PDEA's

Prof. Ramkrishna More Arts Commerce and Science College (Autonomous),

PDEA's

Prof. Ramkrishna More Arts Commerce and Science College, Akurdi, Pune- 411044

Affiliated to

Savitribai Phule Pune University (SPPU)

Choice Based Credit System (CBCS) under

Autonomy & NEP-2020

PG Degree Program in Botany

(Faculty of Science)

M.Sc. I

To be implemented from Academic Year 2023-2024

Board of Studies: Botany

P. D. E. A's.

Prof. Ramkrishna More College, Akurdi, Pune 411044

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

Department of Botany

MSc Botany Part I

Sem	Major Courses	Major Elective Courses	Minor Courses	VSC	IKS
I	5 theory + 2 Practical Plant Systematics - I (Algae & Fungi) Advanced Cell Biology Genetics & Plant Breeding Plant organism Interaction Floriculture and Pomoculture	1 Theory + 1 Practical Crop Physiology or Biodiversity	RM 4 credits	0	0
II	5 theory + 2 Practical Plant Systematics - II (Bryophytes and Pteridophytes) Advanced Molecular Biology Biostatistics Plant Evolution Tools and Techniques in Plant Science	1 Theory + 1 Practical Applied Biotechnology and Nanotechnology or Pharmacognosy	0	0	0

MSc Botany Part II

III	5 theory + 2 Practical Gymnosperms and Palaeobotany Advanced Plant Physiology and Phytochemistry Ecology and Sustainable Development	1 Theory + 1 Practical Cytogenetics or Secondary Metabolites of Plants	Research Project 4 credits		
IV	5 theory + 2 Practical Angiosperms and Palynology Bio-Entrepreneurship and Bioinformatics	1 Theory + 1 Practical Bio-remediation and Bioprospecting or Artificial Intelligence AI in Botany			

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Dept of Botany

B.Sc.(Honours) in Botany is intended to provide a broad framework within which both the undergraduate programs in Botany help to create an academic base that responds to the need of the students to understand the basics of Botany and its ever evolving nature of applications in explaining all the observed natural phenomenon as well as predicting the future applications to the new phenomenon with a global perspective. The curriculum framework is designed and formulated in order to acquire and maintain standards of achievement in terms of knowledge, understanding and skills in Botany and their applications to the natural phenomenon as well as the development of scientific attitudes and values appropriate for rational reasoning, critical thinking and developing skills for problem solving and initiating research which are competitive globally and are on par in excellence with the standard Higher Education Institutions (HEI) in the advanced countries of America, Asia and Europe. The multicultural fabric of our nation requires that the institutions involved in implementing this curriculum framework also work hard towards providing an environment to create, develop and inculcate rational, ethical and moral attitudes and values to help the creation of knowledge society needed for scientific advancement of our nation.

Goals:
The Department has formulated three broad educational goals for the undergraduate degree programs:

Botany knowledge: To provide students with the basic foundation in Botany the interplay of theory and experiment, and to motivate scientific enthusiasm and curiosity and the joy of learning.

Problem solving skills: To provide students with the tools needed to analyse problems, apply experimentation, and synthesize ideas.

Employment and technical skills: To provide the students with technical skills necessary for successful careers in Botany and related or alternative careers for which a physics foundation can be very useful. These include computers and communication skills (oral and written).

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Guidelines for Syllabus Design of all courses under Autonomy and NEP-2023

All HOD's and Teachers Involved in syllabus design under Autonomy and NEP-2023 are informed that you have to design syllabus as per the following general guidelines.

1. One semester = 15 weeks (12 weeks actual teaching and 3 weeks for internal evaluation, tutorials, problem solutions, student difficulty solution, etc.)

2. 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 (practice problem solving sessions, repeated discussion on difficult topics, discussion on student's difficulties, questions discussion and internal evaluation)

3. 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.

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

a. Theory per semester: Contact hours = 24 teaching + 6 tutorials (problem solving sessions, repeated discussion on difficult topics, difficult solution, questions discussion and internal evaluation)

b. Each course will be of two modules, One module = 15 hours

c. Each module may consist of one or more than one chapter.

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

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

b. Each laboratory sessions should be 4 hours.

c. If practical is short, then two short practicals should be included in one laboratory sessions.

d. In 12 laboratory sessions maximum 2 demonstration sessions or table work sessions may be included and must be designed carefully for 4 hours sessions.

e. 4 hours laboratory sessions include - performing table work (practical), calculation, writing results and conclusion, and submission of practical in written form to practical in charge.

f. Prelab oratory reading and post laboratory work / questions should be assigned on each practical and this will be the part of internal evaluation.

6. Design syllabus of each theory and practical course as per above guidelines.

a. **Theory syllabus** should be given module wise and chapter wise.

b. **Theory syllabus** should include name of topic, number of teaching hours allotted, detailed point wise syllabus, page numbers, references book no.

c. It is recommended that**, design syllabus of one theory course from maximum two references books** and they will be called as main reference books/text books. Below that, you can add names of more reference books and they will be supplementary reference books.

d. **Syllabus of practical** must be given practical wise. Name of experiment and aim of the experiment should be clearly mentioned. Mention reference book number or bibliography for each practical. At least 16 practicals must be included in syllabus from which 12 practical will be actually conducted. If practical is short then two short practicals will be considered as one practical.

e. At the end of syllabus of theory and practical course, a list of references book should be given number wise.

f. At the end of each theory and practical course 6 CO should be given.

7. Question Paper Pattern- As per S.P. Pune University Norms.

8. Eligibility- As per S.P. Pune University Norms.

9. **Programme Outcomes.**

i. **Critical Thinking in Plant Science**: Knowledge about plant diversity with respect to its morphological, anatomical, cytological, molecular, embryological, phyto-physiological, biochemical taxonomical and phylogenetic studies.

ii. **Modern tool usage**: They become competent enough in various analytical and technical skills related to plant sciences. Students are also familiarized with the use of bioinformatics tools and databases and in the application of statistics to biological data. Select, apply appropriate resources, and modern biological tools and techniques including taxonomic tools, ecological tools Microscopy, Chromatography, Spectrophotometry, Separation techniques, various Culture techniques and breeding techniques for the fulfilment of societal needs.

iii. **Design/development of solutions**: The student completing the course is able to identify various life forms of plants, design and execute experiments related to basic studies. Design nursery and horticultural practices.

iv. **The Botanist and society:** Apply reasoning informed by the contextual knowledge to assess societal, food, fodder, fiber, medicine, health, safety issues and the consequent responsibilities relevant to the botanical practices.

v. **Environment and sustainability:** Implement problem solving and laboratory skills pertaining to biological techniques and apply strategies for plant conservation, maintaining ecological balance and sustainable development through various ways including conservation practices and Phytoremediation.

vi. **Ethics and Effective Citizenship:** Recognize different value systems, understand the moral dimensions of decisions, and accept responsibility for them.

vii. **Individual and team work:** - Adapt scientific methods in plant research and create educator and entrepreneurs.

viii. **Communication:** Communicate effectively on plant sciences with the scientific as well as with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

ix. **Project management and finance:** Enhances skills in handling scientific instruments, experiments and projects for planning and executing biological research and various plant science related drudgery in the community for fulfillment of financial assistance.

x. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. The student completing the course is capable to perform short research projects using various tools and techniques in plant sciences and develop scientific temperament and research attitude.

10. Program Specific Outcome (PSO)

PSO 1: To apply knowledge in emerging and varied fields of Botany including Anatomy, Morphology, Reproduction, Evolution, Ecology, Physiology, Biochemistry, Genetics and Molecular biology, Taxonomy, Systematics of various life-forms with special reference to plants as well as Plant interactions with microbes and insects and biocontrol and biofertilizers.

PSO 2: To develop leadership and executive skills and understand the need for lifelong learning to be a competent professional. She/he even has an edge over other students as they will be trained in skill enhancement courses like Plant Tissue Culture, biocontrol and biofertilizers as well as Biotechnology.

PSO 3: To acquire and disseminate knowledge in the community and study the changing Environment in our planet. Documentation and report writing on experimental protocols, results and conclusions, study tours and field visits etc.

PSO 4: To be acquainted with good laboratory practices with respect to plant science and safety measures for higher studies and research.

11. 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 student in each course will be done as follows

a. Each theory or practical course will be of 2 credits = 50 mark

b. Internal evaluation 30% weightage (15 mark)

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. Question paper should be designed so that evaluation of CO, PO, PSO can be performed. 10 marks out of 15 will be assigned from these written tests. Remaining 5 marks will be assigned from other types of evaluation such as seminars, orals, poster presentation, open book challenging tests, surprise test, objective test on whole syllabus of the course (at least 40 questions of objective type must be designed), etc. for 5 marks at least two different types technique must be utilized.

b. External Evaluation - External evaluation will be done at the end of semester. For theory, 35 marks written examination will be conducted and time of examination will be 2-hours.

7. 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-: 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.

8. 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.

