

P. D. E. A's
Prof. Ramkrishna More Arts, Commerce and Science
College Akurdi Pune-411044
(Autonomous)

Affiliated to



Savitribai Phule Pune University [SPPU]



B. Sc. With Major Botany
(Three years B. Sc. in Botany / Four Years Honors in Botany)

Choice Based Credit System-2024 Pattern
Under
Autonomy and NEP-2020

From Academic Year
2025-2026

Syllabus

T. Y. B. Sc. With Major Botany

Board of Studies in Botany
Department of Botany
Prof. Ramkrishna More Arts, Commerce and Science
College Akurdi Pune-411044

Rules and Regulations

1. National Credit Framework (NCrF): For creditisation and integration of all higher education qualifications leading to a certificate/ diploma/ degree with multiple entry and exit options, college will refer to National Credit Framework (NCrF) which encompasses the qualification frameworks for higher education, vocational and skill education and school education, namely National Higher Education Qualification Framework (NHEQF), National Skills Qualification Framework (NSQF) and National School Education Qualification Framework (NSEQF) respectively.

2. Structure of Four years multidisciplinary UG Programme and Five Years Integrated Multidisciplinary Master's Degree Programmes with Multiple Entry and Exit Options at Different Levels:

- (i) Students will have the flexibility to enter four years multidisciplinary Under Graduate Programme in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs.
- (ii) Students will get a Certificate after a One year programme (minimum 40 Credits), a Diploma after two years (minimum 80 Credits), a Bachelor's degree after three years (minimum 120 Credits), and a Bachelor's degree with Research or Honours after Four years (minimum 160 Credits).

3. Qualification Type and Credit Requirements of Four Years Multidisciplinary Degree Programme with Multiple Entry and Exit Options

- (i) Details of qualifications, minimum credit requirements, exit credit courses, year and semester are as under:

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Years Bachelor's degree	120	132	6	3
6.0	Bachelor's degree Honour's with Major	160	176	8	4
	Bachelor's degree Honour's with Major	160	176	8	4
7.0	Master's Degree	200	220	10	5
8.0	Ph. D.	----	-----	-----	----

- (ii) An exit 6-credit bridge course(s) lasting two months, including at least 6-credit job specific internship/apprenticeship that will help the graduates acquire job-ready competencies required to enter the workforce will be an additional requirement for the award of the undergraduate Certificate/ Diploma/ three year Bachelor's Degree.
- (iii) On exit, the students will have the option to re-enter the programme in the college, or in a different higher education institution. Re-entry at various levels for lateral entrants in academic programmes should be based on the earned and valid credits as deposited and accumulated in the Academic Bank of Credits (ABC) through Registered Higher Education Institutions (RHEI) and proficiency test records.
- (iv) Eligibility for admission to the fourth year of four-year **Honours with Research Degree Programmes** as per UGC guidelines: Minimum CGPA of 7.5 or minimum 75% at three-year degree.
- (v) PG curriculum, as illustrated below, have flexibility a) One-year Post-Graduate Diploma (PGD), b) Two year Post-graduate Programme and c) 5 Years Master's degree programmes with multiple Entry and Exit options at different levels.
- (a) Post-Graduate Diploma (PGD):** Programme duration- One year (2 semesters) after any bachelor's degree, min. 40 credits
- (i) UGC: 1-Year (2 semesters) Post-Graduate Diploma (PGD) after 3-years Bachelor's degree:

Level 6.0

- (ii) UGC: 1-Year (2 semesters) PGD after 4 years Bachelor's degree (Honors/ Research): Level 6.5

(b) Master's Degree:

- (i) UGC: 2-Years (four semesters) Master's Degree after obtaining a 3-years Bachelor's degree, Minimum 40 credits/year, second year devoted entirely to research, PG – 2nd year: Level 6.5

OR

- (i) 1-Year (two semesters) Master's Degree after obtaining a 4-year Bachelor's degree (Honours/Research): Minimum 40 credits: Level 6.5
- (c) Level 8 represents Ph. D. Research Degree.
- (d) A 5-year Integrated Bachelor's and Master's programme shall have a minimum of 220 credits.
- (e) Master's and doctoral programmes, while providing rigorous research-based specialization, should also provide opportunities for multidisciplinary work, in academia, government, research institutions, and industry.

4. Lateral Entry/ Re-entry at higher Levels after exit from lower levels of four years

multidisciplinary UG degree programme:

- (i) The credit points earned and accumulated shall be used to determine the eligibility for taking admission to various programs at multiple levels, subject to fulfilment of the broad principles laid down under NCrF. Students who leave with a Certification, Diploma, or a Basic Bachelor's Degree will be eligible to re-enter the programme at the exit level to complete or progress to the next level through lateral entry mode. Depending upon the academic and physical facilities available, the State Universities/ Autonomous Colleges (Higher Education Institutions or HEI) may earmark specific seats/ intake for lateral entry into the second year/ third year/ fourth year of a four years multidisciplinary UG degree programme as approved by Professional Standard Setting Bodies (PSSB/Govt. of Maharashtra/ statutory council of affiliating University plus any consequential vacancies caused by exits to an ongoing programme (four-year Degree Programme and Integrated Master's or second year Master's). Lateral entry or Re-entry is open to those students if he/she has either –
- (a) successfully completed the first year/second year/third year of the particular four years multidisciplinary degree programme in any ABC registered HEI with valid credits in ABC and re-entering into the second year/third year/fourth year, respectively of the same four years degree programme of any ABC registered HEI, within stipulated/ permissible period of years as decided by Statutory Councils of that HEI

OR

- (b) Already successfully completed a multidisciplinary four-year first-degree programme and is desirous of and academically capable of pursuing another multidisciplinary four years first-degree programme in an allied subject.
- (ii) A student will be allowed to enter/re-enter only at the odd semester. Re-entry at various levels for lateral entrants in academic programmes should be based on the earned and valid credits as deposited and accumulated in Academic Bank of Credits (ABC) through Registered Higher Education Institutions (RHEI) and proficiency test records. However, in terms of the admission eligibility requirements, the student shall belong to the same faculty/ discipline in terms of Major Subject i.e., the Major subject of his earlier Programme and the Major subject of the new Programme for which he is seeking admission must be from the same faculty/discipline. Reservation for lateral entry will be executed as per the Government of Maharashtra norms.

5. Distribution of Credits across Multidisciplinary Four Years Degree Programme:

- (i) Four-year multidisciplinary degree programme with Honours/ Specialization Degree will have Internship and Core /Major Courses with a minimum of 22 credits per sem. in the Fourth Year.
- (ii) Four-year multidisciplinary degree programme with Research will have Research Projects, Seminars, Dissertations and Internships with a minimum of 22 credits per Sem. in the Fourth Year.
- (iii) Students shall select a 'Major or Core Subject/ Discipline' and a '**Minor Subject/Discipline**'

from the lists of various Subject Combinations and Options provided the Colleges. In general, for the four years multidisciplinary bachelor's degree programme, the distribution of credits will be as follows:

- (a) Disciplinary/interdisciplinary Major/ Core Subject (minimum of 68 credits)- Mandatory and Elective Courses
- (b) Disciplinary/interdisciplinary Minor Subject (maximum of 22 credits)
- (c) Skill based/Vocational studies corresponding to the Major/ Core Subject (8 credits)
- (d) Field projects/internship/apprenticeship/community engagement and service corresponding to the Major/ Core Subject (14-22 credits) with a maximum of six credits per Semester
- (e) Generic/ Open Electives through Baskets of Elective Courses (12 credits),
- (f) Ability Enhancement Courses including Languages, Literature and Environmental Studies (12 credits),
- (g) In-built modules on the Indian Knowledge System (IKS) in Major/ Core Subject at Level 4.5 – 2 credits
- (h) Value-based Education, Life Skills and Professional Ethics: Co-curricular Courses such as Sports and Culture, NSS/NCC and Fine/ Applied/Visual Arts (8 credits).

Student can earn some credits (SEC/VSC/GE/OE) in the form of online from-

- (i) The National Skills Qualifications Framework (NSQF) organizes qualifications for Vocational and Skill Courses in a series of 8 levels based on professional knowledge, professional skills, core skills and responsibilities, in the increasing order of complexity and competency.
- (ii) University Grants Commission (Credit Framework For Online Learning Courses through Study Webs of Active-Learning for Young Aspiring Minds) Regulations, 2021, **permits up to 40 per cent of the total courses being offered in a particular programme in a semester through the Online Learning Courses offered through the Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) platform.**

6. Examination and Assessment Process:

- (i) The basic principle of the credit framework is that credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- (ii) Exit options are provided with certification, diploma and basic Bachelor's degrees to the students at the end of the second, fourth and sixth semesters of a four years multidisciplinary degree programme. Students will receive a Bachelor's degree with Honours/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- (iii) For the smooth success of four-year multidisciplinary degree programme with multiple entry and exit systems, the examination mode will be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes. This is in line with the UGC Report on 'Evaluation Reforms in Higher Educational Institutions (2019)'.

(iv) Evaluation of each students in each course will be done as follows

- a. Each theory or practical course will be of 2 credits = 50 marks
- b. Internal evaluation 30% weightage (15 marks)
- c. External evaluation 70% weightage (35 marks)
- d. Students should secure 40% marks in each type of evaluation for successful completion of a course (student should secure at least 6 marks in internal and 14 marks in external evaluation).

(v) Evaluation Pattern.

- a. **Internal evaluation** - Two written test, each of 20 marks will be conducted i. e. two tests on two modules. 1st assignment after completing 6 weeks of teaching and 2nd on completion of 13th week of teaching. 5 marks out of 15 will be assigned from these written tests. Remaining 10 marks will be assigned from other types of evaluation such as seminars, orals, poster presentation, open book challenging tests, surprise test, objective

test etc. Examination (Internal and external) will conducted so that CO, PO, PSO can be evaluated.

b. External Evaluation - External evaluation will be done at the end of each semester.

- i. For theory, 35 marks written examination will be conducted and time of examination will be 2-hours.
- ii. For practical, 35 marks practical examination will be conducted and time of examination will be 4-hours.
- iii. For project / field project, 35 marks evaluation will done on the basis of viva-voce and examination of thesis by the examiners.
- iv. For OJT 35 marks evaluation will be done on the basis of report of industrial mentor / supervisor / industry and viva-voce. However, student has to produce and submit OJT certificate from competent authority of industry.

7. Attendance: The student must have at least 70% attendance, to appear any type of examination.

8. Declaration of Results:

- (i) Declaration of result is based on the Semester Grade Point Average (SGPA) earned towards the end of each semester or the Cumulative Grade Point Average (CGPA) earned at the completion of all eight semesters of the programme and the corresponding overall alpha-sign or letter grades as given in Table 2. If some candidates exit at the completion of the first, second or third year of the four years Undergraduate Programmes, with Certificate, Diploma or Basic Degree, respectively, then the results of successful candidates at the end of the second, fourth or sixth semesters shall also be classified on the basis of the CGPA obtained in the two, four, six or eight semesters, respectively. Successful candidates at the end of the tenth semester of the integrated Master's Degree Programmes shall also be classified on the basis of CGPA obtained in the ten semesters of the Programmes. Likewise, the successful candidates of one year or two semesters Master's Degree Programme are also classified on the basis of the CGPA of two semesters of the Master's Degree Programme.

Table-2: Grades on degree certificate/mark sheet will be assigned to the students as per the following table

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result
9.00-10.00	90-100	O (outstanding)
8.00 - <9.00	80.00 – <90.00	A+ (Excellent)
7.00 - <8.00	70.00-<80.00	A (Very Good)
6.00 - <7.00	60.00-<70.00	B+ (Good)
5.50 - <6.00	55.00-<60.00	B (Above Average)
5.00 - <5.50	50.00-<55.00	C (Average)
4.00 - <5.00	40.00-<50.00	P (Pass)
Below 4.00	< 40	F (Fail)
Ab	-----	Absent

- (ii) A student obtaining Grade F shall be considered failed and will be required to reappear in the examination. For non-credit courses 'Satisfactory' or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

9. Award of Major and Minor Degree:

- (i) A student pursuing four-year multidisciplinary UG programme will be awarded an appropriate Honours/ Research degree in Major/ Core Subject on completion of VIII Semester with the minimum of 176 credits if he secures in that Subject at least 50% of the total credits for that programme. He shall thus study the specific number of Mandatory Core Courses, Core Electives, Vocational and Skill Courses and Field projects/ Internships connected to Core Subjects in eight semesters so as to cover at least 50% of the total credits.
- (ii) In case of Research Degree, a student shall pursue research project and write dissertation in that Major in the VII and VIII semesters.

On the basis of above rules and regulations under NEP-2020 following course frame work is adopted by the Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune-411044 for the completing of four years honours degree in Major and Minor subjects.

10. Distribution of Credits across Four Years Degree Programmes:

In general, for the four years' bachelor's degree programme, the distribution of credits will be as follows:

(a) Major (Core) Subject comprising Mandatory and Elective Courses:

- i. Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses offered in all Four years;
- ii. 2 credit course on Major Specific IKS shall be included under Major;
- iii. Elective courses of Major will be offered in the third and/or final year.
- iv. Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects connected to Major first to fourth year.

(b) Minor Subject: 18-20 Credits

- i. The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether.
- ii. The credits of Minor subjects shall be completed in the first three years of UG Programme.

(c) Generic/ Open Elective Courses (OE): 10-12 credits

- i. It is to be offered in I and/or II year
- ii. Faculty-wise baskets of OE shall be prepared by University/ Autonomous Colleges.
- iii. OE is to be chosen compulsorily from faculty other than that of the Major.

(d) Vocational and Skill Enhancement Courses (VSEC): 14-16 credits

Vocational Skill Courses (VSC): 8-10 credits, including Hands on Training corresponding to the Major and/or Minor Subject:

- i. To be offered in first to three years;
- ii. Wherever applicable vocational courses will include skills based on advanced laboratory practicals of Major

Skill Enhancement Courses (SEC): 06 credits

- i. To be offered in I and II year;
- ii. To be selected from the basket of Skill Courses approved by University/ Autonomous Colleges

(e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): 14 Credits

• AEC: 08 credits

- i. To be offered in I and II year
 - ii. English: 04 Credits
 - iii. Modern Indian Language: 04 credits
 - iv. To be offered from the Basket approved by the College;
- The focus for both languages should be on linguistic and communication skills.

o IKS: 2 Credits

- i. To be offered in I Year
- ii. Courses on IKS to be selected from the basket of IKS courses approved by the Colleges

o VEC: 04 Credits

- i. To be offered in I year
- ii. Value Education Courses (VEC) Environmental Science Education (Compulsory), Understanding India, and Digital and Technological Solutions.

(f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

o Internship/Apprenticeship corresponding to the Major (Core) Subject: 8 Credits

o Field Projects/Community Engagement and Service corresponding to the Major (Core) Subject: minimum 4-6 credits

To be offered in II, and III years of UG Degree Programmes.

o Co-curricular Courses (CC) such as Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts: 8 credits. To be

offered in I and/or II year

o Research Projects: 12 credits

To be offered in the final year for 4-year Honours with Research UG Degree

The UGC Regulations, 2021 permit up to 40% of the total courses being offered in a particular programme in a semester through the Online Learning Courses offered through the SWAYAM platform and/or other State Level Common Platforms which can be developed in due course with the participation of different Universities/ HEIs.

Abbreviations: Generic/ Open Electives: **GE/OE**; Vocational Skill and Skill Enhancement Courses: **VSEC**; Vocational Skill Courses: **VSC**; Skill Enhancement Courses: **SEC**; Ability Enhancement Courses: **AEC**; Indian Knowledge System: **IKS**; Value Education Courses: **VEC**; **OJT**: On Job Training; Internship/ Apprenticeship; Field projects: **FP**; Community engagement and service: **CEP**; Co-curricular Courses: **CC**; Research Methodology-**RM**; Research Project: **RP** Note: The Credit Distribution Table given above is illustrative only. The Universities/ Autonomous Colleges may suitably modify within the broader framework of credit distribution across six verticals.

11. Definitions:

i. One semester = 15 weeks

ii. 1-credit theory = 15 hours i.e. for 1 credit, 1 hour per week teaching is to be performed.

