documenting tasks, observations, and learning outcomes.

- Bi-weekly review meetings with Faculty Mentor (online/offline).
- Mid-term internship progress evaluation.
- Interaction with researchers, environmental officers, biotechnologists for multi-disciplinary exposure.

4.3 Post-Internship

- Submission of Internship Report (typed, 30–40 pages) including methodology, results, observations, and conclusions.
- Presentation & Viva-Voce before a panel of faculty and industry/research experts.
- Feedback from the host organization/research center on student performance.

5. Learning Agreement (Template):

Guru Jambheshwar University, Moradabad

Faculty of Pure Sciences

M.Sc. Botany Internship Learning Agreement:

Section	**Details**
Student Name:	
Enrollment No.:	
Program/Semester:	M.Sc. Botany / Semester II / IV
Host Organization:	
Internship Duration:	From ___ to ___
Industry/Research Supervisor:	Name, Designation, Contact
Faculty Mentor:	Name, Department
Title of Work / Project:	
Learning Goals:	1. Gain practical research experience in plant sciences.
	2. Apply theoretical botanical knowledge to real-world problems.
	3. Develop scientific communication, data analysis and ethical research skills.
	4. Contribute to host institution's research or fieldwork objectives.
Expected Outcomes:	Internship report, presentation, organization feedback, and certificate.
Signatures:	Student _____ Faculty Mentor _____ Supervisor _____

6. Internship Logbook (Template)

Date/Week	Work/Task Performed	Learning Outcome	Remarks (Mentor)
Week 1	Orientation and lab safety	Awareness of lab equipment and safety	
Week 2	Sample collection in field	Practical field data collection skills	
Week 3	Plant tissue culture techniques	Understanding sterilization techniques	
...	...	...	

Signature of Industry/Research Supervisor: _____ Date: _____

7. Internship Report (Suggested Structure):

1. Title Page
2. Certificate from Host Organization
3. Acknowledgement
4. Index
5. Introduction
6. Objectives
7. Review of Literature
8. Material and Methods
9. Observations
10. Result and Discussion/Result Analysis
11. Conclusion
12. Summary/ Learning Outcomes
13. Future Prospectives
14. References
15. Annexures (like Statistical data analysis sheet, Presented and Published Research Papers etc.)

8. Evaluation Scheme:

Component	Weightage (%)	Evaluated By
Attendance and Punctuality	10	Industry/Research Supervisor
Quality of Work	25	Industry/Research Supervisor
Logbook Maintenance	10	Faculty Mentor
Mid-term Review	10	Faculty Mentor
Internship Report	20	Faculty + Industry/Research
Presentation & Viva	25	Joint Evaluation Committee
Total	**100%**	

9. Roles and Responsibilities:

9.1 Student

- Maintain professionalism, confidentiality, and ethical research conduct.
- Adhere to working hours, laboratory, and field safety protocols.
- Maintain accurate daily logbook and submit report as per deadlines.

9.2 Faculty Mentor

- Guide students in selecting internship projects and setting goals.
- Monitor student progress through reviews and evaluations.
- Liaise with host organizations/research centers.

9.3 Industry/Research Supervisor

- Provide meaningful work assignments and mentorship.
- Monitor student attendance, progress, and practical skills.
- Provide feedback and issue internship completion certificate.

9.4 Department/University

- Approve internship organizations and projects.
- Organize pre-internship orientations and workshops.
- Maintain internship records and coordinate evaluations.

10. Assessment Rubric (Outcomes-Based Evaluation):

Performance Indicator	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Poor (1)
Knowledge Application	Applies concepts thoroughly to real-world botanical problems	Demonstrates good understanding	Average understanding	Partial understanding	Unable to apply knowledge
Professional Skills	Excellent communication, teamwork, and research ethics	Effective collaboration	Average skills	Needs guidance	Ineffective
Technical Competence	Expert use of lab and digital tools	Adequate competence	Basic knowledge	Limited understanding	Not competent
Innovation & Initiative	Proposes new ideas and improvements	Demonstrates initiative	Performs assigned tasks	Passive involvement	No initiative
Ethical Behavior	Consistently ethical and responsible	Generally ethical	Occasionally careless	Neglectful	Unethical

11. Integration with Academic Credits:

- Internship grades will be reflected in the semester mark sheet.

- Degree awarded only after satisfactory internship completion.
- Self-arranged internships may be permitted with prior approval.
- International or virtual internships may be considered equivalent if approved and documented.

12. Key Expected Outcomes (Internship Learning Indicators):

1. Practical skills in botanical research, analysis, and environmental fieldwork.
2. Application of plant science theories in real-world contexts.
3. Professional research communication and scientific report writing.
4. Ethical awareness and commitment to sustainability in botanical sciences.
5. Employability skills in academia, research, environmental agencies, and biotech industries.

Methodology

The M.Sc. Botany program adopts a "Learn – Apply – Reflect – Create – Share – Improve" approach:

- **Learn:** Classroom lectures, lab demonstrations, and theoretical study of plant sciences.
- **Apply:** Hands-on practices in labs, greenhouses, and field settings.
- **Reflect:** Critical analysis of experiments and field data.
- **Create:** Research projects, capstone dissertations developing novel findings.
- **Share:** Presentations, seminars, and scientific discussions.
- **Improve:** Continuous feedback-based refinement of skills and knowledge.