Equivalence of Previous Syllabus of SPPU

2019 CBCS pattern M.Sc. I Sem I	NEP 2020; 2023 CBCS Pattern M.Sc. I Sem I
BOUT 111 Botany Theory Paper 1-Plant Systematics I	BOMAT 511 Plant Systematics I(Algae and Fungi)
BOUT 112 Botany Theory Paper 2- Cell Biology and Evolution	BOMAT 512 Advance cell biology
BOUT 113 Botany Theory Paper 3- Cytogenetics and Plant Breeding	BOMAT 513 Genetics and plant breeding
BOUP 115 Botany Practical Paper based on BOUT 111, BOUT 112 and BOUT 113	BOMAT 514 Plant Organism interaction
BODT 114 Pomoculture and Fruit Processing Technology	BOMAT 515 Floriculture and Pomoculture
BODP 114 Botany Practical Paper 4-based on BO 114	BOMAP 516 Practical based on BOMAT 511 and 512
	BOMAP 517 Practical based on BOMAT 513 514 and 514
	BOMET 511A Crop Physiology
	BOMEP 512 A based on crop physiology
	BOMRT 511 Research Methodology

Equivalence to Previous syllabus i.e. CBCS 2023 pattern, NEP-2020

NEP-2024 CBCS Pattern M.Sc.I Sem II		NEP-2023 CBCS Pattern M.Sc.I Sem II	
Course Code	**Course name**	**Course Code**	**Course name**
BOMAT 511	Plant Systematics I (Algae and Fungi)	BOMAT 511	Plant Systematics I (Algae and Fungi)
BOMAT 512	Advance cell biology	BOMAT 512	Advance cell biology
BOMAT 513	Genetics and plant breeding	BOMAT 513	Genetics and plant breeding
BOMAT 514	Plant Organism interaction	BOMAT 514	Plant Organism interaction
BOMAT 515	Floriculture and Pomoculture	BOMAT 515	Floriculture and Pomoculture
BOMAP 516	Practical based on BOMAT 511 and 512	BOMAP 516	Practical based on BOMAT 511 and 512
BOMAP 517	Practical based on BOMAT 513 514 and 514	BOMAP 517	Practical based on BOMAT 513 514 and 514
BOMET 511A	Crop Physiology	BOMET 511A	Crop Physiology
BOMEP 512 A	Practical based on crop physiology	BOMEP 512 A	Practical based on crop physiology
BOMRT 511	Research Methodology	BOMRT 511	Research Methodology

Equivalence of Previous Syllabus of SPPU

2019 CBCS pattern M.Sc. I Sem II		NEP 2020; 2023 CBCS Pattern M.Sc. I Sem II
BOUT 121	Botany Theory Paper 1-Plant Systematics II	BOMAT 521 Plant Systematics II(Bryophytes and Pteridophytes)
BOUT 112	Botany Theory Paper 2- Cell Biology and Evolution	BOMAT 522 Advance Molecular biology
BOUT 123	Botany Theory Paper 3- Biochemistry	BOMAT 523 Biostatistics
BOUP 125	Botany Practical paper based on BOUT 121, BOUT 122 and BOUT 123	BOMAT 524 Tools and techniques in plant sciences
BODT 124	Floriculture and Nursery Management	BOMAT 525 Plant Evolution
BODP 124	Botany Practical paper 4- based on BODP 124	BOMAP 526 Practical based on BOMAT 521 and 522
		BOMAP 527 Practical based on BOMAT 523 524 and 525
		BOMET 521A Crop Physiology
		BOMEP 522 A based on crop physiology
		BOOTP 521 On Job Training

Equivalence to Previous syllabus i.e. CBCS 2023 pattern, NEP-2020

NEP-2024 CBCS Pattern M.Sc.I Sem II		NEP-2023 CBCS Pattern M.Sc. I Sem II	
Course Code	**Course name**	**Course Code**	**Course name**
BOMAT 521	Plant Systematics II(Bryophytes and Pteridophytes)	BOMAT 521	Plant Systematics II(Bryophytes and Pteridophytes)
BOMAT 522	Advance Molecular biology	BOMAT 522	Advance Molecular biology
BOMAT 523	Biostatistics	BOMAT 523	Biostatistics
BOMAT 524	Tools and techniques in plant sciences	BOMAT 524	Tools and techniques in plant sciences
BOMAT 525	Plant Evolution	BOMAT 525	Plant Evolution
BOMAP 526	Practical based on BOMAT 521 and 522	BOMAP 526	Practical based on BOMAT 521 and 522
BOMAP 527	Practical based on BOMAT 523 524 and 525	BOMAP 527	Practical based on BOMAT 523 524 and 525
BOMET 521A	BOMET 521A Crop Physiology	BOMET 521A	BOMET 521A Crop Physiology
BOMEP 522A	Practical based on crop physiology	BOMEP 522A	Practical based on crop physiology
BOOTP 521	On Job Training	BOOTP 521	On Job Training

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under

Autonomy & NEP-2020

M.Sc Program in Botany

(Faculty of Science)

Syllabus

Major Course

M.Sc. Botany

To be implemented from Academic Year 2023-2024

Board of Studies: Botany

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Choice Based Credit System (CBCS) under Autonomy & NEP-2020

M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Major Courses

To be implemented from Academic Year 2023-2024

Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**1**	**Major Courses**	**BOMAT 511**	**Plant Systematics - I (Algae & Fungi)**	**2**	30L
			BOMAT 512	**Advanced Cell Biology**	**2**	30L
			BOMAT 513	**Genetics & Plant Breeding**	**2**	30L
			BOMAT 514	**Plant organism Interaction**	**2**	30L
			BOMAT 515	**Floriculture and Pomoculture**	**2**	30L
			BOMAP 516	**Practical Botany IX**	**2**	12P
			BOMAP 517	**Practical Botany X**	**2**	12P
	2		**BOMAT 521**	**Plant Systematics - II (Bryophytes and Pteridophytes)**	**2**	30L
			BOMAT 522	**Advanced Molecular Biology**	**2**	30L
			BOMAT 523	**Biostatistics**	**2**	30L
			BOMAT 524	**Tools and Techniques in Plant Science**	**2**	30L
			BOMAT 525	**Plant Evolution**	**2**	30L
			BOMAP 526	**Practical Botany XI**	**2**	12P
			BOMAP 527	**Practical Botany XII**	**2**	12P

BOMAT 511
Plant Systematics - I (Algae & Fungi)
(30 Lectures) (60min/Lecture)

Credit - I : Phycology		**15 Lectures**
1.	Introduction to Algae	1L
2.	Position of Algae in Domains & Kingdom	1L
3.	Classification systems of algae	2L
4.	Brief introduction, structural and reproductive features of Cyanophyta & Chlorophyta	3L
5.	Brief introduction, structural and reproductive features of Charophyta & Euglenophyta	3L
6.	Brief introduction, structural and reproductive features of Chrysophyta, Xanthophyta, Bacillariophyta, & Dinophyta.	3L
7.	Brief introduction, structural and reproductive features of Phaeophyta & Rhodophyta	2L

Credit - II : Mycology		**15 Lectures**
1.	Introduction to Fungi	1L
2.	Position of Fungi in Domains & Kingdom	1L
3.	Classification of fungi as per Ainsworth et al system (1973)	2L
4.	Contribution of fungal studies in India and world.	1L
5.	Distinguishing characters, types of Plasmodium and fruit bodies, Life cycle pattern of Myxomycotina	2L
6.	Distinguishing characters, Thallus structure in Mastigomycotina	2L
7.	Distinguishing characters, Thallus structure, Heterothallism and sexual reproduction in Zygomycotina	2L
8.	Distinguishing characters, thallus structure, types and structure of basidia and basidiocarps in Basidiomycotina	2L
9.	Distinguishing characters, thallus structure, fructifications, types of conidia, conidial ontogeny in Deuteromycotina	2L

References:

1. Lee R.E. (2008). Phycology. Cambridge University Press, pp.547
2. Ainsworth, Sussman and Sparrow (1973). The fungi. Vol IV A & IV B. Academic Press.
3. Brodie J. and Lewis J. (2007). (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York, pp 335.
4. Misra J.N. (1996). Phaeophyceae in India. ICAR, New Delhi
5. Prescott G.W. (1969). The algae
6. Smith G.M. (1950). The fresh water algae of the United States, Mc-graw Hill
7. Sharma O.P. Algae
8. Vashista B.R, Sinha A.K and Singh V.P. (2005). Botany for degree students – Algae, S. Chand's Publication
9. Alexopolous C.J., Minms C.W. and Blackwell M. (1999). (4th edn) Introductory Mycology. Willey, New York, Alford
10. R.A.Deacon J.W. (2006). Fungal Biology (4thEd.) Blackwell Publishing, ISBN. 1405130660.
11. Kendrick B. (1994). The fifth kingdom (paperback), North America, New York Publisher: 3rd edn, ISBN- 10: 1585100226.
12. Kirk et al. (2001). Dictionary of fungi, 9th edn, Wallingford: CABI, ISBN: 085199377X.

Course Outcome:

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

- Algal diversity in terms of thallus organization, reproduction and life history.
- Detailed study of important groups of algae Cyanophyta, Chlorophyta, Xanthophyta, Bacillariopyta, Phaeophyta & Rhodophyta ·
- Fungal diversity with respect to general Characters and reproduction.
- Fungal taxonomy and classification systems for fungi

BOMAT 512
Advanced Cell Biology
(30 Lectures) (60min/Lecture)

Credit - I : Signaling Transduction		**15 Lectures**
1.	Universal features of Cell, Cell theory & Introduction to signalling transduction	1L
2.	Types of receptors in plants	1L
3.	Ca^{2+} Calmodulin cascade.	1L
4.	Significance and types of Phospholipid Signalling.	3L
5.	Specific signalling mechanisms under biotic and abiotic Stress condition in plants	2L
6.	Hormone mediated Signalling in Plants (Auxin, Cytokinin, & ABA)	3L
7.	Two Component signalling mechanism in Plants	1L
8.	Organelle targeting signalling transduction	2L
9.	Diversity in protein kinases and phosphatases	1L

Credit - II : Cellular Processes		**15 Lectures**
1.	Phases of cell cycle structural and functional importance of each phase	2L
2.	Check points, Cyclins and protein kinases.	2L
3.	Molecular events and Regulation of cell cycle.	5L
4.	Intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to cell exterior.	2L
5.	Programmed cell death (PCD) - Molecular aspects, regulation of cell death.	2L
6.	Role of different genes, cell organelles during apoptosis, genetic control of apoptosis.	2L

References:

1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
3. Lodish S, Baltimore B , Berk, C and Lawrence K, 1995 , Molecular Cell Biology , 3rd edn, Scientific American Books, N.Y
4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.
5. Buchanan, Grissem and Jones, 2000, Biochemistry and Molecular Biology of Plants, American Soc. Plant Biologists, Waldorf.
6. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA
7. Cooper G M and Hausman R E,2007 , The Cell: Molecular Approach 4th Edn, Sinauer Associates,USA.