15 hours of 1-credit are splinted as 12 hours actual teaching + 3 hours Tutorial (Numerical problem solving sessions, revision on difficult topics, dialog on student's difficulties, and internal evaluation)

iii. 1-credit practical = 30 hours. Thus, 1 credit practical = 2 contact hours in laboratory per week. 30 hours splinted as 24 hours actual table work and 6 hours for journal competition, oral on each practical and other internal evaluation.

iv. Each theory course of any type (major, minor, VSC, VEC, OE/GE, VEC, SEC, CC, etc.) **is of 2 credits.**

v. Theory per semester: Each theory course is of 2 credits. Thus, for each theory course contact hours = 24 teaching + 6 tutorials

vi. Each practical course is of 2 credits = 60 hours per semester

a. Minimum 12 laboratory sessions will be conducted in one semester.

b. Each laboratory sessions will be of 4 hour.

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Graduate and Honors Degree Course Framework under Autonomy as per NEP-2023

Sem.	Major Courses	Major Elective Courses	Minor Courses	VSC	IKS	FP/OJT/CEP	GE/OE	SEC	AEC	VEC	CC	Total Credits
First Year Certificate Course												
I	2 theory + 1 Practical	0	0	1 Theory	1 Theory	0	1 theory + 1 Practical	1 theory/ practical	1 theory	1 theory	2 Credit	22
II	2 theory + 1 Practical	0	1 Theory	1 Practical	0	0	1 theory + 1 Practical	1 theory/ practical	1 theory	1 theory	2 Credit	22
Second Year Graduate Diploma												
III	3 theory + 1 Practical	0	1 Theory + 1 Practical	1 Theory	0	FP (2 Credit)	1 theory	0	1 theory		2 Credit	22
IV	3 theory + 1 Practical	0	1 Theory + 1 Practical	0	0	CEP (2 Credit)	1 Practical	1 theory/ practical	1 theory		2 Credit	22
Third Year Graduate Degree												
V	3 theory + 2 Practical	1 Theory + 1 Practical	1 Theory + 1 Practical	1 Practical	0	FP/CEP (2 Credit)	0	0	0	0	0	22
VI	3 theory + 2 Practical	1 Theory + 1 Practical	1 Theory + 1 Practical	0	0	OJT (4 Credit)	0	0	0	0	0	22
VII and VIII Semester honours degree with major												
VII	5 theory + 2 Practical	1 Theory + 1 Practical	RM 4 Credits	0	0	0		0	0	0	0	22
VIII	5 theory + 2 Practical	1 Theory + 1 Practical	0	0	0	OJT (4 Credit)	0	0	0	0	0	22
VII and VIII Semester honours degree with research												
VII	4 theory + 1 Practical	1 Theory + 1 Practical	RM 4 Credits	0	0	RP (4 Credit)	0	0	0	0	0	22
VIII	4 theory + 1 Practical	1 Theory + 1 Practical	0	0	0	RP (8 Credit)	0	0	0	0	0	22

Year	Sem	Major Courses	Major Elective Courses	Minor Courses	VSC	IKS	GE /OE	SEC
FY	I	2 Theory + 1 Practical BOMAT -111 Fundamentals of Plant Diversity I BOMAT-112 Introduction to Plant Morphology BOMAP-113 Practical botany I	0	0	1 Theory BOVST-111 Cultivation techniques of Mushroom and Algae	1 Theory BOIKT-111 Indian knowledge system	1 Theory + 1 Practical BOGET-111 Agrotourism & Ecotourism BOGEP-112 Practical on Agrotourism & Ecotourism	1 Practical BOSEP-111 Practical on Biofertilizers and Biopesticides
	II	2 Theory + 1 Practical BOMAT-121 Fundamentals of Plant Diversity II BOMAT-122 Introduction to Plant Anatomy & Utilization BOMAP-123 Practical botany II	0	1 Theory BOMIT-121 Applied Botany	1 Practical BOVSP-121 Practical on Cultivation techniques of Mushroom and Algae	0	2 Theory BOGET-121 Plant Resources BOGEP-122 Practical on Plant Resources	1 Theory BOSET-121 Biofertilizers and Biopesticides
SY	III	3 Theory + 1 Practical BOMAT-231 Angiosperms' Taxonomy BOMAT-232 Phyto-Physiology BOMAT-233 Plant Ecology BOMAP-234 Practical botany III	0	1 Theory + 1 Practical BOMIT-231 Nursery and Gardening Management. BOMIP-232 Practical on Nursery and Gardening Management	1 Theory BOVST-231 Herbal Technology	0	1 Theory BOGET-131 Agriculture for Competitive Exams	
	IV	3 Theory + 1 Practical BOMAT-241 Reproductive Plant Biology BOMAT-242 Plant Biotechnology BOMAT-243 Cell Biology BOMAP-244 Practical botany IV	0	1 Theory + 1 Practical BOMIT-241 Landscape Designing BOMIP-242 Practical on Landscape Designing	0	0	1 Practical BOGEP-141 Practical on Ayurvedic Botany	1 Theory Plant BOSEP-241 Practical on Identification and Herbarium

TY	V	3 theory + 2 Practical BOMAT-351 Lower Cryptogamic Botany BOMAT-352 Advanced Phyto-Physiology BOMAT-353 Molecular Biology BOMAP-354 Practical botany V BOMAP-355 Practical botany VI	1 Theory + 1 Practical BOMET-351A Methods for Plant conservation BOMET-351B Study of Medicinal Plants BOMEF-352A Practical on Methods for Plant Conservation BOMEF-352B Practical on Study of Medicinal Plants	1 Theory + 1 Practical BOMIT-351 Medicinal Botany BOMIP-352 Practical on Medicinal Botany	1 Practical BOVSP-351 Practical on Herbal Technology	0	0	0
	VI	3 theory + 2 Practical BOMAT- 361 Higher Cryptogams and Gymnosperms BOMAT-362 Phytochemistry BOMAT-363 Plant Pathology BOMAP-364 Practical botany VII BOMAP-365 Practical botany VIII	1 Theory + 1 Practical BOMET-361A Computational Botany BOMET-361B Basics of Agroforestry BOMEF-362A Practical on Computational Botany BOMEF-362B Practical on Basics of Agroforestry	1 Theory +1 Practical BOMIT-361 Environmental Botany BOMIP-362 Practical on Environmental Botany	0	0	0	0

VII and VIII Sem honours degree with major								
Year	Sem	Major Courses	Major Elective Courses	Minor Courses	VSC	IKS	GE /OE	SEC
4 th Yr Honours With Major	VII	5 Theory + 2 Practical BOMAT-471 Plant Systematics - I (Algae & Fungi) BOMAT-472 Advanced Cell Biology BOMAT-473 Genetics & Plant Breeding BOMAT-474 Plant organism Interaction BOMAT-475 Floriculture and Pomoculture BOMAP-476 Practical botany IX BOMAP-477 Practical Botany X	1 Theory + 1 Practical BOMET -471A Crop Physiology BOMEPE -472A Practical on Crop Physiology BOMET-471B Pharmacognosy BOMEPE- 472B Practical on Pharmacognosy	RM 4 credits	0	0	0	0
	VIII	5 Theory + 2 Practical BOMAT- 481 Plant Systematics - II (Bryophytes and Pteridophytes) BOMAT-482 Advanced Molecular Biology BOMAT-483 Plant Evolution BOMAT-484 Biostatistics BOMAT-485 Tools and Techniques in Plant Science BOMAP-486 Practical Botany XI BOMAP-487 Practical Botany XII	1 Theory + 1 Practical BOMET-481A Applied Biotechnology and Nanotechnology BOMEPE-482A Practical on Applied Biotechnology and Nanotechnology BOMET-481B Biodiversity BOMEPE- 482B Practical on Biodiversity	0	0	0	0	0
VII and VIII Sem honours degree with research								
4th Yr. Honours With Research	VII	4 Theory + 1 Practical BOMAT-471 Plant Systematics - I (Algae & Fungi) BOMAT-472 Advanced Cell Biology BOMAT-473 Genetics & Plant Breeding BOMAT-474 Plant organism Interaction BOMAT-475 Floriculture and Pomoculture BOMAP-476 Practical botany XI	1 Theory + 1 Practical BOMET -471A Crop Physiology BOMEPE -472A Practical on Crop Physiology BOMET-471B Pharmacognosy BOMEPE- 472B Practical on Pharmacognosy	RM 4 credits	0	0		
	VIII	4 Theory + 1 Practical BOMAT-481 Plant Systematics - II (Bryophytes and Pteridophytes) BOMAT-482 Advanced Molecular Biology BOMAT-483 Biostatistics BOMAT-484 Tools and Techniques in Plant Science BOMAT-485 Plant Evolution BOMAP-486 Practical botany XII	1 Theory + 1 Practical BOMET-481A Applied Biotechnology and Nanotechnology BOMEPE-482A Practical on Applied Biotechnology and Nanotechnology BOMET-481B Biodiversity BOMEPE- 482B Practical on Biodiversity	0	0	0		

Program: B.Sc. [Botany], 2024-25

Program Outcomes (POs)

After completing this course, students will be able to:

1. Understanding Plant Diversity

Demonstrate comprehensive knowledge of plant diversity, including lower and higher plants, their evolution, classification, and ecological roles.

2. Morphological and Anatomical skill

Apply detailed knowledge of plant morphology and anatomy to identify plant structures and explain their functions across various plant groups.

3. Taxonomy and Systematics Skills

Develop skills in the identification, nomenclature, and classification of plants using traditional and modern taxonomic principles.

4. Knowledge of Plant Physiology and Biochemistry

Understand the physiological processes and biochemical mechanisms in plants, including photosynthesis, respiration, nutrient transport, and hormonal regulation.

5. Ecological and Environmental Awareness

Analyze ecological principles, plant-environment interactions, and the role of plants in ecosystem stability and climate adaptation.

6. Cell and Molecular Biology Foundations

Demonstrate a sound understanding of cell biology, genetics, and molecular biology with applications in plant development and biotechnology.

7. Skill in Applied Botany and Technology

Apply theoretical and practical knowledge in areas like floriculture, medicinal plants, agroforestry, tissue culture, and plant biotechnology for sustainable development.

8. Hands-on Laboratory and Field Techniques

Acquire competence in laboratory techniques, herbarium preparation, field studies, and modern tools used in plant science research.

9. Use of Biostatistics and Computational Tools

Utilize statistical methods and computational software for data analysis in plant science research and reporting.

10. Problem Solving and Research Aptitude

Identify plant-related problems and propose scientific solutions using investigative and experimental methods.

11. Ethical and Sustainable Practices

Promote sustainable use of plant resources with ethical awareness in the conservation of biodiversity and natural habitats.

12. Entrepreneurial and Vocational Readiness

Gain skills in mushroom cultivation, nursery management, herbal product development, and other vocational aspects to support self-employment and entrepreneurship.

13. Indigenous and Traditional Knowledge Integration

Appreciate and integrate traditional Indian knowledge systems in agriculture and plant utilization practices.

14. Learning and Competitive Exam

Foster a mind-set for continuous learning, innovation, and readiness for competitive exams, higher studies, and diverse career paths in botany and allied sciences

Program Specific Outcomes (PSOs)

1. PSO 1: Mastery of Plant Classification and Biodiversity

Students will be able to classify and differentiate between diverse plant groups using taxonomic principles and demonstrate expertise in documenting plant biodiversity through field and herbarium techniques.

2. PSO 2: Competence in Plant Structure and Physiology

Students will be able to analyze the anatomical features and physiological processes of plants to explain growth, development, and adaptation mechanisms under various environmental conditions.

3. PSO 3: Understand and Application of Molecular and Cellular Biology in Plant Science

Students will be able to apply cellular, genetic, and molecular biology concepts in understanding plant functions and in developing solutions for crop improvement and biotechnology-based applications.

4. PSO 4: Practical Skills in Laboratory, Fieldwork, and Research

Students will be able to conduct laboratory experiments, perform ecological and environmental assessments, and utilize biostatistics and computational tools in scientific research and reporting.

5. PSO 5: Integration of Traditional Knowledge and Modern Practices

Students will be able to integrate indigenous knowledge systems with modern scientific practices for the sustainable use of plant resources in agriculture, medicine, and environmental conservation.

Department of Botany
T.Y.B.Sc Fifth and Sixth semester

Sr. No.	Subject Code	Subject Name	Allotted Credit	No. of Lecture or Practical
Major Course				
1	BOMAT 351	Lower Cryptogamic Botany	2	30L
2	BOMAT 352	Advanced Phyto-Physiology	2	30L
3	BOMAT 353	Molecular Biology	2	30L
3	BOMAP 354	Practical Botany V (Practical Based on BOMAT 351 & 352)	2	12P
4	BOMAP 355	Practical Botany VI (Practical Based on BOMAT 352 & 353)	2	12P
1	BOMAT 361	Higher Cryptogams and Gymnosperms	2	30L
2	BOMAT 362	Phytochemistry	2	30L
3	BOMAT 363	Plant Pathology	2	30L
3	BOMAP 364	Practical Botany VII (Practical Based on BOMAT 361 & 362)	2	12P
4	BOMAP 365	Practical Botany VIII (Practical Based on BOMAT 362 & 363)	2	12P
Major Elective Course				
1	BOMET 351A	Methods for Plant Conservation	2	30L
2	BOMEPP 352A	Practical on Methods for Plant Conservation	2	12P
3	BOMET 351B	Study of Medicinal Plants	2	30L
4	BOMEPP 352B	Practical on Study of Medicinal Plants	2	12P
1	BOMET 361A	Computational Botany	2	30L
2	BOMEPP 362A	Practical on Computational Botany	2	12P
3	BOMET 361B	Basics of Agroforestry	2	30L
4	BOMEPP 362B	Practical on Basics of Agroforestry	2	12P
Minor Course				
1	BOMIT 351	Medicinal Botany	2	30L
2	BOMIP 352	Practical on Medicinal Botany	2	12P
1	BOMIT 361	Environmental Botany	2	30L
2	BOMIP 362	Practical on Environmental Botany	2	12P
Vocational Skill Course				
1	BOVSP 351	Practical on Herbal Technology	2	12P
Research Project				
1	BORPP 351	Research Project Guideline	2	180 Hrs
On Job Training				
1	BOOJT 361	Guideline for OJT	4	120 Hrs

Minor College basket for science faculty				
1.	BOMIT 351	Medicinal Botany	2	30L
2.	BOMIP 352	Practical on Medicinal Botany	2	12P
3.	BOMIT 361	Environmental Botany	2	30L
4.	BOMIP 362	Practical on Environmental Botany	2	12P
5.	CHMIT- 351	Solid State Chemistry	2	30L
6.	CHMIP-352	Inorganic and Analytical Practical-I	2	12L
7.	CHMIT-361	Environmental Chemistry	2	30L
8.	CHMIP-362	Inorganic and Analytical Practical-II	2	12L
9.	ZOMIT-351	Vermiculture	2	30L
10.	ZOMIP-352	Practical in Vermiculture	2	12P
11.	ZOMIT-361	Livestock management	2	30L
12.	ZOMIP-362	Practical in Livestock management	2	12P
13.	PHMIT-351	Semiconductor Devices	2	12P
14.	PHMIP-352	Physics Lab-III	2	30L
15.	PHMIT-361	Waves and Optics	2	30L
16.	PHMIP-362	Physics Lab-IV	2	12P
17.	MTMIT-351	Numerical Techniques	2	30L
18.	MTMIP-352	Numerical Techniques using Python	2	12P
19.	MTMIT-361	Operation Research	2	30L
20.	MTMIP-362	Operation Research using Python	2	12P
21.	STMIT-351	Continuous Probability Distributions	2	30L
22.	STMIP-352	Statistics Practical-V	2	12P
23.	STMIT-361	Tests of Hypothesis	2	30L
24.	STMIP-362	Statistics Practical-VI	2	12P

Course : Major
Code : BOMAT 351
Subject : Lower Cryptogamic Botany

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module - I Introduction to Lower Cryptogams and Algae

15L

Chapter 1	Introduction to Lower Cryptogams	6L
	1.1 General Characters of Lower Cryptogams	
	1.2 Types and diagnostic features- Lower Cryptogams	
	1.3 Phylogenetic Evolution of lower Cryptogams	
Chapter 2	Algae	9L
	2.1 General characteristics	
	2.2 Habit, Habitat, Distribution, Morphological Peculiarities of thallus organization, pigmentation in algae, Reproduction	
	2.3 Systems of Classifications	
	2.4 Outline of classification as per G. M. Smith (1955) up to classes	
	2.5 Study of algae with reference to taxonomic position, Occurrence, Thallus structure, Reproduction and Life cycle of – Diatom, Oscillatoria, Ulva Chara, Sargassum.	
	2.6 Ecological, Economic and Industrial importance	

Module - II Fungi and Lichens

15L

Chapter 3	Fungi	9L
	3.1 General characteristics	
	3.2 Habit, Habitat, Distribution, Morphological study of thallus organization, Cell wall composition, nutrition, reproduction	
	3.3 Systems of Classifications	
	3.4 Outline of classification as per Alexopoulos and Mims (1979) up to classes.	
	3.5 Study of fungi with reference to taxonomic position, thallus structure, Reproduction and Life cycle of <i>Stemonitis</i> (Myxomycotina), <i>Saccharomyces</i> (Ascomycotina), <i>Penicillium</i> (Ascomycota), <i>Puccinia</i> (Basidiomycotina) and <i>Cercospora</i> (Deuteromycotina)	
	3.6 Ecological, Economic and Industrial importance	
Chapter 4	Lichens and Mycorrhiza	6L
	4.1 General characteristics of Lichens and Mycorrhiza	
	4.2 Types of Lichens	
	4.3 Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance	
	4.4 Study of life cycle of Fruticose lichen (Eg. - <i>Usnea</i>)	
	4.5 Ecological, Economic and Industrial importance of Lichens and Mycorrhiza	

Suggested Reading:

1. Dube, H. C. (1990). An Introduction to Fungi. Vikas Pub. House Ltd. New Delhi, India. Ganguli, H. C. and Kar, A. K. (2001). College Botany Vol. I. Books and Allied Press Ltd. Kolkata, India
2. Kumar H. D. (1988). Introductory Phycology. Affiliated East West Press Ltd. New Delhi
3. Kumar H. D. and H. N. Singh (1976). A Text Book of Algae. Affiliated East West Press Ltd. New Delhi, India
4. Pandey, B. P. (1994). A Text Book of Botany - Algae. S. Chand & Co. Ltd. New Delhi, India.
5. Pandey, S. N., Trivedi, P. S. and S. P. Misra (1995). A Text Book of Algae. Vikas Pub. House Pvt. Ltd. New Delhi, India.
6. Sharma, O. P. (1990). Text Book of Algae. Tata McGraw Hill Pub. Co. Ltd. New Delhi, India.