Course Outcome:

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

- Signal transduction at cellular level, receptors in plants, signalling mechanisms under biotic and abiotic Stress condition in plants.Ca^{2+} Calmodulin cascade
- Protein kinases, phosphatases, PGRs - types and their role in Signal transduction
- Various Cellular processes including cell cycle, Intracellular vesicular trafficking and Programmed cell death
- Role of Cyclins and protein kinases

BOMAT 513
Genetics & Plant Breeding
(30 Lectures) (60min/Lecture)

Credit - I : Classical Genetics		**15 Lectures**
1.	Concept of gene, allele, multiple alleles	1L
2.	Introduction to Mendelian Genetics - Dominance, Segregation, Independent assortment	2L
3.	Neo-Mendelian Genetics - Codominance, Incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance, expressivity	4L
4.	Sex linkage, sex limited and sex influenced characters	1L
5.	Linkage and Crossing over	1L
6.	Cytoplasmic inheritance - Maternal effect, Plastid Inheritance, Mitochondrial Inheritance.	4L
7.	Microbial Genetics - Conjugation, Transformation, Transduction	2L

Credit - II : Plant Breeding		**15 Lectures**
1.	History and Objectives of plant breeding,	1L
2.	Domestication and pattern of evolution in crop	1L
3.	Selection and their types	2L
4.	Selection in self-pollinated crops, The Pure line theory, Effect of self-pollination on genotype, and variation in the Pure line.	3L
5.	Selection in cross-pollinated crops	1L
6.	Hybridization: Objective of Hybridization, Steps involved in the Hybridization	2L
7.	Mutation in crop improvement, Spontaneous and induced mutation, Mechanism of action of Radiation and Chemical mutagen and limitation of Mutation breeding	4L
8.	Application of Plant Breeding	1L

References:

1. Hartle D.L and Jones, E.W 1998 Genetics: Principles and Analysis (Fourth Edition). Jones and Bartlett Publishers, Massachusetts, USA.
2. Singh B.D 1996 Plant Breeding Principles and methods. Kalyani Publications, Ludhiana
3. Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York, Lewis, R. 1997. Human Genetics: Concepts and Application (Second Edition). WCB McGraw Hill, USA.
4. Snustad, D.P and Simmons, M.J 2000. Principles of Genetics (Second Edition). John Wiley and Sons Inc., USA.
5. Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
6. Chahal G.S and Gosal S.S 2002. Principles and Procedures of Plant Breeding, Narosa Publishing House, New Delhi.
7. Phundan Singh Plant Breeding Kalyani Publications

Course Outcome:

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

- Mendelian principles of heredity, Non-Mendelian, and Cytoplasmic inheritance
- Sex linkage, sex limited and sex influenced characters as well as Microbial Genetics
- History and objectives of plant breeding, domestication of crops and their evolution pattern, self-pollinated and cross-pollinated crops.
- Hybridization and Mutation and application in plant breeding.

BOMAT 514
Plant-Organism Interactions
(30 Lectures) (60min/Lecture)

Credit - I : Plant –Plant interactions	**15 Lectures**
1. Introduction to Interaction and their types	1L
2. Allelopathy in plants- Allelopathic plants, Native verses Invasive Plants	4L
3. Types of interactions – Mutualism, Obligate vs facultative Mutualism, Specific verses diffuse association, Exhabitional verses inhabitional Association, Mutualism verses other species interactions	3L
4. Competitive mechanisms in Plants-Mechanisms of plant competition for nutrients, water and light, Complexity of resources, Pre-emption theory	4L
5. Epiphytic plants - Definition, General characteristics, Distribution, Adaptations and examples.	3L

Credit - II : Insect , Organisms And plant Interaction	**15 Lectures**
1. Herbivores Insect-plant interaction, grazing animals–physical and biochemical interactions	2L
2. Plant signalling and defence against herbivores	1L
3. Genetic engineering in plants for improved tolerance against herbivores	2L
4. Carnivorous plants – morphological features, specialized biochemical mechanisms for nutrient processing	2L
5. Lichens	1L
6. Mycorrhizae, Nodulating bacteria	2L
7. Algae-coral, Fungal-insect relationships	1L
8. Pollination & dispersal biology- Pollination types & mechanism Pollination types & mechanism Pollinators- bees, beetles, butterflies, birds & mammal's Co-evolution of pollinators & plants.	2L
9. Fig-fig wasp interaction, humming birds-plant interaction, seed dispersal mechanisms-fruit & seed morphology relevant to seed dispersal.	2L

References

1. Carlos M. Herrera, Olle Pellmyr 2002 "Plant Animal Interactions: An Evolutionary Approach"
2. Jan Schirawski and Michael H. Perlin "Plant Microbe Interaction" 2017.
3. ZdenekLastuvka, Barbara Politycka, S. S. Narwal, Jana Kalinova 2007, "Coactions and

Competition in Higher Plants", Scientific Publisher (India).
4. Malcolm C. Press, Jonathan D. Graves 1995, "Parasitic Plants", Chapman & Hall, 2-6 Boundary Row, London.

Course Outcome:

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

- The different types of interactions and competitive mechanisms in plants.
- Genetic engineering in plants for improving tolerance capacity against herbivores.
- Relationship between algal & coral as well as fungal & insects.
- Explain allelopathic plants and their nature of interaction.
- Descuss the relationship between plant plant and plant organism interaction.
- Understand the economic importance of lichens.

BOMAT 515
Floriculture and Pomoculture
(30 Lectures) (60min/Lecture)

Credit - I : Floriculture		**15 Lectures**
1.	Floriculture: Concept, definition, Scope and Importance of floriculture, global scenario of flowers, scope of floriculture in India	2L
2.	Pre-requisites of commercial floriculture: soil and climate requirements, field preparation, systems of planting, water and nutrient management, weed management, special horticultural practices, use of growth regulators	3L
3.	Harvesting and processing of flowers: harvesting indices, harvesting techniques, post-harvest handling and grading, pre cooling, packing and storage, value addition, concrete and essential oil extraction, transportation and marketing, export potential, agri-export zones	5L
4.	Commercial production of flowers: varietal wealth and diversity, climate, soil preparation, aftercare and manuring, pruning and training, harvesting, yield, important pests and diseases, control measures, harvesting, grading, packing and marketing, storage and transport, export potential of cut flowers: Chrysanthemum, Gerbera, Tuberose, Anthurium; Loose flowers-Scented Rose and Jasmine	5L

Credit - II : Pomoculture		**15 Lectures**
1.	Introduction to Pomoculture and their importance	1L
2.	Present status and scope of fruit growing in India and Maharashtra, importance of fruit growing	3L
3.	Growth and fruiting habits, fruit bud differentiation, fruit setting, fruit drop, seedlessness, cracking of fruits, problems of fruiting, Bahar treatment, Unfruitfulness, pruning and training, role of plant growth substances	3L
4.	Commercial Production Of Fruits: varietal wealth and diversity, climate, soil preparation, aftercare and manuring, pruning and training, pests and diseases, control measures, harvesting and marketing of fruits, care after picking, packing of fruits, systems of marketing, export potential, air transport, transport by sea, cold storage of fruits	3L
5.	Dryland horticulture:- importance of dryland fruits, selection of dry land fruits, rainwater management	3L

6.	Organic horticulture: definition, synonyms and misnomers, principles, methods, merits and demerits, organic farming systems, components of organic horticulture systems, role of bio-fertilizers in organic horticulture	2L

References:

1. Chadha K. L and Pareek O. P Advances in Horticulture Vol. IV, Malhotra Publications
2. Arora J. S Introductory Ornamental Horticulture Kalyani Publications
3. Sudheer K. P and Indira V Post Harvest Technology of Horticultural Crops New Delhi
4. Bose T. K and Yadav L. P Commercial Flowers Naya Prokash

Course Outcome:

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

- Apply concepts of Floriculture science to select, manage, and improve plants and their products
- Demonstrate competence with laboratory and/or field-based technologies used in modern Floriculture
- Commercial product of fruits

BOMAT 516

Practical Botany IX

(12 Practicals) (4hour/Practical)

Practical Based on Plant Systematics - I (Algae & Fungi)	**6 Practical**

1. Handling of compound microscope and methods to study algae — 1P
2. Macro & Microscopic, observations, classification with reasons of taxa belonging to the following group (One forms from each group) — 2P
    1. Chlorophyta
    2. Charophyta
    3. Phaeophyta
    4. Rhodophyta
    5. Cyanophyta
3. Study of vegetative, reproductive structures and classification with reasons of the representative genera belonging to following sub-divisions (One forms from each group) — 3P
    1. Myxomycotina
    2. Mastigomycotina
    3. Zygomycotina
    4. Ascomycotina
    5. Basidiomycotina
    6. Deuteromycotina