Course Outcome:

After successful completion of this course, students will be able to...

1. Describe and compare lower cryptogams of plant kingdom.
2. Analyze and outline life cycle patterns of the cryptogams.
3. Classify the lower cryptogams in a scientific way.
4. Discuss economic and ecological significance of lower cryptogams.

Course : Major
Code : BOMAT 352
Subject : Advanced Phyto-Physiology

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module I Photosynthesis and Translocation

15L

Chapter 1 Introduction to Photosynthesis

03L

- 1.1 Definition, Concept and significance.
- 1.2 Organization of the Photosynthetic Apparatus in prokaryotes and eukaryotes.

Chapter 2 Photosynthesis: Light Reaction

05L

- 2.1 Properties of light
- 2.2 Photosynthetic pigments
- 2.3 Key Experiments in Understanding Photosynthesis
- 2.4 Organization of Light harvesting Antenna Systems (LHCs) & Photosystems.
- 2.5 Mechanisms of Electron Transport (Cyclic and Non-Cyclic)
- 2.6 Photophosphorylation

Chapter 3 Photosynthesis: Dark Reaction

05L

- 3.1 Calvin Cycle (C_3 cycle)
- 3.2 Photorespiration (C_2 cycle): Significance and limitations
- 3.3 Kranz Anatomy, Evolution of carbon fixative enzymes (RUBPcase, PEPcase) in plants, C_4 and CAM Pathway
- 3.4 Significance of Photosynthesis

Chapter 4 Sugar translocation in plants

02L

- 4.1: Pathways of translocation
- 4.2: Concept of Source and Sink, Source and sink relationship
- 4.3: Phloem Loading and unloading

Module II Respiration and Photoperiodism

15L

Chapter 5 Overview of Plant Respiration

10L

- 5.1: Introduction and types of respirations
- 5.2: Structure of Mitochondrion
- 5.3: Glycolysis, Citric Acid Cycle (Kreb's cycle)
- 5.4: Mitochondrial ETC
- 5.5: Oxidative Phosphorylation
- 5.6: Oxydative Pentose Phosphate Pathway
- 5.7: Balance sheet of ATP generation in respiration
- 5.8: Chemi-osmotic hypothesis of ATP synthesis
- 5.9: Significance of respiration

- 6.1 : Introduction
- 6.2 : SDP (Short Day Plants)
- 6.3 : LDP (Long Day Plants)
- 6.4 : DNP (Day Neutral Plants)
- 6.5 : Phytochromes and Cryptochromes
- 6.6 : Vernalization: Introduction, Concept, Mechanism & Significance

Suggested Readings:

1. Berg J.M., Tymoczko J.L., Stryer L. (2002) Biochemistry. 5th Ed. Wlt. Freeman and Company, New York.
2. Buchanan B.B., Gruissem W., Jones R.L. (2000) Biochemistry and Molecular Biology of Plants. IK International, Mumbai.
3. Davis P. J. (Eds.). (2004) Plant Hormones. Kluwer Academic Publishers, Dordrecht, Netherlands.
4. Goodwin T.W., Mercer E.I. (1998) Introduction to Biochemistry. CBS Publishers, New Delhi.
5. Heldt H. W. (2004) Plant Biochemistry. Academic Press, California.
6. Lawlor D.W. (2001) Photosynthesis in C3 and C4 Pathway. 3rd Ed. Viva. New Delhi.
7. Nelson David and Cox Michael. (2007) Lehninger Principles of Biochemistry. W.H. Freeman and Company. New York.
8. Lincoln Taiz and Eduardo Zeiger (2010) Plant Physiology, 5th edition. Sinauer Associates, Inc. Publishers. Sunderland, USA.
9. Salisbury, F.B. and Ross, C. (1969) Plant physiology. Wadsworth Publishing Co., Inc., Belmont.

Course Outcome:**After the completion of this course the students are able to...,**

1. To study the concept of Photosynthesis and respiration in plants.
2. Describe the mechanism of Photosynthesis and its efficiency in plants.
3. Apply theory to interpret plant functions.
4. Discuss the principles of Photoperiodism and Vernalization

Course : Major
Code : BOMAT 353
Subject : Molecular Biology

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module I Introduction to Genetic Material

15L

Chapter 1 Introduction to Molecular Biology

02L

- 1.1 : Definition, Milestones in Molecular Biology
- 1.2 : Scope, Importance and Applications of Molecular Biology
- 1.3 : Future Prospects of Molecular Biology

Chapter 2 Nucleus

05L

- 2.1 : Nuclear envelope, nuclear pore complex, nuclear lamina,
- 2.2 : Molecular organization of chromatin
- 2.3 : Chromosomes: Euchromatin and heterochromatin, Histones, Packing of DNA into chromosomes.
- 2.4 : Polytene chromosomes and Lampbrush chromosomes.
- 2.5 : Karyotype and Ideogram.

Chapter 3 DNA (Deoxyribonucleic acid)

05L

- 3.1 : Historical perspective
- 3.2 : DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment)
- 3.3 : Contribution of Rosalind Franklin, Watson and Crick
- 3.4 : Organization of DNA- Prokaryotes, Viruses, Eukaryotes
- 3.5 : Extrachromosomal DNA: mitochondrial and chloroplast DNA

Chapter 4 Replication of DNA

03L

- 4.1 : Important terminologies in DNA Replication- Definition and Concept
- 4.2 : Enzymes and proteins involved in prokaryotic and eukaryotic DNA replication
- 4.3 : DNA synthesis: Initiation, Elongation and Termination
- 4.4 : General principles- semiconservative and semi discontinuous replication

Module II Central Dogma of life

15L

Chapter 5 Transcription

03L

- 5.1 : Transcription in prokaryotes; Transcription in eukaryotes
- 5.2 : Types of RNA: mRNA, tRNA, rRNA; types of promoters
- 5.3 : Types of RNA polymerase enzymes in eukaryotes
- 5.4 : Molecular mechanism of transcription

Chapter 6 Translation

03L

- 6.1 : Definition, concept and properties of genetic code
- 6.2 : Molecular mechanism of translation
- 6.3 : Post-translational modifications of proteins

Chapter 7	DNA Damage and Repair	03L
	7.1 : Introduction to DNA Damage	
	7.2 : Causes and types,	
	7.3 : DNA repair system- Photoreactivation, Dark excision repair	
Chapter 8	Regulation of gene expression in prokaryotes and eukaryotes	04L
	8.1 : Principles of transcriptional regulation	
	8.2 : Prokaryotes: Concept of operon, lac operon and Trp operon, positive and negative control	
	8.3 : Eukaryotes: Role of enhancers, silencers, promoters, and transcription factors in gene regulation	
	8.4 : Gene silencing, RNA splicing and editing	
Chapter 9	Genomics and Proteomics	02L
	9.1 : Introduction to Genomics and proteomics: Concept, Definition	
	9.2 : Scope importance and Applications	

Suggested Readings:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition
6. Cell and Molecular Biology, S. C. Rastogi
7. Cytology, T. S. Verma and V. K. Agarwal
8. Fundamentals of Molecular Biology, G. K. Pal and Ghaskadabi
9. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition-A. Malcolm Campbell and Laurie J. Heyer (ISBN 0-8053-4722-4)-Cold Spring Harbor Laboratory press and Benjamin Cummings, 28 Feb 2006.

Course Outcome:

After the completion of this course the students are able to...

5. Understand the structure and function of the nucleus and its role in genetic regulation.
6. Describe the structure and function of nucleic acids.
7. Explain the central dogma of life.
8. Identify and categorize various DNA damage repair mechanisms
9. Discuss current proteomic and genomic technologies.

Course : Major
Code : BOMAP 354
Subject : Practical Botany V
 (Practical Based on BOMAT 351 & 352)

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No	Practical Botany V (Practical Based on BOMAT 351 & 352)	12P
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Based on BOMAT 351 Lower Cryptogamic Botany

- | | | |
|----|--|----|
| 1. | Study of Fungi, through permanent section and temporary section preparation, with respect to systematic position, thallus structure and reproduction of: <i>Stemonitis and Penicillium</i> . | 1P |
| 2. | Study of Fungi, through permanent section and temporary section preparation, with respect to systematic position, thallus structure and reproduction of: Tikka disease [<i>Cercospora</i> (Deuteromycotina)] in Groundnut leaf. | 1P |
| 3. | Study of Fungi, through permanent section and temporary section preparation, with respect to systematic position, thallus structure and reproduction of: <i>Puccinia</i> (Basidiomycotina). | 1P |
| 4. | Study of Mycorrhiza: ectomycorrhiza and endomycorrhiza.
Lichens: Study of Fruticose lichen (<i>Usnea</i>) | 1P |

Based on BOMAT 352 Advanced Plant Physiology

- | | | |
|-----|--|----|
| 5. | Estimation of Chlorophyll pigment in C3 and C4 Plants. | 1P |
| 6. | Estimation of Carotenoids by using suitable plant material | 1P |
| 7. | Isolation of Anthocyanins from suitable flowers | 1P |
| 8. | Separation of leaf pigments by TLC/ Paper Chromatography | 1P |
| 9. | Measurement of respiration and photosynthetic rates using oxygen electrode (demonstration) | 1P |
| 10. | Study of experimental Instruments used in Phyto-physiology (Leaf Area Meter) | 1P |
| 11. | Study of Kranz anatomy in C4 plants | 1P |
| 12. | Study of Ringing Experiment | 1P |

Suggested Readings:

1. Pandey, B. P. (1994). A Text Book of Botany - Algae. S. Chand & Co. Ltd. New Delhi, India
2. Kumar H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd New Delhi
3. Sharma, O.P.-Fungi Economic importance of fungi
4. Vashishta B.R. et al., Botany for degree students- Fungi
5. Vashishta B. R. et al., Botany for degree Students-Algae

Course Outcome

After successful completion of this course, students will be able to....,

1. Identify, describe and classify various forms of Lower cryptogams.
2. Study the sectioning and observation of Lower cryptogams under microscope.
3. Describe economic importance of Lower cryptogams.
4. Analyze and quantify the photosynthetic pigments and physiological processes.

Course : Major
Code : BOMAP 355
Subject : Practical Botany VI
 (Practical Based on BOMAT 352 & 353)

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No	Practical Botany VI (Practical Based on BOMAT 352 & 353)	12P
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Based on BOMAT 352 Advanced Phyto-Physiology

- | | | |
|----|---|----|
| 1. | Study of Algae, through permanent section and temporary section preparation, with respect to systematic position, thallus structure and reproduction of <i>Oscillatoria</i> . | 1P |
| 2. | Study of Algae, through permanent section and temporary section preparation, with respect to systematic position, thallus structure and reproduction of: <i>Sargassum</i> . | 1P |
| 3. | Study of Algae, through permanent section and temporary section preparation, with respect to systematic position, thallus structure and reproduction of: <i>Chara</i> . | 1P |
| 4. | Field Visit to rich Biodiversity regions. Students are expected to submit two forms or photographs of Algae, Fungi and Lichens along with the tour report. | 1P |

Based on BOMAT 353 Molecular Biology

- | | | |
|-----|---|----|
| 5. | Isolation of plant genomic DNA by suitable method. | 1P |
| 6. | Extraction and estimation of RNA by Orcinol Method | 1P |
| 7. | Amplification of Specific Genes using PCR | 1P |
| 8. | To separate and analyse DNA fragments based on size using agarose gel electrophoresis | 2P |
| 9. | Separation of proteins using SDS-PAGE | 2P |
| 10. | Extraction of proteins from cells/tissues and quantify their concentration | 1P |
| 11. | Industrial Visit | 1P |

Suggested Readings:

- Sharga, B.M., Chromiak, U.I., Pylypiv, D.B. and Feketa, V.P., 2022. Molecular biology practicals.
 - Pylypiv, D.B., Molecular Biology Practical.
 - Davis, L., 2012. Basic methods in molecular biology. Elsevier.
 - Karp, G., 2009. Cell and molecular biology: concepts and experiments. John Wiley & Sons.
- Scott, P.H., Veitch, N.J., Gadegaard, H., Mughal, M., Norman, G. and Welsh, M., 2018. Enhancing theoretical understanding of a practical biology course using active and self-directed learning strategies. Journal of Biological Education, 52(2), pp.184-195.

Course Outcome

After successful completion of this course, students will be able to....,

1. Identify, describe and classify various forms of Lower cryptogams.
2. Study the sectioning and observation of Lower cryptogams under microscope.
3. Understand the basic principles and techniques used in molecular biology
4. Perform the steps including extraction and purification of DNA, RNA, and proteins
5. Analyze the results of PCR and electrophoresis experiments.

Course : Major Elective Course
Code : BOMET 351A
Subject : Methods for Plant Conservation

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module - I Basics of Plant Conservation

15L

Chapter 1 Introduction to Plant Conservation:

03L

- 1.1: Concept and Importance: Plant conservation's definition, scope, and objectives.
- 1.2: Biodiversity Loss: Causes, consequences, and impacts of biodiversity loss on ecosystems.
- 1.3: Values of Plant Biodiversity: Ethical, ecological, economic, and cultural importance.
- 1.4: Hotspots and Endemism: Global hotspots of biodiversity and endemic plants.

Chapter 2 Community and Legislative Approaches:

04L

- 2.1: Community Involvement: Role of local communities and traditional knowledge.
- 2.2: Sustainable Practices: Agroforestry, organic farming, and eco-tourism.
- Conservation Laws: National and international legal frameworks (CBD, CITES, Wildlife Protection Act).
- 2.3: Role of Organizations: Contribution of IUCN, WWF, and UNEP in plant conservation

Chapter 3 In-situ Conservation:

08L

- 3.1 Definition and Importance: Concept and benefits of in-situ conservation.
- 3.2 Protected Areas: National parks, wildlife sanctuaries, biosphere reserves – features and significance.
- 3.3 Sacred Groves and Community Reserves: Role in conserving biodiversity.
- 3.4 Ecological Restoration: Principles and practices for restoring degraded ecosystems.
- 3.5 Case Studies: Examples of successful in-situ conservation projects.

Module – II: Advances in plant conservation

15L

Chapter 4 Ex-situ Conservation:

08L

- 4.1 Definition and Importance: Concept and benefits of ex-situ conservation.
- 4.2 Botanical Gardens and Arboreta: Role in plant conservation and research.
- 4.3 Seed Banks: Importance, storage techniques, and global seed vaults.
- 4.4 Cryopreservation: Methods and applications.
- 4.5 Tissue Culture Techniques: Micropropagation, somatic embryogenesis, and organogenesis.
- 4.6 Field Gene Banks and Pollen Storage: Methods and challenges.
- 4.7 Case Studies: Successful examples of ex-situ conservation.
- 4.8 Limitations and Challenges: Constraints in ex-situ conservation.

Chapter 5 Conservation Challenges and Future Directions:

07L

- 5.1 Climate Change: Effects on plant biodiversity and adaptive strategies.
- 5.2 Invasive Species: Management and control of alien invasive plants.
- 5.3 Public Awareness and Education: Role in promoting conservation ethics.
- 5.4 Emerging Tools and Technologies: Remote sensing, GIS, and AI in conservation.
- 5.5 Future Perspectives: Integrating traditional and modern conservation methods.
- 5.6 Role of Biotechnology in Plant Conservation,

Suggested Readings:

1. Primack, R. B. – Essentials of Conservation Biology.
2. Krishnamurthy, K. V. – An Advanced Textbook on Biodiversity.
3. Heywood, V. H. – Global Biodiversity Assessment.
4. Singh, G. – Plant Systematics: Theory and Practice.
5. Articles and reports from IUCN, WWF, and UNEP.

Course Outcome:

After successful completion of this course, students will be able to....

1. To study the methods and importance of plant conservation.
2. To understand knowledge of in-situ and ex-situ strategies for plant biodiversity conservation.
3. Apply the role of biotechnology and community involvement in conservation efforts.
4. To discuss the challenges and advancements in plant conservation methods.

Course : Major Elective Course	Total Credit : 2
Code : BOME P 352A	Course Type : Practical
Subject : Practical on Methods for Plant Conservation	Total Practical : 12

Sr. No	Practical on Methods for Plant Conservation	12P
1.	Determination of temperature, pH & turbidity of polluted and non-polluted water samples.	1P
2.	Application of Remote Sensing and GPS in Plant Conservation: Mapping and Monitoring Vegetation	1P
3.	Study of wetland plants: submerged, emergent, free-floating, marshy plants with suitable examples.	1P
4.	Learn how to establish a botanical garden and its role in plant conservation and to create a herbarium of local plant species as a conservation tool.	1P
5.	Learn seed storage techniques for long-term conservation using silica gel, airtight containers, and a refrigerator.	1P
6.	To understand the process of seed conservation and test the viability of stored seeds.	1P
7.	Explore tissue culture technique for plant propagation. Monitor and document the growth stages: callus formation, shoot, and root development	1P
8.	Embryo Rescue Technique: In Vitro Culture for Hybrid Plant Development	1P
9.	Reintroduction and Hardening of In Vitro Propagated Plants for Conservation	1P
10.	To study various methods of vegetative propagation for plant conservation	1P
11.	Visit a nearby national park/wildlife sanctuary/Sacred grooves and document the flora. And analyse the role of protected areas in preserving ecosystems.	2P

Suggested Readings:

1. Primack, R. B. – Essentials of Conservation Biology.
2. Krishnamurthy, K. V. – An Advanced Textbook on Biodiversity.
3. Heywood, V. H. – Global Biodiversity Assessment.
4. Singh, G. – Plant Systematics: Theory and Practice.
5. Articles and reports from IUCN, WWF, and UNEP.

Course Outcome

After successful completion of this course, students will be able to....

1. Assess and compare water quality parameters (temperature, pH, turbidity) for ecological health evaluation.
2. Use remote sensing and GPS for vegetation mapping and conservation monitoring.
3. Identify and classify wetland plants, understanding their ecological roles and adaptations.
4. Learn techniques for botanical garden establishment and herbarium creation for conservation.
5. Use master seed storage, viability testing, and plant propagation methods for biodiversity conservation.

Course : Major Elective Course
Code : BOMET 351B
Subject : Study of Medicinal Plants

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module I Introduction to Medicinal Botany:

15L

Chapter 1 Indigenous Medicinal Systems of India

08L

- 1.1 Medicinal Plants: History, Scope and Importance
- 1.2 Definition and scope of Indigenous medicinal systems of India as mentioned below:
 - Ayurveda
 - Siddha
 - Unani
 - Homeopathy
 - Amchi system of medicine
- 1.3 Chinese system of medicine.
- 1.4 Introduction and Definition of Ethnobotany
Scope and importance of Ethnobotany in India.
- 1.5 Methods to study Ethnobotany and Applications of Ethnobotany.
- 1.6 Pharmacognosy: Definition, scope, and significance.
- 1.7 Sources of drugs: plant, Animal, and mineral origin.

Chapter 2 Study of Ayurveda, Siddha, and Unani:

07L

- 2.1 Study of Ayurveda: History, Origin, Panchamahabhootas, Saptadhatu and Tridosh concept and Plants used in Ayurveda.
- 2.2 Siddha: History Scope and Origin of the Siddha medicinal system of India,
- 2.3 Unani: History, Concept: Umoor-e-tabiya, tumors treatments/therapy, polyherbal formulations.

Module II: Folk Medicines, Conservation and propagation of Medicinal plants

15L

Chapter 3 Folk medicines:

05L

- 3.1 Folk medicines of Ethnobotany, Ethnomedicine, Ethnoecology, and Ethenic communities of India
- 3.2 Applications of natural products to certain diseases such as Jaundice, Cardiac, infertility, diabetes, blood pressure, and skin diseases.

Chapter 4 Conservation and propagation of Medicinal plants:

10L

- 4.1 Propagation of medicinal plants: Objectives of Nursery Classifications and important nursery components, sowing, Pricking.
- 4.2 Propagation through cuttings, Layering, grafting, and budding.
Conservation of endangered and endemic plants: Definition, Endemic and
- 4.3 Endangered medicinal plants, Red list Criteria; In-situ conservation: Biosphere
- 4.4 reserves, Sacred grooves, National Parks; Ex-situ conservation: Botanic gardens and Ethnomedicinal plant gardens.

Suggested Readings:

1. Chopra, R.N., Nayar, S.L., & Chopra, I.C. — Glossary of Indian Medicinal Plants.
2. Kirtikar, K.R., & Basu, B.D. — Indian Medicinal Plants.
3. Jain, S.K. — Manual of Ethnobotany.
4. Kokate, C.K., Purohit, A.P., & Gokhale, S.B. — Pharmacognosy.
5. Evans, W.C. — Trease and Evans' Pharmacognosy.
6. Nadkarni, K.M. — Indian Materia Medica.
7. Dash, B. — Materia Medica of Ayurveda.
8. Ghosh, G.R. — A Treatise on Natural Products.

Course Outcomes:**By the end of this course, students will be able to:**

1. Understand the history, scope, and importance of medicinal plants
2. Describe the foundations of Indigenous Medicinal Sciences: Ayurveda, Siddha, and Unani
3. Explain the core concepts of Ayurveda (Panchamahabhutas, Saptadhatu, Tridosha, Rasayana)
4. Compare the use of medicinal plants in Ayurvedic and Siddha treatments
5. Evaluate the conservation status of endangered and endemic medicinal plants.

Course : Major Elective Course
Code : BOME P 352B
Subject : Practical on Study of Medicinal Plants

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No.	Practical on Study of Medicinal Plants	12 P
1.	Identification and collection of medicinal plants in the field.	1P
2.	Preparation of herbal formulations (e.g., teas, oils, creams, etc.).	1P
3.	Laboratory work: Extraction and analysis of plant compounds	1P
4.	Study of plant morphology, anatomy, and pharmacological effects of selected species.	1P
5.	Evaluation of antimicrobial or antioxidant activity of plant extracts.	1P
6.	Study of the indigenous use of plants in local communities and gather data on traditional knowledge.	1P
7.	Conservation of Medicinal Plants	1P
8.	Pharmacological Evaluation	1P
9.	Plant Identification and Herbarium Preparation	1P
10.	Extraction of Active Compounds	1P
11.	Plants used in Ayurveda: properties and medicinal uses	1P
12.	Study the propagation of medicinal plants	1P
13.	Case studies on the development of drugs from plants	1P
14.	Preparation of Triphala Churna	1P
15.	Taxonomy of medicinal plants.	1P

Suggested Readings:

1. Hamilton, A.C., 2004. Medicinal plants, conservation and livelihoods. *Biodiversity & Conservation*, 13, pp.1477-1517.
2. World Health Organization, 2003. *WHO guidelines on good agricultural and collection practices [GACP] for medicinal plants*. World Health Organization.
3. Ardiansyah, B., Ramdani, A., Hakim, A. and Makhrus, M., 2023. Natural Science Mini Project Practicum through The Practical Instructions Module for Identifying Natural Chemicals in Medicinal Plants. *International Journal of Contextual Science Education*, 1(1), pp.29-37.

4. Jamshidi-Kia, F., Lorigooini, Z. and Amini-Khoei, H., 2017. Medicinal plants: Past history and future perspective. *Journal of herbmed pharmacology*, 7(1), pp.1-7.
5. Martin, G.J., 2010. *Ethnobotany: a methods manual*. Routledge.
6. Cunningham, A.B., 2014. *Applied ethnobotany: people, wild plant use and conservation*. Routledge.
7. Gurib-Fakim, A., 2006. Medicinal plants: traditions of yesterday and drugs of tomorrow. *Molecular aspects of Medicine*, 27(1), pp.1-93.
8. Jamshidi-Kia, F., Lorigooini, Z. and Amini-Khoei, H., 2017. Medicinal plants: Past history and future perspective. *Journal of herbmed pharmacology*, 7(1), pp.1-7.

Course Outcomes:

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

1. Identify and collect medicinal plants from the field
2. Prepare herbal formulations using plant materials
3. Extract and analyse plant compounds from medicinal plants
4. Evaluate the antimicrobial activity of plant extracts
5. Demonstrate the propagation techniques of medicinal plan.

Course	: Minor Course	Total Credit	: 2
Code	: BOMIT 351	Course Type	: Theory
Subject	: Medicinal Botany	Total Lecture	: 30

Module - I Introduction and uses of Medicinal plants

15L

Chapter 1 Introduction to Medicinal Plants:

08L

- 1.1 Definition Scope and Importance of Medicinal Plants.
- 1.2 Importance of medicinal plants in traditional and modern medicine.
- 1.3 Overview of global and Indian medicinal plant diversity.
- 1.4 Traditional Medicine Systems:
 - Introduction to Ayurveda, Siddha, Unani, and Homeopathy.
 - Role of plants in ethnomedicine and tribal healthcare.
- 1.5 Classification of Medicinal Plants:
 - Based on chemical constituents and therapeutic uses.
 Examples: Alkaloid-rich plants (*Rauvolfia serpentina*), flavonoid-rich plants (*Citrus*), and essential oil plants (*Mentha*).

Chapter 2 Medicinal Plants and Their Uses:

07L

- 2.1 Study of Some Common Medicinal Plants:
 - *Ocimum sanctum* (Tulsi): Antioxidant and antimicrobial properties.
 - *Azadirachta indica* (Neem): Antiseptic and insecticidal properties.
 - *Aloe vera*: Skin and gastrointestinal health.
 - *Withania somnifera* (Ashwagandha): Adaptogenic properties.
 - *Zingiber officinale* (Ginger): Anti-inflammatory and digestive aid.
- 2.2 Case Studies: Plant-based drugs: Curcumin (from *Curcuma longa*), Taxol (from *Taxus*), and Reserpine (from *Rauvolfia*).

Module – II: Phytochemicals and Conservation of Medicinal Plants

15L

Chapter 3 Phytochemicals and their Importance:

08L

- 3.1 Introduction, Definition, and Classification of Phytochemicals (Primary and secondary metabolites).
- 3.2 Role of phytochemicals in plant defense and human health.
- 3.3 3.2 Types of Secondary Metabolites:
- 3.4 Alkaloids (e.g., Morphine, Quinine).
- 3.5 Flavonoids (e.g., Rutin, Catechin).
- 3.6 Terpenoids (e.g., Menthol, Camphor).
- 3.7 Phenolics, tannins, and glycosides.
- 3.8 Applications of Medicinal, industrial, and pharmaceutical uses of secondary metabolites.

4.1 Threats to Medicinal Plants:

- Overharvesting, habitat destruction, and climate change.

4.2 Conservation Strategies:

- In situ conservation (National parks, biosphere reserves).
- Ex situ conservation (Botanical gardens, seed banks).
- Role of organizations like NMPB (National Medicinal Plants Board) and WHO.

4.3 Sustainable Use:

- Good Agricultural Practices (GAP) for medicinal plants.
- Role of community participation in conservation.

Suggested Readings:

- Evans, W. C. (2009). *Trease and Evans' Pharmacognosy*. Elsevier Health Sciences.
- Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2017). *Pharmacognosy*. Nirali Prakashan.
- Chopra, R. N., Nayar, S. L., & Chopra, I. C. (1956). *Glossary of Indian Medicinal Plants*. CSIR, New Delhi.
- Taiz, L., Zeiger, E., Moller, I. M., & Murphy, A. (2015). *Plant Physiology and Development*. Sinauer Associates.
- Harborne, J. B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. Springer.

Course Outcomes:**By the end of this course, students will be able to:**

1. Understand the significance of medicinal plants in healthcare.
2. Identify important medicinal plants and their phytochemical properties.
3. To study conservation and sustainable use of medicinal plants.
4. To introduce students to the basic concepts of medicinal botany
5. Explain the role of medicinal plants in traditional and modern healthcare systems.

Course : Minor practical botany
Code : BOMIP 352
Subject : Practical on Medicinal Botany

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No.	Practical on Medicinal Botany	12P
1)	Identify and describe morphological features of medicinal plants and Prepare an herbarium of any 5 plants.	1P
2)	Classify medicinal plants based on their chemical constituents.	1P
3)	Qualitative analysis of alkaloids from suitable plant sample	1P
4)	Qualitative analysis of flavonoids from suitable plant sample.	1P
5)	Qualitative analysis of phenolic compounds and tannins from suitable plant sample	1P
6)	Use steam distillation to isolate essential oils from suitable plant sample.	1P
7)	Qualitative analysis of antioxidant by using a DPPH (2,2-diphenyl-1-picrylhydrazyl) assay.	1P
8)	Evaluate the antimicrobial properties of from suitable plant sample.	1P
9)	Prepare an herbal formulation such as ointment or cream and document the process.	1P
10)	Extract curcumin from curcuma longa check solubility and colorimetric properties of Curcuma longa.	1P
11)	Develop a cultivation plan for <i>Withania somnifera</i> (Ashwagandha), focusing on soil preparation, irrigation, and harvesting practices.	1P
12)	Visit a nearby medicinal plants garden/Medicinal plants nursery/Medicinal plants industry.	1P

Suggested Readings:

- 1) Jain, S. K. (1991). Dictionary of Indian Folk Medicine and Ethnobotany.
- 2) Sharma, P. C., & Yelne, M. B. (2005). Database on Medicinal Plants.
- 3) Duke, J. A. (2002). Handbook of Medicinal Herbs.
- 4) Harborne, J. B. (1998). Phytochemical Methods.
- 5) Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2008). Pharmacognosy.
- 6) Sofowora, A. (1993). Medicinal Plants and Traditional Medicine in Africa.

Course Outcomes:

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

1. Remembering key morphological features and document in an herbarium of medicinal plants.
2. Understanding and Analyzing the medicinal relevance of different phyto constituents.
3. Develop herbal formulations and cultivation plans.
4. Critically assess the effectiveness of products and cultivation strategies.