Practical Based on Cell Biology	**6 Practical**

1. Isolation of Chloroplasts to study Hill reaction to measure intactness — 1P
2. Isolation of Mitochondria for Estimation of succinic dehydrogenase activity — 1P
3. Isolation of Lysosomal fraction and estimation of acid phosphatase activity — 1P
4. Study of induced cell senescence in leaf discs — 1P
5. Study of cell cycle using BrdU (demonstration) — 1P
6. Study of programmed cell death in plants — 1P

Course Outcome

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

- The macro and microscopic characters and classification of different algal groups.
- The vegetative, reproductive, and classification of different subdivisions of fungi
- The cellular components are used to generate and utilize energy in cells

BOMAP 517
Practical Botany X
(12 Practical) (4hour/Practical)

Practical Based on Genetics and Plant Breeding	**6 Practical**
1. Study of Mitosis and Meiosis	1P
2. Problems based on Mendelian Inheritance and analysis of F2 data by Chi-square Test, Gene and Genotypic frequencies, Gene Mapping	1P
3. Study of polygenic inheritance by using suitable trait.	1P
4. Use of Colchicine for induction of polyploidy in appropriate plant material.	1P
5. Karyotype analysis, and preparation of C- metaphase chromosomes of appropriate material	1P
6. Study of Meiotic configuration	1P

Practical Based on Plant-Organism Interaction	**3 Practical**
1. Study of Parasitic, Epiphytic, Carnivorous Plant	1P
2. *In-vitro* Allelopathic studies	1P
3. Study of seed dispersal mechanism in plants	1P

Practical Based on Floriculture and Pomoculture	**3 Practical**
1. Propagation method for the economically important ornamental plants	1P
2. Study of Grafting and budding method	1P
3. Study of Air Layering and cutting method	1P

Course Outcome

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

- The basic principles of inheritance at the molecular, cellular and organism levels.
- Students will learn the mechanism of seed dispersal in plants
- Different methods of propagation

BOMAT 521
Plant Systematics - II (Bryophytes & Pteridophytes)
(30 Lectures) (60min/Lecture)

Credit - I : Bryophytes		**15 Lectures**
1.	Introduction, characteristic features and diversity of Bryophytes, Medicinal, Ecological and economic importance of Bryophytes.	2L
2.	Systems of classification of Bryophytes.	1L
3.	Distribution, morphological, anatomical, reproductive studies along with comparative account of sporophyte and gametophyte, interrelationships and evolutionary trends of the following orders: (development of sex organs is not included). (a) Sphaerocarpales (b) Calobryales, Takkakiales (c) Marchantiales (d) Jungermanniales (e) Anthocerotales (f) Sphagnales (g) Andraeales (h) Polytrichales (i) Buxbaumiales (j) Funariales	11L
4.	Fossil bryophytes	1L

Credit - II : Pteridophytes		**15 Lectures**
1.	Introduction, diversity and importance of Pteridophytes	1L
2.	Recent systems of classification	1L
3.	Telome concept, Soral evolution in Filicales	2L
4.	Gametophyte evolution, Heterospory and seed habit, Stellar evolution	1L
5.	Study of Fossil groups- Psilopsida sailent features of Psilophytes	1L
6.	Pteridosperms sailent features of Pteridosperms - Lyginopteris, Oldhamia, Lagenostoma	2L
7.	External and internal morphology of Rhynia and Lycopsida sailent features of Lepidodendrales	1L
8.	External and internal morphology of Calamites, Annularia, Calamostactys	1L

9.	Comparative account of distribution, morphology, anatomy, gametophyte, sporophyte and interrelationship of following orders - Psilotales, Lycopodiales, Isoetales, Equisetales, Ophioglossales,	5L

References:

1. Sharma OP (1990) textbook of Pteridophyta. Mac Millan India Ltd. Delhi.
2. Parihar NS (1976) Biology and morphology of the Pteridophytes. Central Book Depot
3. Kashyap, S. R. (1932). Liverworts of the Western Himalayas and the Panjab plain (illustrated): Part 2 The Chronica Boanica New Delhi.
4. Rashid A (1999) An introduction to Pteridophyta. Vikas Publishing House Pvt.Ltd. New Delhi.
5. Parihar, N. S. (1980). Bryophytes: An introduction to Embryophyta Vol I, Bryophya central Book Depot
6. Watson, E. V. (1971). Structure and life of bryophytes 3rd, Hutchinson University Library London
7. Prem puri (1981). Bryophytes: Morphology, Growth and Differentiation, Atma ram and Sons, New delhi
8. Sporne KR (1986) The morphology of Pteridophytes. Hutchinson University Press. London.
9. Surange KR (1966) Indian fossil Pteridophytes. Council of Scientific and Industrial Research.

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

- Know the systematic, morphology, and structure of Bryophytes and Pteridophytes
- Identify the Bryophytic and Pteridophytic plant material.
- Understand the Biodiversity of Bryophytes and Pteridophytes
- Understand the importance of Bryophytic and Pteridophytic plants.
- Understand the economic importance of Bryophytic and Pteridophytic plants.

BOMAT 522
Advanced Molecular Biology
(30 Lectures) (60min/Lecture)

Credit - I : Gene Expression	**15 Lectures**
1. Organization and structure of Prokaryotic and Eukaryotic gene	1L
2. Promotor, Initiator, Enhancer, Terminator, Classes of Promoter	1L
3. Transcription in Prokaryotes & Eukaryotes: Types of RNA Polymerase, Transcription Factors, Effect of mutation on the efficiency of RNA polymerases, Interaction of multiple regions of RNA polymerase with DNA Promoter, Elongation, Termination, Anti-termination, and Post-transcriptional changes.	7L
4. Translation in prokaryotes & Eukaryotes - Structure of RNA, Ribosomal assembly, Genetic code, Codon anticodon recognition, Initiation, elongation, elongation factor, termination.	6L

Credit - II : Instructive Molecular Biology	**15 Lectures**
1. Operon concept (Lac, Tryptophan, Arabinose)	3L
2. Phage Strategies: Lytic and Lysogenic Cycle, Regulation of Lytic and Lysogenic Cycle.	3L
3. Recombinant DNA Technology, Steps involved in Recombinant DNA Technology, Cloning Vectors (Plasmids, Phages, Cosmids, Phagemids, BACs and YACs)	3L
4. Genomics and proteomics: Introduction, types (structural and functional)	4L
5. DNA Sequencing methods: Sanger's dideoxy chain termination sequencing method and Maxam-Gilbert sequencing method	2L

References:

1.Pal Jayanta and Saroj S. Ghaskadabi Fundamentals of Molecular Biology, Oxford Higher Education.
2.Lewin B. Genes XI. Oxford University Press, New York
3.Alberts, B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter (1999). Molecular Biology of the Cell.Garland Publishing, Inc., New York.
4.Wolfe S.L (1993) Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
5.Buchanan B.B, Gruissm W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plant.American Society of Plant Physiologist, Maryland, USA.

6.Kleinsmith L.J and Kish V.M (1995).Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York, USA.

Course Outcome:

After the completion of the course, students are able to,

- Understand the prokaryotic, eukaryotic, and viral genetics
- Explain the central dogma of molecular biology
- Understand the importance of Recombinant DNA Technology
- Understand the DNA Sequencing methods and their significant importance

BOMAT 523
Biostatistics
(30 Lectures) (60min/Lecture)

Credit - I : Basic Biostatistics		**15 Lectures**
1.	Introduction to Statistics, Sample, and Sampling Type.	1L
2.	Data, Data Types, Graphical presentation of data - frequency distribution	1L
3.	Measures of central tendency: Mean, Mode, Median	1L
4.	Measures of dispersion: Variance, Standard deviation, coefficient of variance	2L
5.	Symmetry and skewness, kurtosis	2L
6.	Correlation: Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's rank correlation coefficient	4L
7.	Regression: Equations of regression lines	3L
Credit - II : Experimental Statistics		**15 Lectures**
1.	Experimental designs- completely randomized, randomized block and factorial experimental designs	2L
2.	F-Distribution, Analysis of variance for different experimental designs	3L
3.	Tukey's test, Dunnet's test, Mann–Whitney U test	5L
4.	Chi-square test for goodness of fit and independence	2L
5.	Normal (z) distribution, t distribution, confidence interval	3L

References:

1. Statistical Methods – Snedecor G.W. and Cochran W.G. Affiliated East-West Press Pvt. Ltd. 1989.
2. Statistical methods in Agriculture and Experimental Biology – Mead, R. and Curnow, R.N. Chapman and Hall, 1983.
3. Practical statistics and experimental design for plant and crop science – Clewer, A.G. and Scarisbrick, A.H., John Wiley, New York, 2001.
4. Bioinformatics - Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003.
5. P.N. Arora and P.K. Malhan (2002) Biostatistics, Himalaya publishing House.
6. Rama Krishnan, P. (1995) Biostatics, Saras publication A.R.P. camp Road, Periavilai, Kottar, po. Nagercoil, Kanyakumari- Dist. Pin- 629 002.

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

- Design the experimental work
- Identify the data and their types.
- Understand the methodology to be implemented for the analysis
- Apply the solution to analyze the data.