Course : Vocational Skill Course
Code : BOVSP 351
Subject : Practical on Herbal Technology

Total Credit : 2
Course Type : Practical
Total Lecture : 12P

Sr. No.	Practical on Herbal Technology	12P
1.	Examine plant specimens and Document their morphological features Use a dichotomous key for botanical identification	1P
2.	Perform microscopic analysis of powdered samples to detect foreign matter (Adulterations).	1P
3.	To prepare Decoction and infusion of plants, Compare the yield and concentration of extracts using different methods.	2P
4.	Perform tests for alkaloids, flavonoids, tannins, Ferric, and glycosides. Record results with observations	2P
5.	Perform Thin layer chromatography of the plant material and separate secondary metabolite contents from it.	1P
6.	Use steam distillation to extract essential oils from suitable plant material and analyse the yield and fragrance using the Clevenger apparatus.	1P
7.	Determination of Extractive Values of Different Medicinal Plants using appropriate solvents.	1P
8.	Prepare different herbal teas or infusions and document them traditional culinary applications and medicinal benefits.	1P
9.	Prepare herbal face cream using appropriate plant material and Formulate herbal shampoo with Neem and Hibiscus.	1P
10.	Visit any herbal medicinal plant garden/Nursery/herbal medicine producing labs/Pharmacognosy lab.	1P

Suggested Readings:

1. Plant Systematics: A Phylogenetic Approach by Walter S. Judd, et al. (2008) – A comprehensive guide to plant morphology and identification.
- 2) The Plant Lover's Guide to Magnolias by Jim Gardiner (2013) – An excellent resource for identifying plant species using keys.
- 3) Pharmacognosy: Medicinal Plants by P. K. Gupta (2010) – Focuses on identifying adulterants using microscopy.
- 4) Essentials of Pharmacognosy by G. E. Trease & W. C. Evans (2002) – Offers insight into identifying adulterations using microscopy.

- 5) Handbook of Phytochemical Methods" by Harborne J. B. (1998) – Discusses methods of preparing decoctions, infusions, and extraction techniques.
- 6) Medicinal Plants: Chemistry and Properties" by J. S. T. Y. Lim (2016) – Covers extraction techniques and comparison of yields.
- 7) Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis" by J. B. Harborne (1998) – Provides detailed protocols for phytochemical testing.
- 8) Textbook of Pharmacognosy" by T. E. J. S. N. K. Rai (2005) – Covers identification and testing of key plant compounds.

Course Outcomes:

Upon completing this practical syllabus, students will be able to:

1. Remembering and understanding the morphological features of medicinal plants.
2. Applying various methods to prepare herbal extracts.
3. To study chromatographic techniques, and evaluate essential oils using steam distillation.
4. Analyze extract yields, and determine extractive values and active compounds.
5. Developing herbal teas, infusions, and cosmetics (e.g., creams and shampoos).

Course : Research Project
Code : BORPP 351
Subject : Research Project Guideline

Total Credit : 2C
Course Type : Practical
Total Lecture : 12P

[Compulsory Paper, Six Credits] [Equivalent to 180 h]

GUIDELINE TO CARRY OUT PROJECTWORK

- 1. Duration of Project work:** - One semester, 180 Laboratory hours. In each week 3 laboratory sessions of 4 hours should be allotted to the students.
- 2. College should allot research guide (mentor) to each student.**
- 3. Choice of Research Problem and Workout:** Student should select research-based project with the help of his mentor. Research problem should be related to any branch of chemistry but preferably to any branch of analytical chemistry. Outline should be prepared by student with the help of mentor to perform and complete research project within stipulated time.
- 4. Internal Evaluation and Schedule for Submission of Project Work:**
 - a. Experiment work must be completed by within 12 weeks from the start of IV semester.**
 - b. Internal evaluation will be performed by mentor and one internal examiner when project is near to completion.**
 - c. The final copy of the project work (two Copies) should be submitted to department at the end of semester (15 th week after commencement of IV semester.**

Format for submission of project -

The project containing about 45-60 pages (A 4 size paper, 1 inch margin from all sides, font - Times New Roman, Font size – 12 pt). Should be divided into the following parts: -

- a. Tittle page**
- b. Certificate of completion of Project Work from mentor and HOD.**
- c. Declaration by candidate regarding plagiarism**
- d. Index**
- e. Chapter-1: Introduction to problem (introduction, signification of research problems selected, aims and objectives) (6-8 Pages)**
- f. Chapter-2: Review of Literature (Related Research Problem) (12-15 pages)**
- g. Chapter-3: Material and Methods (8-10 Pages)**

h. Chapter-4: Results and Discussion (20-25 Pages)

f. Chapter-5: Conclusions (1-2 page)

g. Bibliography

h. Acknowledgement

GUIDELINE FOR SUBMISSION AND ASSESMENT OF PROJECT WORK

- 1. Internal assessment 30% marks of 150 marks and External assessment 70% marks of 150 marks.**
- 2. At the end of IV semester two copies of research project must be submitted for certification and get both copies certified.**
- 2. The certified copy of research project should be produced at the time of university project Examination by the candidate.**
- 3. Project External evaluation – Power point presentation (20-30 minutes) by candidate followed by Viva- voce Exam purely based in project work. Marks will be assigned to i) Project work report (experimental work and accuracy in interpretation of results, discussions on results) – 50 marks; power point presentation and explanations given on results – 30 marks, question-answers – 25 marks.**

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- 4. After university project examination i.e. external evaluation of research project one copy must be submitted to department and one must be retained by the candidate.**

Note:

- 1. Project can be completed at college laboratory or in research laboratory recognized by SPPU / Government of Maharashtra / Government of India.**
- 2. In case, student is performing project work outside the college laboratory, then department should allot internal guide to the student and such guide will monitor the progress of research work of student. External guide will be from research institute where student is performing the research work. Student should obtain certificate of project completion from external guide which should be duly signed by internal guide. In this case Internal Evaluation will be jointly done by external and internal guides.**

Pattern for External Evaluation

Theory: For the four credit papers (70 marks) (paper with two sections); question paper will be set section wise. Each section will be of 35 marks. For two credit paper will be of 35 marks.

Question paper format will be as follows:

- ----- **Course Outcomes:**

By the end of this practical Course, students will be able to

Course Outcome:

After successful completion of this course, students will be able to...

1. Identify and formulate research problems.
2. Design and develop solutions to the problem.
3. Analyze and solve complex problems.
4. Write effective technical reports and present their findings.
5. Understand and apply research methodologies appropriate to their chosen field.
6. Critically evaluate existing research and identify gaps in knowledge.

Question Paper Pattern Courses Related to Botany

Marks: 35		Time: 2 Hour	
Instructions to the Candidate: 1. All questions are compulsory. 2. Figures to right indicate full marks. 3. Use of Log table and scientific calculator is allowed./ Draw well labelled diagram wherever necessary.			
Question-1	Solve Any five of the following (Short Answers) i. ii. iii. iv. v. vi.	Three def. type, two tricky questions and two questions problem type (if applicable)	5 Marks
Question-2	A. Solve any two of the following i. ii. iii. iv.	Note or Describe type questions	6 Marks
	B. Solve the following Any Single question of four marks	Problem type or tricky reasoning type question	4 marks
Question-3	A. Solve any two of the following i. ii. iii. iv.	Write Note / Differentiate type questions	6 Marks
	B. Solve the following Any Single question of four marks	Problem type or Derive equation or Tricky discussion type question	4 marks
Question-4	Solve Any four of the following i. ii. iii. iv. v.	Application type, Justification type question	10 marks

Course : Major
Code : BOMAT 361
Subject : Higher Cryptogams and Gymnosperms

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module - I Higher Cryptogams

15L

Chapter 1 Introduction

01L

1.1 Higher Cryptogams

Bryophytes:

07L

1.1 General characters of Bryophytes

1.2 Classification Systems

1.3 Classification of Bryophyte as per G. M. Smith (1955) up to classes giving reasons with two examples of each class.

1.4 Life cycle of Marchantia, Anthoceros, Polytricum with respect to: Systematic position, distribution, habit, External and internal morphology of gametophytes, Reproduction: Vegetative and sexual, Structure of sex organs. (Development is not expected) Fertilization, Structure of sporophyte.

1.5 Economic importance.

Chapter 2 Pteridophytes:

07L

2.1 General characters of Pteridophytes

2.2 Classification Systems Pteridophytes

2.3 Classification as per G. M. Smith (1955) of up to classes giving reasons with two examples of each class.

2.4 Life Cycle of Psilotum, Lycopodium, Marsilea with respect to: Systematic position, distribution, habit, External and internal morphology of gametophytes, Reproduction: Vegetative and sexual, Position and structure of sex organs. (Development is not expected), Structure of sporophyte.

2.5 Economic importance.

Module - II Gymnosperms

15L

Chapter 3 Gymnosperms:

03L

3.1 Introduction and General characters of Gymnosperms

3.2 Distinguishing features

3.3 Classification Systems

3.4 Classification of Gymnosperms by K. R. Sporne up to orders giving reasons

3.5 Alternation of generation

3.6 Economic importance of Gymnosperms

Chapter 4 *Pinus*:

06L

4.1 General Characters and distribution in India

4.2 Systematic position with reasons

4.3 External and Internal morphology: a) Primary structure of root, stem and leaf.

4.4 Life cycle

4.5 Reproductive structure: a) Male cone b) Structure & development of Male gametophyte c) Female cone d) Structure & development of Female gametophyte e) Fertilization

Chapter 5 *Gnetum*

06L

- 5.1 General Characters and Distribution in India
- 5.2 Systematic position with reasons
- 5.3 External and Internal morphology:
 - a) Primary structure of root, stem and leaf b) Anomalous Secondary growth in Gnetum.
- 5.4 Life cycle
 - Reproductive structure a) Male cone b) Structure and development of Male gametophyte c) Female cone d) Structure and development of Female Gametophyte e) Fertilization
- 5.5 Resemblance with Angiosperms.

Suggested Readings:

1. Datta, S. C. (1966). Introduction to Gymnosperms. Asia Pub. House, New Delhi, India.
2. Datta, S. C. (1998). Systematic Botany, 4th Ed. New Age International Pvt. Ltd. New Delhi, India.
3. Vashishta, P. C. (1983). Botany for degree students: Gymnosperms. S. Chand & Co. New Delhi, India.
4. Sporne, K. R. (1967). Morphology of Gymnosperms. Hutchinson university library London, U. K.

Course Outcome:

After successful completion of this course, students will be able to...

7. Describe higher cryptogams.
8. Compare different plant forms based on characteristic features and distinguish them from their respective group.
9. Discuss different taxonomic forms of higher cryptogams.
10. Explain life cycle patterns of different groups.
11. Understand economic and ecological significance of different groups.

Course : Major
Code : BOMAT 362
Subject : Phytochemistry

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module - I Basics of Phytochemistry

15L

Chapter 1 Introduction to Phytochemistry:

06L

- 1.1 Definition, scope, and importance of phytochemistry
- 1.2 Classification of phytochemicals: Primary and secondary metabolites
- 1.3 Overview of metabolic pathways: Primary metabolism (glycolysis, TCA cycle) and Secondary metabolism (shikimic acid pathway, mevalonate pathway).
- 1.4 Role of phytochemicals in plants and their ecological significance

Chapter 2 Primary and Secondary Metabolites:

09L

- 2.1 Carbohydrates: Structure, types, and functions in plants
- 2.2 Proteins and amino acids: Types and significance
- 2.3 Lipids: Types, and functions in plants
- 2.4 Nucleic acids: Basic structure and role in plants
- 2.5 Alkaloids: Definition, Types, and examples.
- 2.6 Phenolic compounds: Flavonoids, tannins, lignins,
- 2.7 Terpenoids and steroids: Types, and biological significance
- 2.8 Glycosides: Types, and examples (e.g., cardiac glycosides, saponins)
- 2.9 Resins and volatile oils: Composition and applications.

Module – II: Extraction techniques and Role of Phytochemicals

15L

Chapter 3 Phytochemical Analysis Techniques:

07L

- 3.1 Methods of extraction: Soxhlet extraction, maceration, steam distillation
- 3.2 Qualitative and quantitative analysis: Thin Layer Chromatography (TLC), High-Performance Liquid Chromatography (HPLC), Gas Chromatography (GC), UV-Vis Spectroscopy
- 3.3 Chromatographic techniques in metabolite profiling.

Chapter 4 Applications of Phytochemicals in Modern Science and Human Health:

08L

- 4.1 Drug discovery and development: Case studies of plant-derived drugs (e.g., Taxol, Artemisinin)
- 4.2 Role of phytochemicals in nutraceuticals and functional foods
- 4.3 Applications in agriculture: Biopesticides, biofertilizers, and plant growth regulators
- 4.4 Industrial applications: Flavors, fragrances, and natural dyes.
- 4.5 Mechanisms of action: Antioxidant, anti-inflammatory, and antimicrobial properties
- 4.6 Role in managing chronic diseases: Cancer, diabetes, cardiovascular diseases
- 4.7 Toxicology of phytochemicals: Safe dosage and side effects

Suggested Readings:

1. Harborne, J.B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. Springer.

2. Dewick, P.M. (2009). Medicinal Natural Products: A Biosynthetic Approach. Wiley.
3. Taiz, L., Zeiger, E., Møller, I.M., & Murphy, A. (2015). Plant Physiology and Development. Sinauer Associates.
4. Pandey, B.P. (2013). Economic Botany and Biotechnology. S. Chand & Company.
5. Stumpf, P.K., & Conn, E.E. (1981). Biochemistry of Plants: A Comprehensive Treatise. Academic Press.
6. Journals:
 - Phytochemistry
 - Journal of Natural Products
 - Plant Physiology
 - Critical Reviews in Plant Sciences

Course Outcomes

Upon successful completion of this course, students will be able to,

1. Understand and explain the fundamental concepts of Phytochemistry, including the classification and roles of phytochemicals.
2. Discuss the biosynthetic pathways involved in the production of primary and secondary metabolites
3. Interpret extraction and characterization techniques.
4. Recognize the ecological significance and industrial applications of plant-derived compounds.
5. Identify safe practices and toxicological aspects of phytochemical use in various domains.

Course : Major
Code : BOMAT 363
Subject : Plant Pathology

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module - I Introduction to plant pathology

15L

Chapter 1 Fundamentals of Plant Pathology:

6L

- 1.1 History of plant pathology- Contribution of Anton De Bary and Prof. B.B. Mundkur
- 1.2 Concepts of plant pathology- Incitants, Host, Symptoms, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease.
- 1.3 Economic impact of plant diseases

Chapter 2 Disease Development:

9L

- 2.1 Concept of disease cycle, Inoculation, Pre-penetration, Penetration, Infection, Dissemination. Epidemics-Forms, Decline, Exponential model.
- 2.2 Defense Mechanisms: Concept and Definition, Types-Preexisting-Structural and chemical, Induced- Structural and Biochemical, Phytoalexins,
- 2.3 Methods of Studying Plant Diseases: Macroscopic study, microscopic study, Koch's postulates. Types of culture Media, Pure culture methods- Serial dilution, Streak plate, pour plate, Spread plate.

Module - II Diseases and Control Measures

15L

Chapter 3 Fungal Plant Diseases:

5L

- 3.1 Introduction to fungi as plant pathogens.
- 3.2 Study of Diseases- Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut with reference to causal organism, symptoms and disease management.

Bacterial Plant Diseases: -

- 3.3 Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism.
- 3.4 Symptoms and disease management.

Chapter 4 Mycoplasma Plant Diseases:

4L

- 4.1 Introduction to Mycoplasma as plant pathogens
- 4.2 Study of Diseases Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to causal organism, symptoms and disease management.
- 4.3 Nematodal Plant Diseases:
- 4.4 Introduction to Nematodes as plant pathogens.
- 4.5 Study of Diseases Root knot diseases of vegetables, Soybean cyst, Nematodes with reference to causal organism.
- 4.6 Symptoms and disease management.

Chapter 5 Viral Plant Diseases:

4L

- 5.1 Introduction of Virus as plant pathogens.
- 5.2 Study of Diseases- Papaya Mosaic Disease, Bunchy top of Banana with reference to causal organism, symptoms and causal organism.
- 5.3 Symptoms and disease management.

Non-Parasitic Diseases:

- 5.4 The impact and abiotic causes- Temperature, Soil moisture and relative humidity, Poor oxygen, Poor light, Air pollutants, mineral deficiencies.
- 5.5 Herbicidal injury, Study of Mango necrosis, Black Heart of Potato.
- 5.6 Symptoms and disease management

Chapter 6 Principles of plant diseases control: 2L

- 6.1 General account, Quarantine, Eradication, cultural control practices, Biological control.
- 6.2 Introduction to Indian Agriculture Research Institute (IARI), International Crop Research Institute for Semi-Arid Tropics (ICRISAT)
- 6.3 Integrated management of Diseases – GMO, Chemical control, Soil Treatment.
- 6.4 Curative measures, chemical control.
- 6.5 Use of Effective Microorganism solution (EMS), Microbial Pesticides

Suggested Readings:

1. Singh R. S. (2019) Introduction to Principles of Plant Pathology 4th Ed (PB2019) Paperback.
2. Plant Pathology 2/e PB Sharma PD Paperback – 1 January 2016
3. A.V.S.S. Sambamurthy (2010) Principles of plant pathology, Wiley distributor
4. George Agrios (2004) Plant Pathology 5th Edition, Academic Press.

Course Outcome:

After successful completion of this course, students will be able to,

1. Understand organisms and causal factors responsible for plant diseases and methods of studying plant diseases.
2. To study the early development and role of different micro-organisms in development of plant disease.
3. Explain general concepts and classification of plant diseases.
4. Identify different strategies for management of plant diseases.
5. To study of research institutes working on plant disease management.

Course : Major
 Code : BOMAP 364
 Subject : Practical Botany VII
 (Practical Based on BOMAT 361 & 362)

Total Credit : 2
 Course Type : Practical
 Total Practical : 12

Sr. No	Practical Botany VII (Practical Based on BOMAT 361 & 362)	12P
Based on Higher Cryptogams and Gymnosperms		
1.	Study the morphology and Anatomy of <i>Marchantia</i> .	1P
2.	Study the reproductive structure and life cycle of <i>Marchantia</i> .	1P
3.	Study the morphology and Anatomy of <i>Polytrichum</i> .	1P
4.	Study the reproductive structure and life cycle of <i>Polytrichum</i> .	1P
5.	Study the morphology and Anatomy of <i>Pinus</i> .	1P
6.	Study the reproductive structure and life cycle of <i>Pinus</i> .	1P
7.	Study the morphology and Anatomy of <i>Gnetum</i> .	1P
8.	Field Visit to rich Biodiversity regions Students are expected to submit two forms or photographs of Bryophytes Pteridophytes and Gymnosperm along with tour report	1P
Based on BOMAT 362 Phytochemistry		
9.	Perform qualitative tests to identify carbohydrates, proteins, and lipids in plant extracts (e.g., Benedict's test for reducing sugars, Biuret test for proteins).	1P
10.	Isolate alkaloids from plant sources (e.g., <i>Rauvolfia serpentina</i>) using acid-base extraction and confirm their presence using Dragendorff's and Mayer's tests.	1P
11.	Use plant extracts (e.g., tea leaves or <i>Citrus</i> peels) to detect phenolic compounds and flavonoids using ferric chloride and Shinoda tests.	1P
12.	Extract essential oils from <i>Mentha</i> leaves using steam distillation and test for glycosides in plant samples using Keller-Kiliani tests.	1P
13.	Extract secondary metabolites from a plant sample using the Soxhlet apparatus and prepare the extract for further analysis.	1P
14.	Use a DPPH assay to measure the antioxidant activity of <i>Ocimum sanctum</i> (Tulsi) extracts and determine their free radical scavenging potential.	1P
15.	Perform a literature-based study and presentation on the extraction, characterization, and applications of Taxol (from <i>Taxus</i> species) or Artemisinin (from <i>Artemisia annua</i>).	1P

Suggested Readings:

1. Practical handbook of Ashok kumar and bendre.
2. Harborne, J.B. (1998). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis.
3. Taiz, L., Zeiger, E., Møller, I.M., & Murphy, A. (2015). Plant Physiology and Development.
4. Stumpf, P.K., & Conn, E.E. (1981). Biochemistry of Plants: A Comprehensive Treatise.
5. Publications and journals on phytochemistry and plant metabolites.
6. Datta, S. C. (1966). Introduction to Gymnosperms. Asia Pub. House, New Delhi, India.
7. 2. Datta, S. C. (1998). Systematic Botany, 4th Ed. New Age International Pvt. Ltd. New Delhi, IndiaA.V.S.S. Sambamurty (2010) Principles of plant pathology, Wileydistributor
8. Vashishta, P. C. (1983). Botany for degree students: Gymnosperms. S. Chand & Co. New Delhi, India.
9. Sporne, K. R. (1967). Morphology of Gymnosperms. Hutchinson university library London,U. K.

Course Outcomes:

After successful completion of this course, students will be able to,

1. To study the life cycles of gymnosperm plants.
2. Understanding the morphological and anatomical diversity of Bryophytes, Pteridophytes and Gymnosperms.
3. Explain different techniques for the extraction and analysis of phytochemicals.
4. Describe the major phytochemical compounds understand its biochemical pathways in plants.
5. Identify the chemical diversity of plant-derived compounds.
6. Describe the biosynthesis, functions, and applications of phytochemicals.
7. Discuss the analytical techniques for phytochemical extraction and characterization.

Course : Major
Code : BOMAP 365
Subject : Practical Botany VIII
 (Practical Based on BOMAT 362 & 363)

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No	Practical Botany VIII (Practical Based on BOMAT 362 & 363)	12P
Based on Phytochemistry		
1.	Extract secondary metabolites from a suitable plant sample using the Soxhlet apparatus.	1P
2.	To separate plant metabolites using TLC and visualize the separated compounds under UV light.	1P
3.	To measure the antioxidant activity and determine their free radical scavenging potential.	1P
4.	Perform a literature-based study and presentation on the extraction, characterization, and applications of Taxol or Artemisinin.	1P
5.	Perform qualitative tests to identify carbohydrates, proteins, and lipids in plant extracts (e.g., Benedict's test for reducing sugars, Biuret test for proteins).	2P
6.	Use plant extracts (e.g., tea leaves or Citrus peels) to detect phenolic compounds and flavonoids using ferric chloride and Shinoda tests.	1P
Based on BOMAT 363 Plant Pathology		
5.	Preparation of any one culture media for isolation of plant pathogens.	1P
6.	Culture technique- Streak plate methods, pour plate methods, Spread plate methods.	2P
7.	Study of any two of fungal (Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut) diseases.	2P
8.	Study of any two of each bacterial and mycoplasma diseases	1P
9.	Study of any two of each bacterial and mycoplasma diseases	1P
10.	Preparation of 1% Bordeaux mixture and Bordeaux paste 10% & Preparation of Jivamruta.	1P
11.	Study of Koch's Postulates.	1P

Suggested Readings:

1. Singh R. S. (2019) Introduction to Principles of Plant Pathology 4th Ed (PB2019) Paperback.
2. Plant Pathology 2/e PB Sharma PD Paperback – 1 January 2016
3. A.V.S.S. Sambamurty (2010) Principles of plant pathology, Wiley distributor
4. George Agrios (2004) Plant Pathology 5th Edition, Academic Press.
5. Harborne, J.B. (1998). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Springer.
6. Dewick, P.M. (2009). Medicinal Natural Products: A Biosynthetic Approach. Wiley.

7. Taiz, L., Zeiger, E., Møller, I.M., & Murphy, A. (2015). Plant Physiology and Development. Sinauer Associates.
8. Pandey, B.P. (2013). Economic Botany and Biotechnology. S. Chand & Company.
9. Stumpf, P.K., & Conn, E.E. (1981). Biochemistry of Plants: A Comprehensive Treatise. Academic Press.

Course Outcome:

After successful completion of this course, students will be able to,

8. Understand organisms and causal factor responsible for plant diseases and methods of studying plant diseases.
9. To study the early development and role of different micro-organism in development of plant disease.
10. Discuss the general concepts and classification of plant diseases.
11. Explain the different strategies for management of plant diseases.
12. To study the research institutes working on plant disease management.
13. Describe secondary metabolites its extraction process and its qualitative analysis of different secondary metabolites.
14. To apply knowledge regarding antioxidants its qualitative analysis and its applications and uses.

Course : Major Elective Course
Code : BOMET 361A
Subject : Computational Botany

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module - I Biostatistics: Sampling & Data Representation

15L

Chapter 1 Introduction to Biostatistics:

02L

- 1.1 Definition, importance of statistics in Botany
- 1.2 Statistical terms: Population, sample, primary and secondary data, qualitative and quantitative data,

Chapter 2 Sample and sampling

03L

- 2.1 Definition, Types of Sampling, need of sampling
- 2.2 Merits and demerits of sampling

Chapter 3 Methods of representation of statistical data:

10L

- 3.1 Classification of data
- 3.2 Objectives of classification
- 3.3 Classification according to class interval
- 3.4 Overlapping and non-overlapping frequency table
- 3.5 Essential features of tabular presentation
- 3.6 Advantages of tabular presentation
- 3.7 Graphic representation of data and its advantages
- 3.8 Types of graphic representation
 - Histogram
 - Frequency polygon
 - Frequency curve
 - Scatter or dot diagram
- 3.9 Merits and limitations of graphic representation
- 3.10 Diagrammatic representation of data
 - Line diagram
 - Bar diagram
 - Pie diagram

Module II: Statistical Methods

15L

Chapter 4 Measures of central tendency

03L

- 4.1 Mean Mode Median Standard Deviation, Standard Error
- 4.2 Advantages and disadvantages

Chapter 5 Measures of dispersion

04L

- 5.1 Range: Computation in individual, discrete and continuous series, coefficient of range, merits and limitations
- 5.2 Mean deviation and standard deviation: computation for grouped and ungrouped data, merits and limitation
- 5.3 Variance: Definition, coefficient of variance

Chapter 6	Correlation and regression	05L
	6.1 Definition and types of correlation	
	6.2 Coefficient of correlation and its properties	
	6.3 Methods of studying correlation:	
	6.4 Scatter diagram	
	6.5 Karl Pearson's coefficient of correlation.	
	6.6 Spearman Rank's coefficient of correlation	
	6.7 Regression analysis: Definition and types of regression and analysis	
Chapter 7	Tests of significance	03L
	7.1 Introduction	
	7.2 Meaning of statistical hypothesis, level of significance, null hypothesis and alternative hypothesis	
	7.3 t-test, z-test and Chi Square Test	
	7.4 Merits and demerits	

Suggested Readings:

1. Introduction to biostatistics, Pranab Kumar Banerjee.
2. Fundamentals of biostatistics, Khan and Khanum
3. Methods in Biostatistics for medical students and research workers, B K Mahajan
4. ABC of Research Methodology and Applied Biostatistics, M N Parikh and Nithya.
5. Biostatistics in brief, K Viswesara Rao
6. Introduction to Biometry, S G Purohit, V D Ranade and A V Dusane
7. Biostatistics-Basic Concepts and Methodology for the Health Sciences, Wayne W Daniel
8. Basic statistics, B L Agarwal

Course Outcome:

After successful completion of this course, students will be able to,

1. To study the importance of statistics in botany
2. Analyse the data by using statistical formula
3. Apply the different formula for experimental analysis
4. Discuss different Statistical methods for research

Course : Major Elective Course
Code : BOME P 362A
Subject : Practical on Computational Botany

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No	Practical on Computational Botany	12P
1.	Study of Sample and population and preparation of frequency class for analysis	1P
2.	Calculate the Mean, Median, Standard Deviation, Standard Error.	1P
3.	Calculate the skewness of the provided data	1P
4.	Calculate the Kurtosis of the provided data	1P
5.	Representation of data by various graphical methods	1P
6.	Statistical problems based on t-test	1P
7.	Statistical problems based on z-test	1P
8.	Statistical problems based on Chi Square test	1P
9.	Calculate the Karl Pearson's coefficient of correlation.	1P
10.	Calculate the Spearman Rank's coefficient of correlation	1P
11.	Draw a regression line and calculate the a and b value.	2P

Suggested Readings:

1. Introduction to biostatistics, Pranab Kumar Banerjee.
2. Fundamentals of biostatistics, Khan and Khanum
3. Methods in Biostatistics for medical students and research workers, B K Mahajan
4. ABC of Research Methodology and Applied Biostatistics, M N Parikh and Nithya.
5. Biostatistics in brief, K Viswesara Rao
6. Introduction to Biometry, S G Purohit, V D Ranade and A V Dusane
7. Biostatistics-Basic Concepts and Methodology for the Health Sciences, Wayne W Daniel
8. Basic statistics, B L Agarwal

Course Outcome:

After successful completion of this course, students will be able to,

1. Understand the types of data
2. Analysis the biological data.
3. Apply the different formula for calculation.

Course : Major Elective Course
Code : BOMET 361B
Subject : Basics of Agroforestry

Total Credit : 2
Course Type : Theory
Total Lecture : 30L

Module I Agriculture and Soil Fertility

15L

Chapter 1 Importance of Agriculture/Forestry/Livestock in National Economy **11L**

- 1.1 Principles of crop ecology and crop adaptation,
- 1.2 Climate shift and its ecological implications,
- 1.3 Argo-ecological regions in India.
- 1.4 Geographical distribution of crop plants,
- 1.5 Greenhouse effect,
- 1.6 Climatic factors and their effect on plant processes and crop productivity,
- 1.7 Role of GIS and GPS in agriculture.
- 1.8 Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management.
- 1.9 Important rural development programmed in India

Chapter 2 Agricultural Soil fertility and fertilizer use **04L**

- 2.1 Essential plant nutrients and their deficiency symptoms,
- 2.2 concept of essentiality of plant nutrients,
- 2.3 Indicators of soil fertility and productivity.

Module II Forestry and Agroforestry Systems

15L

Chapter 3 Forestry **07L**

- 3.1 Importance, types, classification, ecosystem,
- 3.2 Biotic and abiotic components,
- 3.3 Ecological succession and climax,
- 3.4 Nursery and planting technique,
- 3.5 Social forestry, farm forestry, urban forestry, community forestry, forest management,
- 3.6 Silvicultural practices, forest mensuration,
- 3.7 Natural regeneration, man-made plantations, shifting cultivation, taungya, dendrology, hardwoods, softwoods, pulp woods, fuel woods, multipurpose tree species, wasteland management.

Chapter 4 Agroforestry **08L**

- 4.1 Importance and land use systems,
- 4.2 Forest soils, classification and conservation,
- 4.3 Watershed management,
- 4.4 Wildlife - importance, abuse, depletion, management, major and minor forest products including medicinal and aromatic plants,
- 4.5 Forest inventory, aerial photo interpretation and remote sensing,
- 4.6 Forest depletion and degradation- importance and impact on environment,
- 4.7 Global warming, role of forests and trees in climate mitigation, tree diseases, wood decay and discoloration,
- 4.8 Tree pests, integrated pest and disease management, biological and chemical wood preservation,

4.9 Forest conservation, Indian forest policies, Indian forest act, forest engineering, forest economics, joint forest management and tribology.

Suggested Readings:

1. Nair, P.K.R. Agroforestry for Sustainable Agriculture. CRC Press, 2010.
2. Kumar, A., & Nair, P.K.R. Agroforestry: Principles and Practices. Springer, 2018.
3. Nair, P.K.R. Introduction to Agroforestry. Springer, 1993.
4. Yadav, G.L.L., & Jat, M.H.R. Agroforestry for Biodiversity and Ecosystem Services. Springer, 2017.
5. Nair, A.A.F.S. Tropical Agroforestry. Springer, 1993.
6. Reddy, M.G.R., Reddy, M.R., & Bawa, S.K. (Eds.). Agroforestry Systems. Wiley, 2015.
7. Nair, M.K., Jaiswal, R.S., & Anwar, R.H. (Eds.). Agroforestry and Climate Change. CRC Press, 2016.
8. Francis, C.A., & Power, E.J.R. (Eds.). Agroforestry in Sustainable Agricultural Systems. CRC Press, 1995.
9. Wilkins, D.E.B. The Agroforestry Handbook. Agronomy Press, 2002.
10. Shekhawat, G.S., & Singh, K.P. Agroforestry in India. Oxford & IBH, 2004.
11. Singh, D.L. Agroforestry: A Practical Approach. Agrotech Publishing Academy, 2010.
12. Nair, A.W., Stewart, C.N., & Wilkinson, C.P. Ecological and Socioeconomic Aspects of Agroforestry Systems. Springer, 2008.
13. Nair, P.S. Agroforestry in the Tropics. Oxford University Press, 1985.