BOMAT 524
Tools and Techniques in Plant Science
(30 Lectures) (60min/Lecture)

Credit - I : Instrumentation Part First	**15 Lectures**
1. Dissection, Maceration, Squash, Peeling and Pre-treatment, Mounting of specimen for Microscopy	3L
2. Microscopic Techniques: Properties of Lights, Lens, and their Types, Magnification and Resolution, Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM TEM and STEM), and Atomic force microscopy	5L
3. Chromatography techniques: Principle, method and applications of Paper, Thin layer Chromatography, Gel filtration, Affinity Chromatography, Ion exchange Chromatography, HPLC, and Gas chromatography.	4L
4. Electrophoretic techniques: Principle, method, and applications of Agarose gel electrophoresis, Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis, and 2 Dimensional Gel Electrophoresis (2-D method).	3L

Credit - II : Instrumentation Part Second	**15 Lectures**
1. Spectroscopic techniques: Beer and Lambert's Law, Electromagnetic radiations, Wavelength, Frequency, Light absorption and excitation of spectra. Principle, working and applications of UV-Visible spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Infrared spectroscopy, Atomic absorption spectroscopy	5L
2. Centrifugation techniques: Principles of Centrifugation, Types of Rotors, Speed and Unit, Factors affecting centrifugation Ultra-centrifugation, Density Gradient Centrifugation	3L
3. Immunological techniques: Introduction and Principles of Immunology, Antigen, Antibody, Immuno diffusion, Immuno precipitation, Radio-immuno assay, Rocket Immuno-electrophoresis, ELISA	4L
4. Electrical conductivity, pH meter, Oxygen electrode	2L
5. Traditional and Digital Herbarium	1L

References:

1. SrivistavaM.L. (2008). Bioanylatical Techniques. Narosa Publishing House (P) Ltd.
2. Plummer David (1987). An Introduction to Practical Biochemistry. 3rd Eds. Tata McGraw-Hill Publishing Company Ltd.
3. Sadasivam S.,Manickam A. (1996). Biochemical Methods. 2ndEdn. New Age International (P) Ltd.
4. Khasim S.M. (2002). Botanical Microtechniques: Principles and Practice. Capital Publishing Company.
5. Wilson K., Walker J. (2005). Principles and Techniques in Biochemistry and Molecular Biology. Cambridge University Press.
6. Sharma V.K. (1991). Techniques in Microscopy and Cell Biology. Tata McGraw-Hill Publishing Company Ltd.

Course Outcome:

After the completion of the course, students are able to,

- Understand the working mechanism and principle behind the instrumentation.
- Handle the instrument needed for the experiment.
- Analyze biological samples by using the different instruments
- Understand the data generated after the analysis of biological data

BOMAT 525
Plant Evolution
(30 Lectures) (60min/Lecture)

Credit - I : Basics of Evolution	**15 Lectures**
1. Introduction to evolution and its importance	1L
2. Origin of Earth, Historical account of Origin of life,	1L
3. Origin of Earth Vs Origin of life: Gaia Hypothesis, Earliest Fossils, Prebiotic Evolution, Abiotic synthesis of organic matter, Primordial soup, origin of membranes, Theory of Panspermia,	4L
4. Organic Evolution: The concept of organic evolution, Theories of Evolution, Pre-Darwinian period, Theory of Inheritance of acquired characters (Lamarck's theory), Darwinism- Theory of Natural Selection, Post-Darwinian period- Modern synthetic theory	5L
5. Concepts of Oparin and Haldane, Experiment of Miller, The first cell, evolution of prokaryote, origin of eukaryotic cells, evolution of unicellular eukaryotes,	4L

Credit - II : Theories in Evolution	**15 Lectures**
1. Concepts of natural evolution, molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence	3L
2. Evolution Through Ages: Fossils and Geological Time scale: Fossils and Fossilization, Conditions of fossilization,	2L
3. Dating of fossils: Uranium Lead method, Radio-carbon method, U-series and ESR method, Geological Time scale: Eras, Periods, epochs, and duration in millions of years and plant life Major events in the evolutionary time scale; Multicellular evolution, Major groups of plants & Animals; Fossils- Formation, Nature, Types, Geological time scale	4L
4. The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms;	4L
5. Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.	2L

References:

1. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
2. Shukla R.S. & Chandel P.S. Cytogenetics, Evolution & Biostatistics,
3. Tomar & Singh Evolutionary Biology, Rastogi Publications
4. Darbeshwar Roy Crop Evolution & Genetic Resources.
5. P. K Gupta, Cytology, Genetics and Evolution, Rastogi Publications
6. Veer Bala Rastogi. Organic Evolution, Scientific Inernational Pvt. Ltd

Course Outcome:

After the completion of the course, students are able to,

- Know the plant relationships phylogenetic systematics
- Evolution pattern of the plants,
- Explain the theories related to evolution of the organism
- Understand the fossil history plants

BOMAP 526
Practical Botany XI
(12 Practical) (4 hours/Practical)

Practical Based on Plant Systematics - I (Bryophytes & Pteridophytes)	**6 Practical**
1. Morphological, anatomical, and reproductive studies of any two members of Hepaticopsida (Liverworts)	1P
2. orphological, anatomical, and reproductive studies of any two members of Anthocerotopsida (Hornworts)	1P
3. Morphological, anatomical, and reproductive studies of any two members of Musci (Mosses)	1P
4. Morphological, anatomical and reproductive studies of *Psilotum*, *Lycopodium*, *Selaginella, Equisetum, Pteris, Adiantum*, and *Marsilea*	2P
5. Study of available fossils specimen or Photographic Image of Pteridophytes	1P

Practical Based on Molecular Biology	**6 Practical**
1. Effect of temperature and alkali on absorption of DNA	1P
2. Determination of absorption maxima of Nucleic acid and Protein	1P
3. Separation and quantification of Seed Storage Protein by using a suitable method	2P
4. Isolation of plant Genomic DNA.	1P
5. Study of instruments used in Molecular Biology (photographs/PPT): 1. PCR thermal cycler 2. Gel documentation system 3. ELISA reader 4. Millipore distillation apparatus 5. Lyophilizer 6. Refractometer	1P

Course Outcome:

After the completion of the course, students are able to,

- Understand the morphological, anatomical, and reproductive of Bryophyta and Pteridophyta.
- Know the properties of Nucleic Acid
- Isolate the DNA & Protein from the plants
- Understand the working principle of different instruments in molecular biology.

BOMAP 527
Practical Botany XII
(12 Practical) (4 hours/Practical)

Practical Based on Biostatistics		**6 Practical**
1.	Calculation of Mean, Mode, Median, Variance, Standard Deviation, Standard Error of the different types of data	1P
2.	Determination of Karl-Pearson's coefficient of correlation from the given data	1P
3.	Determination of Spearman coefficient of correlation from the given data	1P
4.	Determination of regression lines from the given data	1P
5.	Problems based on t-test	1P
6.	Analysis of variance of the given data	1P
Practical Based on Tools and Techniques in Plant Science		**4 Practical**
1.	Study of Micrometry	1P
2.	Separation of given sample by using the chromatography and TLC	1P
3.	Study of Maceration technique	1P
4.	Study of Rocket immune electrophoresis	1P
Practical Based on Plant Evolution		**2 Practical**
1.	Study of Types of Fossils	1P
2.	Construction of Phylogenetic tree by using suitable software.	1P

Course Outcome:

After the completion of the course, students are able to,

- Analyze the primary and secondary data.
- Calculate the correlation between the data and significant effect of treatment.
- Do the experimental work by using the different techniques and tools
- Construct the phylogenetic tree as well as evolution pattern

PDEA's

Prof. Ramkrishna More Arts Commerce & Science College, Akurdi, Pune - 44

Affiliated to Savitribai Phule Pune University (SPPU)

Choice Based Credit System (CBCS) under Autonomy & NEP-2020

M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Minor Course

To be implemented from Academic Year 2023-2024

Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**1**	**Minor Courses**	**BORMT 511**	**Research Methodology**	**4**	**60L**

NEP-2020: First Year PG Minor

Course Code- BORMT 511 **Course Type -Theory**
Course Name - Research Methodology
Credits allotted - 4 **Lectures allotted - 30**

Module - I : 15 Lectures

Chapter - I

Introduction: History of research. Indian, Egyptian, Greek ideas methodologies and research in agriculture, chemistry, metallurgy, medical. Ancient Indian research methodology applications — 6L

Chapter - II

Concept and Introduction to Research Methodology: — 9L

1. Meaning, Objectives, Motivation in Research
2. Types of Research and their Approaches
3. Significance of Research
4. Research and Scientific Method
5. Research Process and Criteria of Good Research
6. Problems Encountered by Researchers in India

Module - II : 15 Lectures

Chapter - III

Designing of Research: — 7L

1. Selection of Problem for Research
2. Steps involved in the selection for Research Topic
3. Sample and Sampling
4. Methods for data collection

Chapter - IV

Literature survey and documentation: — 8L

1. Methods of literature survey,
2. Use of library, books, journals, e-journals, thesis, abstracts and patent database,
3. Importance of documentation,
4. Documentation techniques,
5. Use of computer programs/packages (online resources such as-scientific search engines and online servers) in literature survey and documentation.

Module - III : 15 Lectures

Chapter - V

Technical writing and reporting of research: — 8L

Types of research report: Dissertation and thesis, research paper, review article, short communication, conference presentation, meeting report etc. Structure and organization of research reports: Title, abstract, key words, introduction, methodology, results, discussion, conclusion, acknowledgement, references, footnotes, tables and illustrations. Use of reference managing softwares (such as-MENDELEY, ENDNOTE). Impact factor, rating, indexing and citation of journals.

Chapter - VI

Research ethics, plagiarism and impact of research: 7L

Research ethics, responsibility and accountability of the researchers, ethical consideration during animal experimentation including CPCSEA guidelines, Plagiarism and use of plagiarism detection software.

Module - IV : 15 Lectures

Chapter - VII

Project cost management: 5L

Cost analysis of the project, cost incurred on raw materials, procedure, instrumentation and biological testing.