Course Outcome:

After the completion of the course the students are expected to

1. Understand the basic principles, concepts, and significance of agroforestry in land use systems.
2. Discuss the role of trees in agricultural systems for soil conservation, biodiversity, and climate change mitigation.
3. Identify and differentiate between various agroforestry systems, such as silvopasture, alley cropping, and forest farming.
4. Describe agroforestry management plans that integrate tree-crop-livestock interactions to optimize productivity and sustainability

Course : Major Elective Course
Code : BOMEF 362B
Subject : Practical on Basics of Agroforestry

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No.	Practical on Basics of Agroforestry	12P
1.	Demonstration of the interaction between forest trees and plant crops.	1P
2.	Assessment of the soil fertility (pH, Water holding Capacity, any one Nutrient matter)	1P
3.	Mapping Agroforestry Systems Using GIS Tools	1P
4.	Study of various stages of plant succession	1P
5.	Identification of different types of agroforestry and Forest Farming.	1P
6.	Measurement of the growth parameters (height, diameter) and calculation of biomass of trees planted in agroforestry systems.	1P
7.	Comparative study of soil nutrient content (e.g., nitrogen, phosphorus, potassium) in agroforestry and conventional farming systems.	1P
8.	study of root distribution of agroforestry species and their impact on soil structure.	1P
9.	Study of Soil Erosion Control in Agroforestry Systems	1P
10.	Estimation of Carbon Sequestration in Agroforestry	1P
11.	Biodiversity Assessment in Agroforestry Systems	1P
12.	Visit to nearby agroforestry area	1P

Suggested Readings:

1. Nair, P.K.R. Agroforestry for Sustainable Agriculture. CRC Press, 2010.
2. Kumar, A., & Nair, P.K.R. Agroforestry: Principles and Practices. Springer, 2018.
3. Nair, P.K.R. Introduction to Agroforestry. Springer, 1993.
4. Yadav, G.L.L., & Jat, M.H.R. Agroforestry for Biodiversity and Ecosystem Services. Springer, 2017.
5. Nair, A.A.F.S. Tropical Agroforestry. Springer, 1993.
6. Reddy, M.G.R., Reddy, M.R., & Bawa, S.K. (Eds.). Agroforestry Systems. Wiley, 2015.
7. Nair, M.K., Jaiswal, R.S., & Anwar, R.H. (Eds.). Agroforestry and Climate Change. CRC Press, 2016.
8. Francis, C.A., & Power, E.J.R. (Eds.). Agroforestry in Sustainable Agricultural Systems. CRC Press, 1995.
9. Wilkins, D.E.B. The Agroforestry Handbook. Agronomy Press, 2002.
10. Shekhawat, G.S., & Singh, K.P. Agroforestry in India. Oxford & IBH, 2004.
11. Singh, D.L. Agroforestry: A Practical Approach. Agrotech Publishing Academy, 2010.
12. Nair, A.W., Stewart, C.N., & Wilkinson, C.P. Ecological and Socioeconomic Aspects of Agroforestry Systems. Springer, 2008.
13. Nair, P.S. Agroforestry in the Tropics. Oxford University Press, 1985.

Course Outcomes:

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

1. Understand the importance of Forest and auricular
2. To study the different measurement unit for the agroforestry
3. Explain the composition of soil and their significant role in the plant growth and development
4. Identify the types of forest area and origin of agriculture.

Course : Minor Course
Code : BOMIT 361
Subject : Environmental Botany

Total Credit : 2
Course Type : Theory
Total Lecture : 30

Module - I	Plants and their Environmental Interactions	15L
Chapter 1	Introduction to the Environmental Botany	03L
	1.1 Physical environment, components of environment: Air and atmosphere, troposphere, stratosphere, mesosphere and thermosphere.	
	1.2 Concept of sustainability and sustainable development	
Chapter 2	Ecosystems	05L
	2.1 Ecosystem structure and function, Energy flow in an ecosystem, food chains, food web	
	2.2 Types of Ecosystems and their case studies:	
	a) Forest ecosystem	
	b) Grassland ecosystem	
	c) Desert ecosystem	
	d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
	2.3 Ecological succession	
Chapter 3	Plant Resources:	04L
	3.1 Forest types of India, distribution of Indian forests, factor governing distribution of Indian forests. forest stratification and canopy structure, microclimate.	
	3.2 Plant resources as Food, Fodder, Fiber, Timber, Medicinal and Aromatic plants	
Chapter 4	Plant Organism Interactions:	03L
	4.1 Positive and negative interspecific interactions (commensalism, mutualism, predation, competition, parasitism, antibiosis), co-evolution, cooperation and complexity, allelopathy	
Module - II	Environmental Pollution: Control Measures and Legal Framework	15L
Chapter 5	Environmental Pollution	06L
	5.1 Environmental pollution: types, causes, effects and control measures: Air, water, soil and noise pollution,	
	5.2 Photochemical Smog-Concept, inhibition, adverse effect of photochemical smog, Nuclear hazards and human health risks	
	5.3 Pollution control using engineered microorganisms, Role of microbes in control of air pollutants, Biomass and Biofuel, bio filters for air pollution control, Biosensors.	
Chapter 6	Solid waste management:	04L
	6.1 Control measures for various types of urban, industrial waste, Hazardous waste, biomedical wastes, Electronic wastes, and their environmental effects.	
	6.2 Pollution case studies: Ganga Action plan (GAP), Plastic waste management rules.	

Chapter 7 Environmental Ethics and Social Responsibility:

5L

- 7.1 Ethical considerations in environmental decision-making, role of individuals and communities in environmental sustainability.
- 7.2 The Environmental Protection Act 1986 and Rules 1986, Hazardous waste management and handling rules 1989 amendments thereof 2000, Disaster management Act 2005.
- 7.3 Wildlife Protection Act 1972, Amended 1991, Forest Conservation Act 1980, Indian forest Act (revised) 1982, Biodiversity Rules 2004.

Suggested Readings:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
3. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
5. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
6. World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press

Course Outcome:

After successful completion of this course, students will be able to,

1. Understand how plants interact with their environment, including soil, water, air, and other living organisms (e.g., animals, fungi, microorganisms).
2. To study the adaptations of plants to different environmental conditions such as drought, extreme temperatures, salinity, and low nutrient availability.
3. Describe the knowledge about climate change, including changes in temperature, precipitation, and CO₂ levels, impacts plant growth, distribution, and health.
4. Discuss about environmental ethics and social responsibility

Course : Minor practical botany
Code : BOMIP362
Subject : Practical on Environmental Botany

Total Credit : 2
Course Type : Practical
Total Practical : 12

Sr. No.	Practical on Environmental Botany	12P
		1P
1)	Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.	
2)	Determination of organic matter of different soil samples by Walkley & Black rapid titration method	1P
3)	Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.	1P
4)	Study of ecological adaptations of hydrophytes, xerophytes and halophytes (Any two)	1P
5)	Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.	1P
6)	Study of physicochemical properties of water body by using Sacchi disc, pH meter and electric conductivity meter	1P
7)	Identification of microclimatic variations across different habitats based on temperature, humidity, wind speed, precipitation, and light intensity measurements.	1P
8)	Study of polluted water body with reference to BOD (D zero day and D fifth day)	1P
9)	Study of suitable ecosystem by line/belt transect method/nested quadrat method.	1P
10)	Acquisition of ecological data of particular locality by using GPS/altimeter/geographical maps etc.	1P
11)	Determination of bulk density, porosity and rate of infiltration of water in soil of three habitats	1P
12)	Field visit to familiarize students with ecology of different sites.	1P

Suggested Readings

1. Rina Majumdar, Renuka Kashyap. (2019). Practical Manual of Ecology and Environment Science.
2. Prestige Books Publications, New Delhi, India. ISBN-10:8193651278.
3. Rohit R, Bharti S, Sudeep S, Rakesh K, Mamta B. (2022). Practical Manual in Environment Sciences. Narendra Publishing House. Delhi, India. ISBN:9789392851339
4. Ramesh T, Swarajya Lakshmi G, Prabhu P. (2018). Environmental Science: A Practical Manual. B.S Publications, Hyderabad, India. ISBN-10 :9389974720

Course Outcomes:

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

1. Apply analytical skills that will deepen their understanding of plant-environment interactions.
2. Identify the tools needed to contribute in plant conservation.
3. To apply practical skills are essential for tackling environmental challenge

P. D. E. A's
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Affiliated to

Savitribai Phule Pune University [SPPU]

NEP-2020 Implementation

Choice Based Credit System [CBCS]
Under

Autonomy

Guideline for

On Job Training Internship Policy
and

According to
Higher and Technical Education
Department Government of Maharashtra

From Academic Year
2023-2024

Applicable to

UG and PG under Autonomy and NEP-2020

UG and PG under Autonomy and NEP-2020

1. Introduction: All the Higher Educational Institutions (HEIs) are mandated to enable all the eligible students to take an active part in the Internship selection process. The Internship Cell constituted at the HEIs will extend all the possible support to the students. It will help in achieving the best-paid internship results in the given condition through the assistance and full cooperation of all the students, alumni, and recruiting organizations, making the HEI their most favoured destination. The internship policy detailed hereunder will apply to academic session 2023-2024 onwards.

- 1. Background:** The National Education Policy (NEP)¹, 2020 suggests that students must actively engage with the practical side of their learning as part of a holistic education to further improve their employability. It states that students at all HEIs will be provided with opportunities for internships with local industry and businesses as well as research internships with faculty and researchers at their own or other HEIs/research institutions.

University Grants Commission (UGC) released National Credit Framework (NCrF)² in April 2023. It underscores the significance of experiential learning as part of the curricular structure through internships, on-the-job training, industrial projects, etc. The focus is further streamlined through the Guidelines for Internship/Research Internship released later in October 2023.

In line with the NEP and tracing the provisions of NcrF, Government of Maharashtra has subsequently released two Government Resolutions (GRs)³ to reinforce NEP implementation and credit revision across Maharashtra HEIs. These GRs lay out detailed guidelines for curriculum interventions for Four Year UG Engineering and other UG AICTE courses, B.A./ B.Sc./ B.Com. (and all Non-AICTE UG courses), and M.A./ M.Sc./ M.Com. (and all PG courses).

To foster holistic education, which encompasses hands-on experience, the focus of Government now turns towards strengthening the internship ecosystem through a formalized Internship Policy. This strategic move comes as a response to the NEP's call for students to engage with practical learning through internships and apprenticeships, a practice proven to enhance employability and refine skill sets.

- 2. Objective and Vision:** Internships serve as pivotal educational and career development opportunities, offering hands-on experience in specific fields or disciplines. They are structured, short-term, supervised Internships often centered around particular tasks or projects with predefined timeframes. An internship may be compensated, partially compensated, or unpaid; however, it must be meaningful and beneficial to both the intern and the hosting organization. Following are the objectives of the Internships envisaged for the students enrolled in State HEIs: • Exposing students to industrial environments that cannot be replicated in a classroom. • Providing opportunities to acquire and refine analytical and managerial skills crucial for a professional career. • Offering hands-on experience in teamwork, thereby enhancing professional skills like communication, work ethics, conflict resolution, etc., with a lasting impact on lifelong learning and professional development. • Establishing links between students and potential future job or research opportunities.

- 3. Types of Internships:** Internships are an integral part of the academic curricula. Satisfactory completion of an internship is a mandatory requirement for the degree to be awarded by the HEI. Furthermore, considering the curriculum structure approved by the HEI, multiple modes of internships are possible and are assigned academic credits within the curricula. The general idea is to enable students to undertake immersive assignments within the organizations for a limited period.

The following is a brief overview of credit requirements in line with GoM GRs, UGC, and AICTE⁴:

- 12 credits of Internship activities may be accounted for UG Engineering (AICTE) courses.
- 12-14 credits of Internship activities may be accounted for B.A., B.Sc., B.Com. and all Non-AICTE professional UG degree courses.
- 10-12 credits of Internship activities may be accounted for M.A., M.Sc., M.Com. and all professional PG degree courses.

It must be noted that 1 credit is equivalent to minimum 30 hours of work. An intern is expected to spend 30 hours per week on Internship and related activities. Furthermore, Internships may be done through offline / online mode.

However, indicative requirement regarding Internship duration and credits for Four Year UG Engineering and other UG AICTE courses is as follows:

Internship	Schedule	Duration	Activities	Credits
Semester Integrated Internship	6 th / 8 th Semester	full-time across semester with other courses on online mode	Project work, Seminar, Industrial Training (excluding credits for Advanced Courses). This can be Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship / academic / industry research project	12

For B.A., B.Sc., B.Com. and all Non-AICTE professional UG degree courses, the indicative requirement regarding Internship duration and credits is as follows:

Internship	Schedule	Duration	Activities	Credits
Summers	After 4 th or 6 th Semester	4-8 weeks	Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship	8
Winters	After 3 rd / 5 th Semester	2-4 weeks	Inter/ Intra Institutional Activities, Research Project, Community Engagement	2-4
Semester Integrated	6 th / 8 th Semester	can be part-time- duration can be as per HEI's discretion	Project work, Seminar (excluding credits for Advanced Courses)	2-4

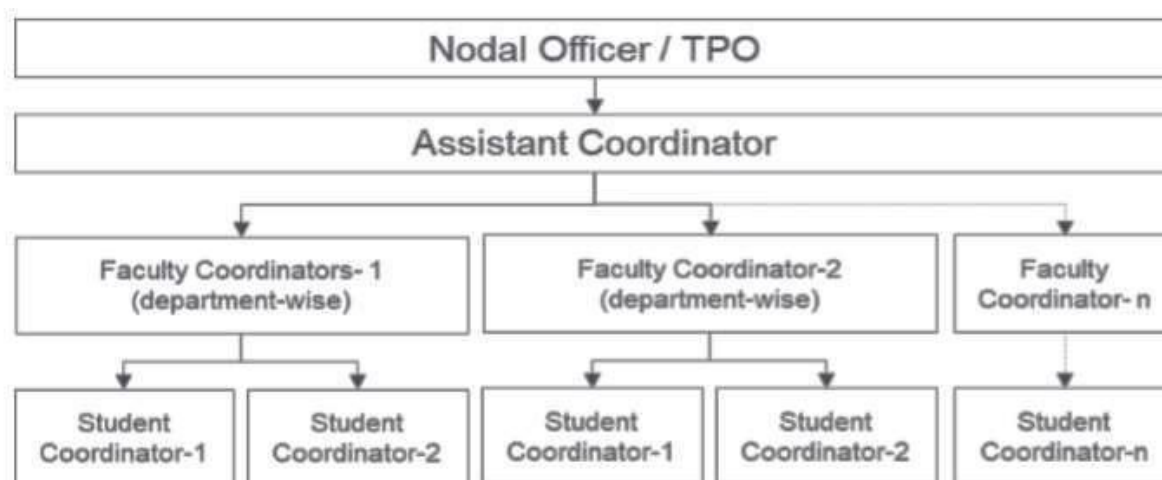
* Internship/Apprenticeship: 8 Credits + Field Projects/Community Engagement: 4-6 Credits For M.A., M.Sc., M.Com. and all professional PG degree courses, the indicative requirement regarding Internship duration and credits is as follows:

Internship	Schedule	Duration	Activities	Credits
Summers	After 2 nd Semester	4-6 weeks	Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship	4
Semester Integrated	3 rd & 4 th Semester	can be part-time- duration can be as per HEI's discretion	Project work, Seminar, Industrial Training (excluding credits for Advanced Courses). This can be Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship / academic / industry research project	10-12

During the internship registration, the students are to notify their preference on whether they are seeking academic or industrial internships.

2. Internship Cell

- Governance Structure:** For every HEI, the Internship Cell shall be led by Internship Governing Council comprising of Vice Chancellor/Dean/Principal, Nodal Officer/TPO, and Assistant Coordinator(s). The Cell will further have Department-level Faculty Coordinators. Additionally, Student Coordinators shall be appointed from each Department by the nominated Faculty for efficient outreach to students. The following chart illustrates the Governance structure envisaged for the Cell:



It must be noted that: • The Nodal Officer/TPO and Assistant Coordinators shall be appointed by the Vice Chancellor/Dean/Principal. • Each HEI Campus will have an Assistant Coordinator reporting to Nodal Officer. • The Nodal Officer shall report the progress and details of internships in each academic year to Vice Chancellor/Dean/Principal.

2. **Duties and Responsibilities:** The Internship Cell shall be responsible for the proper functioning of the Internship processes at the HEI. The overall role of the Cell is of a facilitator and counsellor for Internship related activities. The brief activities of the Cell would include: • The Cell shall work to identify projects linked to the local industry needs and create a pool available. • The Cell is responsible to conceptualize a digital portal where they can register experts, industries, organizations, mentors, faculty members which are visible to students.