Chapter - VIII

Funding agencies and research grants: 10L

Introduction to various research funding agencies such as-DST, DBT, AICTE, UGC, CSIR, ICMR, AAYUSH, and DRDO along with their functions in India. Writing a research project and procurement of research grant.

Reference:

1. Research Methodology Methods and Techniques by C R Kothari (1990), New Age International Limited Publisher.
2. Research Methodology by Shradha Bhome et.al. (2013), Himalaya Publishing House.
3. Handbook of Research Methodology A Compendium for Scholars & Researchers by Shanti Bhushan Mishra (2019), Educreation Publishing.
4. Kothari,C.K.,Research methodology-Methods and techniques ,second ED., New Age International, New Delhi.
5. Kumar,R.,Research Methodology – A step by step Guide for beginners, Pearson Education, Delhi, 2006.]
6. Fundamentals of modern statistical methods by Rand R. wilcox
7. Power Analysis for Experimental Research a Practical Guide for the Biological
8.

9. Medical and Social Sciences by R. Barker Bausell, Yi-Fang Li Cambridge University Press.

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

- Explain safe working procedure and protective environment.
- Know the growth pattern of the plant
- Understand the disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals.
- Define and describe terms like Research, Ethics, plagiarisms, safety, MSDS sheet, errors, precision, linear regression, CAS number, manuscript, search engine, citation, reviews, indices, etc.

PDEA's

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under

Autonomy & NEP-2020

M.Sc Program in Botany

(Faculty of Science)

Syllabus

Major Elective Course

M.Sc. Botany

To be implemented from Academic Year 2023-2024

Board of Studies: Botany

PDEA's

Prof. Ramkrishna More Arts Commerce & Science College, Akurdi, Pune - 44

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Choice Based Credit System (CBCS) under Autonomy & NEP-2020

M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Major Elective Course

To be implemented from Academic Year 2023-2024

Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**1**	**Major Elective Courses**	**BOMET 511A**	**Crop Physiology**	**2**	30L
			BOMET 511 B	**Pharmacognosy**	**2**	30L
			BOMEP 512A	**Practical based on Crop Physiology**	**2**	12P
			BOMEP 512 B	**Practical based on Pharmacognosy**	**2**	12P
	2		**BOMET 521A**	**Applied Biotechnology and Nanotechnology**	**2**	30L
			BOMET 521B	**Biodiversity**	**2**	30L
			BOMEP 522A	**Practical based on Applied Biotechnology and Nanotechnology**	**2**	12P
			BOMET 522B	**Practical based on Biodiversity**	**2**	12P

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMEP 511A**	**Course Type**	**:Theory**
Subject	**: Crop Physiology**	**Total Lecture**	**:30 L (60 Min/L)**

Credit 1: 15 Lectures

UNIT 1: Introduction to Crop Physiology 05 L

- Introduction – Importance of crop physiology in agriculture and horticulture
- Crop physiological aspects of rice, wheat, maize, sorghum, millets, sugarcane, pulses, oil seeds, cotton Crops
- Sustainable Agriculture

UNIT 2: Plant Water Relations 06 L

- Role and significance of water - diffusion, imbibition, osmosis and its significance, plasmolysis,
- Definitions- field capacity, water holding capacity of soil and permanent wilting point
- Absorption of water - mode of water absorption – active and passive absorption and factors affecting absorption,
- Translocation of solutes - phloem and xylem transport,
- Transpiration - types - Steward's theory of mechanism - significance, factors affecting transpiration and guttation - antitranspirants.

UNIT 3: Mineral Nutrion/ Nutrio-Physiology 04 L

- Mineral nutrition- introduction- criteria of essentiality of elements - macro, secondary and micronutrients
- sand and soil less culture- hydroponics, Mechanism of uptake - physiological role of nutrients Foliar diagnosis - nutritional and physiological disorders - foliar nutrition and fertigation
- Role of Mineral Nutrion in crop productivity

Credit 2: 15 Lectures

Unit 4: Growth Physiology 07 L

- Photosynthesis- its significance in plant growth, development and crop productivity, energy utilization efficiency by crops
- Growth- growth curve, phases of growth and factors influencing growth, Growth analysis - LAI, LAD, SLW, SLA, LAR, NAR, RGR and CGR in relation to crop productivity, - Source sink relationship -
- Photoperiodism- Role of phytochrome in flowering and regulation of flowering. Transmission of stimulus - theories of flowering- Vernalisation – devernalisation

- Plant growth regulators (PGRs)/ growth hormones- definition, classification and physiological role of PGRs synthetic growth regulators and their uses in crop productivity, Practical application of Plant Growth Regulators in crop productivity

UNIT 5: Stress Physiology **8 L**

- Environmental stresses-
  - Water stress - physiological changes - adaptation to drought and amelioration,
  - Temperature stress - Physiological changes - low and high temperature - chilling injury - tolerance – alleviation, Low light and UV radiation stresses –
  - Salt stress - physiological changes and alleviation,
  - Global warming – Carbon Sequestration physiological effects on crop productivity
- Biotic Stress-
  - Causal organisms- Virus, bacteria, fungi, insects and pests, control measures
  - Strategies for development of new tolerant crop varieties

References:

2. Bidwell, R.G.S. 1974. Plant Physiology. Macmillan Pub. Co., N.Y.
3. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Associates, Saunders land, Massachusetts, USA
4. Salisbury F.B. and Ross C.B. 2005. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
5. Helgi OPik, Stephen A. Rolfe, Arthur J. Willis. 2005. The Physiology of Flowering Plants, Cambridge University Press, UK
6. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
7. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.
8. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.

Course Outcome:

After the completion of the course, students are able to,

- Understand the Physiological condition of the crop plants.
- Know the growth pattern of the plant
- Understand the environmental impact on the growth of crop plants.
- Explain the role of micro and macronutrients in plant growth.
- Understand the importance of soilless culture and mix cropping.

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMEP 512A**	**Course Type**	**:Practical**
Subject	**: Practical Based on Crop Physiology**	**Total Lecture**	**:4 hrs/ Practical**

Practical Based on Crop Physiology	**12 Practical**

1.	Preparation of solutions	1P
2.	Measurement of Relative Water content of Leaf	1P
3.	Study of Structure and Distribution of Stomata, Stomatal Index	1P
4.	Diagnosis of nutrient deficiencies for mineral nutrient	1P
5.	Study of rate of photosynthesis	1P
6.	Estimation of Chlorophyll Stability Index	1P
7.	Estimation of soluble protein.	1P
8.	Determination of starch and sucrose content	1P
9.	Estimation of soluble proline	1P
10	A) Effect of moisture and salinity stress on seed germination and seedling growth, B) Measurement of chlorophyll stability index (CSI) in response to drought and salinity	1P
11.	Effect of ABA on stomatal closure	1P
12.	Field visit for foliar diagnosis	1P

Course Outcome:

After the completion of the course, students are able to,

- Isolate and estimate the protein concentration
- Understand the physiology of stomata
- Know the importance of chlorophyll pigments

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMET 512B**	**Course Type**	**:Theory**
Subject	**: Pharmacognosy**	**Total Lecture**	**: 30L (60 min/L)**

Credit - I : Pharmacognosy I — 15 Lectures

1. **Definition and scope of Pharmacognosy**: Historical background and current trends, Classification of crude drugs, Indian trade in medicinal and aromatic plants. **2L**

2. **Cultivation and collection of medicinal Plants**: General aspects involved in cultivation of medicinal plants. Factors affecting the cultivation of crude drugs. (I) Exogenous, (II) Endogenous factors, (III) Mineral supplements, (IV) Nutrients, (V) Soil and Soil fertility, (VI) Pest and Pest control, (VII) Plant Growth Regulators, (VIII) Genetic manipulators, and (IX) Diseases management of medicinal and aromatic plants. **3L**

3. **Adulteration and Deterioration:** Introduction, Types of Adulteration/ Substitution of Herbal drugs, Causes and Measures of Adulteration, Sampling Procedures, Determination of Foreign Matter, detection of heavy metals, pesticide residues, phytotoxin, microbial contamination in herbs and their formulations. **5L**

4. **Extraction Methods and Chromatography**: General methods, types and principles of sextraction. Selection of solvents for extraction and purification of extracts using chromatographic methods including TLC, HPLC and HPTLC. **5L**

Credit - II : Pharmacognosy II — 15 Lectures

1. **Ethnobotany:** Ethnobotany in herbal drug evaluation, Impact of Ethnobotany in traditional medicine, Role of Ethno-pharmacology in drug evaluation, Reverse Pharmacology. **3L**

2. **Pharmacognostic study of drugs:** With reference to source, cultivation, collection, macroscopic characters, and application – Isabgol (Plantago ovata), Aloes (Aloe vera), Digitalis (Digitalis purpurea), Dioscorea (Dioscorea bulbifera), Safed Musli (Chlorophytum borivilianum), Shatavari (Asparagus racemosus), Brahmi (Bacopa monnieri). **5L**

3. **Phyto-pharmaceuticals**: Occurrence, isolation and characteristic features (Chemical nature, uses in pharmacy, medicinal and health benefits) of following.
a) Carotenoids – i) α and β - Carotene ii) Xanthophyll (Lutein); b) Limonoids – i) d-Limonene ii) α – Terpineol; c) Saponins – i) Shatavarins; d) Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin; e) Phenolic acids- Ellagic acid; f)
Vitamins; g) Tocotrienols and Tocopherols; h) Andrographolide (alkaloids), Glycolipids, Gugulipids, Withanolides, Vascine, Taxol and i) Miscellaneous. **7L**

References:

1. Kokate C.K., Purohit A.P. and Ghokhale S.B (1996.) Text book of Pharmacognosy. Nirali Prakasshan, Pune
2. Rajopadhye A.A. and Upadhye AS. 2013. Determination of phenolic content and in vitro antioxidant potential of ethanol extract of seven sources of Ayurvedic drug 'Pittapapda'. Indian Journal of Natural Products and Resources 4(1): 81-87
3. Upadhye A. S., Rajopadhye A. A. and Kumbhalkar B. B. 2012. Pharmacognostic standardization to diminish involuntary adulteration and substitution in Ayurvedic herbs. Current Science 102(8): 1087-1088 8. Farooqui A.A. and Sreeramu B.S. (2001) Cultivation of medicinal and aromatic crops, University Press,
4. Wallis T.E. (2005) Text Book of Pharmacognosy, 5Th Edition, CBS.

Course Outcome:

After the completion of the course, students are able to,

- Understand the principles and methods of quality control of herbal drugs and the importance of standardization
- Explain techniques used to extract and isolate bioactive compounds from natural sources.
- Understand the cultural and traditional uses of medicinal plants.
- Understand the current trends in pharmacognosy research, of modern science with traditional knowledge.

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMEP 512B**	**Course Type**	**:Practical**
Subject	**: Practical Based on Pharmacognosy**	**Total Lecture**	**:4 hrs/ Practical**

Practical Based on Pharmacognosy	**12 Practical**
1. To study the morphological and anatomical features of medicinal plants.	1P
2. To extract active compounds from medicinal plants using different solvent.	2P
3. To prepare different forms of herbal medicines.	2P
4. To separate and identify compounds in plant extracts.	2P
5. To determine the concentration of bioactive compounds in plant extracts.	2P
6. To study the antimicrobial activity of plant extracts against microorganisms.	2P
7. To separate and identify plant compounds using TLC.	1P
9. Field visit to the pharmaceutical industry.	1P

Course Outcome:

After the completion of the course, students are able to,

- Identify different compounds based on their mobility on the TLC plate.
- Understand to extract bioactive compounds from medicinal plants using various techniques.
- Know the importance of chlorophyll pigments
- Understand to extract bioactive compounds from medicinal plants using various techniques.

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMET 521A**	**Course Type**	**:Theory**
Subject	**: Applied Biotechnology and Nanotechnology**	**Total Lecture**	**:30L(60min/L)**

Credit - I : Applied Biotechnology — 15 Lectures

1. Basics of genomics and proteomics: 3L
   A brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria, and chloroplast.

2. Introduction to Genomic and cDNA libraries, Screening of libraries, and isolation of specific clones- Nucleic acid hybridization using specific nucleotide probes, antibodies, PCR amplification using gene-specific primers 5L

3. GMOs, Potential problems with GMOs, efforts to prevent these problems, gene containment, and excision of antibiotic resistance markers from transformed plants. Regulatory bodies in the government 4L

4. CRISPR-CAS: 3L
   History of its discovery, elucidation of the mechanism including introduction to all the molecular players, development of applications for in vivo genome engineering for genetic studies, promise of the technology as a next generation therapeutic method

Credit - II : Nanotechnology — 15 Lectures

1. Introduction to Nanotechnology and Nanomaterials 1L

2. Atomic structures: Molecular and atomic size, Bohr radius, Emergence of Nanotechnology, Challenges in Nanotechnology, Carbon age (New form of carbon from Graphene sheet to CNT) 4L

3. Nanomaterials and their Properties: 3L
   Carbon Nanotubes (CNT), Metals, Metal oxides, Semiconductors, Ceramic, Polymeric Nanoparticles, Physical and Chemical properties.

4. Nanomaterial Fabrication: 5L
   Physical method, Physico-Chemical method, Chemical method, Biogenic method

5. Characterization of Nanoparticles 2L

References:

1. Zhong Lin Wang, Handbook of Nanophase and Nanomaterials (Vol 1 and II) Springer
2. J.C.Vickerman, Surface Analysis: The Principal Techniques, John Wiley and Sons
3. Roland Wiesendanger, Scanning Probe Microscopy and Spectroscopy: Methods and Applications, Cambridge Univ press
4. Recombinant DNA – Principles and Methodologies. Greene JJ and Rao VS, Marcel Dekker, New York, 1998.
5. Principles of gene manipulation and genomics. VIIth edition Primrose SB, Twyman RM, Blackwell Science, Oxford, 2006

Course Outcome:

After the completion of the course, students are able to,

- Know the importance of tools used in genetic Engineering
- Understand the Chromosomal organization in Viruses, Prokaryotes and Eukaryotes.
- Understand the phenomenon involved in GMO production.
- Understand the properties of Nanomaterial
- Utilize the nanomaterial for different purposes

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMEP 521A**	**Course Type**	**:Practical**
Subject	**: Practical Based on Applied biotechnology and Nanotechnology**	**Total Lecture**	**:4 hrs/ Practical**

Practical Based on Applied Biotechnology	**8 Practical**
1. Isolation of Plasmid DNA and its Quantification	1P
2. Separation of Plasmid DNA	1P
3. Isolation and Quantification of Plant Genomic DNA.	1P
4. Restriction Digestion of Plasmid DNA and its separation by using electrophoresis	2P
5. SDS-PAGE separation of seed storage proteins from legumes	3P

Practical Based on Nanotechnology	**6 Practical**
1. Synthesis of Nanoparticles by using a suitable method	2P
2. Determination of Absorption Maxima of synthesized nanoparticles	1P
3. Characterization methods for the nanomaterials (Demonstrative/PPT)	1P

Course Outcome:

After the completion of the course, students are able to,

- Isolate the DNA from Bacteria as well as Plant
- Understand the technique of proteins separation
- Understand the technique of DNA restriction and separation
- Synthesize the biogenic nanomaterials

NEP 2020
M.Sc. First Year

Course	**:**	**Major Elective**	**Total Credit**	**:**	**2C**
Code	**:**	**BOMET 521B**	**Course Type**	**:**	**Theory**
Subject	**:**	**Biodiversity**	**Total Lecture**	**:**	**30L**

Module I : Plant Diversity — 15L

Chapter 1 Introduction to Biodiversity — 04L

1. Introduction & Definition of Biodiversity
2. Importance of Biodiversity Conservation
3. Types of Biodiversity
   i. Genetic Diversity
   ii. Species Diversity
   iii. Ecosystem Diversity

Chapter 2 Extent of plant diversity — 05L

1. Global perspective - Overview of plant biodiversity across different continents
2. Indian Perspective
   i. Diversity of Plant Species in India
   ii. Endemic Species iii. Hotspots of Plant Biodiversity in India

Chapter 3 Habitat diversity and plant diversity — 06L

1. Relationship of habitats with plant diversity
2. Distribution of different major habitats across India
3. Habitat diversity in Maharashtra - Description of major habitats in Maharashtra

Module II: Ecology and Conservation — 15L

Chapter 4 Status of Plant Diversity — 05L

1. Assessment of diversity Species richness and abundance Ecosystem health indicators
2. Threats to plant diversity
   i. Human activities (Deforestation, Habitat fragmentation, Pollution, etc.)
   ii. Invasive species, Overexploitation of resources

Chapter 5 Ecology of Biodiversity — 07L

1. Ecological principles and biodiversity.
2. Habitat structure and species diversity.
3. Biogeography and its relationship to biodiversity.
4. Energy flow, nutrient cycles, and their impact on ecosystems.
5. Ecological interactions (competition, predation, symbiosis).

1. *In-situ* conservation
    i. Traditional ways of conservation
    ii. Sacred Groves,
    iii. Community reserves
    iv. Reserve forests,
    v. Protected Areas (Wildlife Sanctuaries, National Parks, Biosphere reserves)
    vi. Legal and Policy framework for conservation
2. Ex-Situ Conservation
    i. Botanical gardens,
    ii. Seed Banks

Chapter 6 Methods of Conservation 03L

- *In-situ* conservation (Traditional ways of conservation, Sacred Groves, Community reserves, Reserve forests, Protected Areas (Wildlife Sanctuaries, National Parks, Biosphere reserves), Legal and Policy framework for conservation
- Ex-Situ Conservation (Botanical gardens, Seed Banks**)**
- Habitat restoration,
- Species reintroduction
- Public awareness and participation

References:

1. Ambasht R.S. & N.K. Ambasht. A Textbook of Plant Ecology (15th edition.) CBS Publishers & Distributors.
2. Rahangdale S.S. & S.R. Rahangdale. 2024. Deorai. Department of Forests, Government of Maharashtra (Marathi).
3. Shukla and Chandel. Textbook of plant Ecology. S. Chand Publications.
4. Prema Michael. Ecological Methods for Field and Laboratory Investigations. Tata McGraw Hill publications. 1984.