Internship Cell shall maintain a uniform record-keeping mechanism. It shall also ensure that the evaluation rubrics are implemented as per the mandate of NEP, 2020, GRs released by Government of Maharashtra, and National Credit Framework by UGC. • The cell shall streamline internship selection process including, but not limited to Resume Screening, PPTs, Tests, GDs, Interviews, etc. • The Cell shall map students to student coordinators from the department. They are first point of contact in the Cell and would help throughout the process – answering all queries and managing the whole process. • The Student Coordinators in consultation with the department/school-level faculty shall carry out the task of resume verification at the start of the academic session. • Internship Cell shall make a sincere effort every year to bring in new companies in upcoming sectors to ensure better and more diverse opportunities for students., the Cell shall make their best efforts in reaching out to the organizations preferred by students. • The Cell shall work towards connecting with the organization and signing MOUs with them on the behalf of HEI to establish long-term collaboration for providing internship. • The Cell shall organize preparatory events throughout the year. Information regarding the sessions will be provided to the students via mail and other mediums. The Cell shall collate and share reference books, sample questions, mock test papers among students. • The Cell shall facilitate the on boarding of students for Internships, through online or offline medium, in line with Organization’s requirements. • The Cell shall ensure protection of students in case of any offenses by the organizations. The Nodal Officer/TPO shall be the final arbiter on such matters.

Additional functions of the Internship Cell include arranging experts for student’s personality development, improve communication skills, vocabulary, prepare students for resume preparation & email writing, group discussion, interview skills, aptitude training & practice tests, technical report writing, presentation skills, foreign languages proficiency etc.

The department-level Faculty Coordinators and student coordinators shall act as facilitators between HEI, recruiters and students. The team will be responsible for managing databases, facilitating and overseeing outreach, addressing Internship-related Q&As, understanding and reporting student preferences, and resolving queries with respect to the internships.

Additionally, a Mentor shall be identified by the Internship Cell or by each student through their network. The role of a Mentor shall be to provide professional/research guidance to the student during the internship. They shall also facilitate networking with other subject matter experts/professionals, which will enhance the internship experience and learning of the students.

The department-level Faculty Coordinator and Mentors will be nominated at the start of the academic year for each department. Student Coordinators will be elected by the students through the process laid down by the Nodal Officer/TPO. These Student Coordinators, upon satisfactory performance and contribution, shall be promoted to being Student Placement Coordinators in their later years of study.

2.3. Organization Outreach: The Cell, through the powers vested by Nodal Officer/TPO, shall reach out to the prospective companies in a formal and professional manner. The primary outreach shall be inclusive of following processes: • Development of Internship Brochure – soft copy as well as hard copy. • Preparing list of potential recruiters and past recruiters • Preferences mentioned by students in their Internship Undertaking

On these lines, the HEI is mandated to create Industry / academic linkages with organizations and institutions for establishing long-term partnership in recruiting interns. These linkages are to be made accessible on the University portal. The HEI shall further enable these potential recruiters to register on public platforms like AICTE for better visibility of opportunities across Maharashtra.

2.4. Data Management: The Cell shall maintain a uniform database for Internships at department-level and HEI level. The Cell shall have a restricted access to the database. It shall have detailed profiles of students, their contact details, prior education & experience, academic credentials, location / sectoral preferences, and internship status (companies shortlisted, awaiting response, internship offer, etc.). This database shall have a common skeletal framework and it shall be archived every academic year. Additionally, the data pertaining to Organization profiles shall be revised and updated with organization POCs and their coordinates.

3. Internship Guidelines for Students

1. Eligibility and Timeline All the bonafide students enrolled in the HEI are eligible for internships, provided they have two or fewer backlogs at the start of the odd semester of the academic year. The HEI shall, at the start of each academic year, specify the timelines pertaining to undertakings, resume submission deadlines, resume proof-checking and verification, organizing outreach, and selection process.

2. Internship Application

- The Internship Cell shall proactively inform the students when internship opportunities are floated along with the nature of internship, compensation structure, work mode/location, etc.
- Interested students shall give their names to the department coordinators, who shall pass them on to the Assistant Coordinator with their resume.
- Once the resumes are submitted to the organizations, the selection process shall start.

The Cell will assist companies in scheduling pre-placement talks, tests, GDs, Interviews.

- Students are to strictly adhere to the schedule such events

3. Code of Conduct

- Each student is eligible to accept at most one Internship offer through the process. They would be deregistered from the process after receiving the offer.
- Any off-campus opportunities given to the students must be reported to the HEI for subsequent procedures of relieving to take place in time.
- Students are required to dress in formal clothing and footwear with a presentable persona throughout the selection process. Casual clothing will not be allowed during any part of the whole process.
- If any student has any grievances with respect to termination and/or any penal action ordered by concerned HOD, then such student can submit his appeal in writing to the Nodal Officer/TPO, who shall be the final arbitrator on such matters.
- After performing exceedingly well in the Internship, the student may be provided with a Pre-Placement Offer (PPO). It needs to be accepted/rejected by the student within the deadline as set forth by the organization. A student who accepts the PPO will be considered “placed” and deregistered from the Placement process. If a student rejects a PPO, they can appear for further placements with the cell without any restrictions.

3.4. Internship Evaluation

After completion of Internship, students are to prepare a comprehensive report highlighting their learnings and takeaways during the internship period. The report shall be signed by the Internship Supervisor, Nodal Officer/TPO and Faculty Mentor.

The students are mandated to give a seminar based on the internship undertaken before an expert committee constituted by the concerned department, as per Performa for Evaluation of Internship (Appendix IX).

The internship shall be evaluated on the basis of performance, as reflected in the student log (Appendix V), Attendance record (Appendix VI), supervisor evaluation form (Appendix VII).

The assessment of internship will be based on the following criteria:

- Quality and effectiveness of presentation
- Depth of knowledge and demonstrated skills
- Variety and relevance of learning experience
- Practical applications and relationships with concepts taught in the course
- Internship Report

Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students. The weightage given to the Internship evaluation shall be as per the discretion of the concerned HODs and Nodal Officer/TPO. The credits will be allocated on the basis of overall grade (above Pass) received by the students during the assessment.

4. Appendix

4.1. Appendix I:

Internship Undertaking

1. Student Name:			
2. Current Address			
3. Residence Address			
4. Email id			
5. Mobile Nos.			
6. Aadhar card			
7. PAN			
8. Overall GPA			
9. Mode of Internship			
10. Internship Preferences			
	Location	Core Area	Organization / Institute
Preference-1			
Preference-2			
Preference-3			
confirm that I agree with the terms, conditions, and requirements of the Internship Policy Student Signature: Date: _____			

I confirm that the student has attended the internship orientation and has met all paperwork and process requirements to participate in the internship program, and has received approval from his/her mentor.

Sign of Department Faculty Coordinator:

Date :

4.2. Appendix II:

Draft Resume Template

Name:

Contact Number and Email ID:

Education:

HEI Name	Year
----------	------

Degree / Specialization:	Year
--------------------------	------

CGPA:

HEI Name: <bachelor's degree>

Degree / Specialization:

CGPA:

Internship / Work Experience

Year

Organization

Project:

Brief:

Academic Experience

Semester	Year
----------	------

Project:

Brief:

- Emphasize accomplishments that are relevant to the field
- Be specific—omit unnecessary words and sentences
- Start your sentence with an action verb, not a passive one Use past-tense verbs to show what you have accomplished Quantify results as much as possible
- Use key words that will catch a recruiter's eye

Other Achievements and Personal Interests

- List other achievements also in reverse chronological order
- Leadership positions held outside of your formal work environment
- Personal interests and accomplishments that will distinguish you from other applicants
- Volunteer service/Social Work

4.3. Appendix III:

Organization Outreach Letter

<HEI Letter Head> To,
The (Manager, HR)

Subject: Request for ____ weeks internship of Students pursuing < >

Dear Sir,

The HEI established in <year>, <HEI>, Maharashtra reflects the vision of leading industrialists and educationalists. Institute is accredited with '< >' grade by NAAC in March 2015. The HEI has been recognized about it's over all academic excellence and infrastructure.

In view of the above, I request your good self to allow our following (no. of students) students for practical raining in your esteemed organization. Kindly accord your permission and give at least one-week time for students to join training after confirmation.

No.	Name	Roll no.	Year	Department

The resumes of these students are attached with this letter. If vacancies exist, kindly do plan for Interviews for the students in above branches.

A line of confirmation will be highly appreciated.

Yours sincerely,

Nodal Officer/TPO
<HEI Name and Date>

4.4. Appendix IV:

Relieving Letter of Student

<HEI Letter Head>

To,

The General Manager (HR)

.....

Subject: Relieving letter of student

Dear Sir,

Kindly refer your letter/e-mail dated..... on the above cited subject. As permitted by your good self the following students will undergo Industrial Internship in your esteemed organization under your sole guidance and direction

No.	Name	Roll no.	Year	Department

This training being an essential part of the curriculum, the following guidelines have been prescribed in the curriculum for the training. You are therefore, requested to please issue following guidelines to the concerned student mentor.

- Internship schedule may be prepared and a copy of the same may be sent to us.
- Each student is required to prepare Internship diary and report.
- Kindly check the Internship diary of the student daily.
- Issue instruction regarding working hours during training and maintenance of the attendance record
You are requested to evaluate the student's performance on the basis of grading i.e.

Excellent, Very Good, Satisfactory and Non-Satisfactory on the below mentioned factors:

- Attendance and general behaviour
- Relation with workers and supervisors
- Initiative and efforts in learning
- Knowledge and skills improvement
- Contribution to the organization

The performance report may please be forwarded to the undersigned on completion of training in sealed envelope.

Your efforts in this regard will positively enhance knowledge and practical skills of the students, your cooperation will be highly appreciated, and we shall feel obliged.

The students will abide by the rules and regulation of the organization and will maintain a proper discipline with keen interest during their internship. The students will report to you on dated..... along with a copy of this letter.

Yours sincerely,
Nodal Officer/TPO
<HEI Name and Date>

4.5. Appendix V:

Student Diary (Log) Recording Format

Week	Date From - to	Task Assigned	Activities Performed	Key Learnings	Additional Remarks
1					
2					
3					
4					
5					
6					

Signature of Industry Supervisor

4.6. Appendix VI:

Attendance Sheet

<Organization Letter Head>

Name & Address of Organization

Name of the Student	
Roll Number	
Name of Course	
Date of Commencement of Training	
Date of Completion of Training	

Week	Mon	Thu	Wed	Thu	Fri	Sat
1						
2						
3						
4						
5						
6						

- Attendance Sheet should remain affixed in Daily Training Diary. Do not remove or tear it off.
- Holidays should be marked in Red Ink in attendance column. Absent should be marked as 'A' in Red Ink.

Name and Signature with date of Internship Supervisor: _____

4.7. Appendix VII:

Supervisor or Evaluation of Intern

<Organization Letter Head>

Student Name: _____ Date: _____

Work Supervisor: _____ Title: _____

Organization: _____

Internship Address: _____

Dates of Internship: From _____ To _____

Please evaluate intern by indicating the frequency with which you observed the following behaviours:

Parameters	Needs Improvement	Satisfactory	Good	Excellent
Behaviours				
Performs in a dependable manner				
Cooperates with co-workers and supervisors				
Shows interest in work				
Learns quickly				
Shows initiative				
Produces high quality work				
Accepts responsibility				
Accepts criticism				
Demonstrates organizational skills				
Uses technical knowledge and expertise				
Shows good judgment				
Demonstrates creativity/originality				
Analyses problems effectively				
Is self-reliant				
Communicates well				
Writes effectively				
Has a professional attitude				
Gives a professional appearance				
Is punctual				
Uses time effectively				

Overall performance of student intern (circle one): (Needs improvement / Satisfactory / Good / Excellent) Additional comments, if any:

Signature of Industry supervisor_____

HR Manager _____

4.8. Appendix VIII:

Student Feedback of Internship

(To be filled by Students after Internship completion)

Student Name: _____ Date: _____

Industrial Supervisor: _____ Title: _____

Supervisor Email: _____ Internship is: ____ Paid ____ Unpaid ____

Organization: _____

Internship

Address: _____

Faculty Coordinator: _____ Department: _____

Dates of Internship: From _____ To _____

Give a brief description of your internship work (title and tasks for which you were responsible):

Was your internship experience related to your major area of study?

- Yes, to a large degree
- Yes, to a slight degree
- No, not related at all

Indicate the degree to which you agree or disagree with the following statements.

Experience has:	Strongly Agree	Agree	No opinion	Disagree	Strongly Disagree
Given me the opportunity to explore a career field					
Allowed me to apply classroom theory to practice					
Helped me develop my decision-making and problem-solving skills					
Expanded my knowledge about the work world prior to permanent employment					
Helped me develop my written and oral communication skills					
Provided a chance to use leadership skills (influence others, develop ideas with others, stimulate decision-making and action)					
Expanded my sensitivity to the ethical implications of the work involved					
Made it possible for me to be more confident in new situations					
Given me a chance to improve my interpersonal skills					
Helped me learn to handle responsibility and use my time wisely					
Helped me discover new aspects of myself that I didn't know existed before					
Helped me develop new interests and abilities					
Helped me clarify my career goals					
Provided me with contacts which may lead to future employment					

Allowed me to acquire information and/ or use equipment not available at my Institute					
---	--	--	--	--	--

- In the Institute internship program, faculty members are expected to be mentors for students. Do you feel that your faculty coordinator served such a function? Why or why not?
- How well were you able to accomplish the initial goals, tasks and new skills that were set down in your learning contract? In what ways were you able to take a new direction or expand beyond your contract? Why were some goals not accomplished adequately?
- What areas did you most develop and improve?
- What has been the most significant accomplishment or satisfying moment of your internship?
- What did you dislike about the internship?
- Considering your overall experience, how would you rate this internship? (Circle one). Satisfactory/ Good/ Excellent
- Give suggestions as to how your internship experience could have been improved. (Could you have handled added responsibility? Would you have liked more discussions with your professor concerning your internship? Was closer supervision needed? Was more of an orientation required?)

<Signature of Student>

<Name, Roll number, Date>

4.9. Appendix IX:

Performa for Evaluation of Internship by Institute

<HEI Letter Head>

1. Name of Student _____
2. Mob. No. _____
3. Roll No. _____
4. Branch/Semester _____
5. Period of Training _____
6. Home Address with contact No. _____
7. Address of Training Site: _____
8. Address of Training Providing Agency: _____
9. Name/Designation of Training In- charge _____
10. Type of Work _____ 11. Date of Evaluation _____
12. Please rate the following:

S.no.	Particular	Grade
1	Quality and effectiveness of presentation	
2	Depth of knowledge and demonstrated skills	
3	Variety and relevance of learning experience	
4	Practical applications and relationships with concepts taught	
5	Internship Report	
6	Attendance record, student log, supervisor evaluation	

Overall grade: _____

Additional Remarks:

Signature of Faculty Mentor

Course Outcomes:

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

1. Better understanding of the work environment
2. Increased engagement and retention
3. Opportunities for career
4. adaptability and Improved efficiency
5. Increased productivity
6. Faster integration and onboarding

Question Paper Pattern Courses Related to Botany

Marks: 35

Time: 2 Hour

Instructions to the Candidate:

1. All questions are compulsory.
2. Figures to right indicate full marks.
3. Use of Log table and scientific calculator is allowed. / Draw well labelled diagram wherever necessary.

Question-1	Solve Any five of the following (Short Answers) i. ii. iii. iv. v. vi. vii.	Three def. type, two tricky questions and two questions problem type (if applicable)	5 Marks
Question-2	A. Solve any two of the following i. ii. iii. iv.	Note or Describe type questions	6 Marks
	B. Solve the following Any Single question of four marks i. ii.	Problem type or tricky reasoning type question	4 marks
Question-3	A. Solve any two of the following i. ii. iii. iv.	Write Note / Differentiate type questions	6 Marks
	B. Solve the any one of the following Any Single question of four marks i. ii.	Problem type or Derive equation or Tricky discussion type question	4 marks
Question-4	Solve Any four of the following i. ii. iii. iv. v.	Application type, Justification type question	10marks