Course Outcome:

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

- The biodiversity of the plants.
- Levels and extent of plant diversity.
- Habitat diversity across India and Maharashtra
- Assessment methods and threats to plant diversity.
- Traditional and recent methods of conservation

NEP 2020

M.Sc. First Year

Course	**: Major Elective**	**Total Credits**	**: 2C**
Code	**: BOMEP 522B**	**Course Type**	**:Practical**
Subject	**: Practical Based on Biodiversity**	**Total Lecture**	**:4 hrs/ Practical**

Practical Based on BOMET 521B		12P
1	Understanding the species and genetic diversity. [Plant Materials: Grains of different varieties of rice/wheat/beans, different colored flowers of *Hibiscus* for within species diversity]	2P
2	Study of endemic species and possible causes of endemism and threatened.	1P
3	Ecosystem Exploration i. Visit different ecosystems in Maharashtra, such as forests, grasslands, wetlands, and coastal areas. ii. Observe and document the biotic and abiotic components of each ecosystem. iii. Note variations in vegetation, soil type, topography, and hydrology.	3P
4	Ecosystem mapping: - Key features and special positions of components in an ecosystem	2P
5	Species inventory of an ecosystem- Quadrat, Line and Belt transect methods of Sampling.	2P
6	Estimation of Ecological parameters on the basis of data generated from practical no. 3 & 5.	1P
7	Identification of indicator species of the ecosystem on the basis of data analyzed.	1P
8	Ecological food web construction Identify trophic levels and species interactions within each ecosystem. i. Construct food webs depicting energy flow and nutrient cycling. ii. Discuss the role of keystone species and the consequences of species loss.	2P

References:

1. Ambasht R.S. & N.K. Ambasht. A Textbook of Plant Ecology (15th edition.) CBS Publishers & Distributors.
2. Prema Michael. Ecological Methods for Field and Laboratory Investigations. Tata McGraw Hill publications. 1984.
3. Rahangdale S.S. & S.R. Rahangdale. 2024. Deorai. Department of Forests, Government of Maharashtra (Marathi).
4. Shukla and Chandel. Textbook of plant Ecology. S. Chand Publications.

Course Outcome:

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

- The biodiversity of the plants.
- Levels and extent of plant diversity.
- Habitat diversity across India and Maharashtra
- Assessment methods and threats to plant diversity.
- Traditional and recent methods of conservation.

PDEA's

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M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Minor Course

To be implemented from Academic Year 2023-2024

Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**1**	**Skill Course**	**PGHRT-511**	**Human Rights I**	**1**	**30L**

PDEA'S
Prof. Ramkrishna More Arts Commerce and Science College Akurdi-44.
Department of Political Science
2024202-5
PG Courses offered by the Department
All PG Part I - First Semester

Human Rights|-

Credit- 1

Objectives:
This course is aimed at introducing the basic idea of Human rights; equip the student with an ability to distinguish between human rights, fundamental rights and also between individual rights and group rights.
The course operates at two levels: it discusses human rights in the context of global political order and secondly, discusses the implementation of human rights in the context of rights movements in India.

Learning Outcomes:
● The paper will help students to critically understand historical evolution of human rights till present global age.
● The students shall comprehend the nature and types of human rights and its various dimensions
● The students will be analysis the politics of human rights through global institutional perspectives.

1. Human Rights: Historical Traditions 5
a. Evolution
b. Changing Nature
c. Universalist Conceptions of Rights
d. Relativist Conceptions of Rights

2. Understanding Human Rights 5
a. Universal Declaration of Human Rights
b. Civil and Political Rights
c. Economic, Social and Cultural Rights
d. Evaluation

3. Rights And Duties 5

a. Rights

b. Typesof rights

c. Duties- Nature

Readings:

1. Baxi Upendra, 2002, The Future of Human Rights, New Delhi, Oxford University Press.
2. Byrne Darren, 2003, Human Rights, Delhi, Pearson.
3. Campbell Tom and Goldberg David et al., 1986, Human Rights, Oxford, Basil Blackwell
4. Coicaud J. M. and Doyle M. W. et al., 2004, The Globalization of Human Rights, Tokyo, United Nations University Press.
5. देवळाणकर शैलेंद्र, 2010, समकालीन जागतिक राजकारण , संभाजीनगर,
6. प्रवीण, 2016, मानवी हक्कांचे संरक्षण व संवर्धन , पुणे, यशदा.
7. Evans Tony, 2005, The Politics of Human Rights, London,Pluto Press.
8. Hawkesworth Mary and Kogan Maurice (ed.), 1992, Encyclopaedia of Government and Politics-Vol. II, London, Routledge.
9. जाधव तुकाराम आणि शिरापूरकर, 2015, मानवी हक्क ,पुणे युनिक ,अॅकडमी.
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PDEA's

Prof. Ramkrishna More Arts Commerce & Science College, Akurdi, Pune - 44

Affiliated to Savitribai Phule Pune University (SPPU)

Choice Based Credit System (CBCS) under Autonomy & NEP-2020

M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Minor Course

To be implemented from Academic Year 2023-2024

Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**II**	**Skill Course**	**PGHRT-521**	**Human Rights II**	**1**	**15L**

PDEA'S
Prof. Ramkrishna More Arts Commerce and Science College Akurdi-44.
Department of Political Science
2024202-5
PG Courses offered by the Department
All PG Part I - Second Semester

Human RightsVulnerable and Disadvantaged groups -

Objectives:

This course is aimed at introducing the basic idea of Human rights; equip the student with an ability to distinguish between human rights Human Rightsof Vulnerable and Disadvantaged .groups

The course operates it discusses human rights in the context of global political order and secondly, discusses the implementation of human rights women, child and other valunarable groupsin the context of rights movements in India.

Learning Outcomes:

- The paper will help students to notify Vulnerable and Disadvantaged groups.
- The students shall comprehend socially, economically disadvantaged people and its various dimensions
- The students will be analysis the politics of human rights Human rights of vulnerable groups through global institutional perspectives.

1. Human Rights: Vulnerable and Disadvantaged groups 5
a. Womens Human Rights
b. National Policy for Women
c. Childrens Human Rights
d. UN Organs for Childrens

2. Status and rights of socially, economically disadvantaged people 5
a. Status of Indigenous People and the Role of the UN
.b Status of SC/ST and Other Indigenous People in the Indian Scenario
.cHuman Rights of Aged and Disabled

.dThe Minorities and Human Rights

3. Human rights of vulnerable groups 5
a. Stateless Persons
.bSex Workers
.cMigrant Workers
.dHIV/AIDS Victims

Readings:

1. Baxi Upendra, 2002, The Future of Human Rights, New Delhi, Oxford University Press.
2. Byrne Darren, 2003, Human Rights, Delhi, Pearson.
3. Campbell Tom and Goldberg David et al., 1986, Human Rights, Oxford, Basil Blackwell
4. Coicaud J. M. and Doyle M. W. et al., 2004, The Globalization of Human Rights, Tokyo, United Nations University Press.
5. देवळाणकर शैलेंद्र, 2010, समकालीन जागतिक राजकारण , संभाजीनगर,
6. प्रवीण, 2016, मानवी हक्कांचे संरक्षण व संवर्धन , पुणे, यशदा.
7. Evans Tony, 2005, The Politics of Human Rights, London,Pluto Press.
8. Hawkesworth Mary and Kogan Maurice (ed.), 1992, Encyclopaedia of Government and Politics-Vol. II, London, Routledge.
9. जाधव तुकाराम आणि शिरापूरकर, 2015, मानवी हक्क ,पुणे ,युनिक अॅकडमी.
10. कांबळे बाळ, 2012, मानव संसाधन विकास आणि मानवी हक्क ,पुणे डायमंड, प्रकाशन.

PDEA's

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M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Minor Course

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Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**1**	**Skill Course**	**PGCRT-521**	**Cyber Security I**	**2**	**30L**

Introduction to Cyber Security / Information Security

Syllabus for 'Introduction to Cyber Security / Information Security' program* for students of University of Pune is given below.

The program will be of 4 credits and it will be delivered in 60 clock hours**.

*: Course material for this program will be developed by CINS

**: These clock hours also includes practical sessions and demonstrations wherever required.

SR. NO.	TOPIC	HOURS	MARKS
1	**Module 1: Pre-requisites in Information and Network Security**	**14**	**25**
	Chapter 1: Overview of Networking Concepts	3	
	Chapter 2: Information Security Concepts	3	
	Chapter 3: Security Threats and Vulnerabilities	5	
	Chapter 4: Cryptography / Encryption	3	
2	**Module 2: Security Management**	**13**	**25**
	Chapter I: Security Management Practices	7	
	Chapter 2: Security Laws and Standards	6	

Detail Syllabus for Cyber Security I Credit Course for University of Pune

All PG First Year

Semester II

Module 1: Pre-requisites in Information and Network Security

Chapter 1: Overview of Networking Concepts

1. Basics of Communication Systems
2. Transmission Media
3. Topology and Types of Networks
4. TCP/IP Protocol Stacks
5. Wireless Networks
6. The Internet

Chapter 2: Information Security Concepts

1. Information Security Overview: Background and Current Scenario
2. Types of Attacks
3. Goals for Security
4. E-commerce Security
5. Computer Forensics
6. Steganography

Chapter 3: Security Threats and Vulnerabilities

1. Overview of Security threats
2. Weak / Strong Passwords and Password Cracking
3. Insecure Network connections
4. Malicious Code
5. Programming Bugs

6. Cyber crime and Cyber terrorism
7. Information Warfare and Surveillance

Chapter 4: Cryptography / Encryption

1. Introduction to Cryptography / Encryption
2. Digital Signatures
3. Public Key infrastructure
4. Applications of Cryptography
5. Tools and techniques of Cryptography

Module 2: Security Management

Chapter I: Security Management Practices

1. Overview of Security Management
2. Information Classification Process
3. Security Policy
4. Risk Management
5. Security Procedures and Guidelines
6. Business Continuity and Disaster Recovery
7. Ethics and Best Practices

Chapter 2: Security Laws and Standards

1. Security Assurance
2. Security Laws
3. IPR
4. International Standards
5. Security Audit
6. SSE-CMM / COBIT etc

PDEA's

Prof. Ramkrishna More Arts Commerce & Science College, Akurdi, Pune - 44

Affiliated to Savitribai Phule Pune University (SPPU)

Choice Based Credit System (CBCS) under Autonomy & NEP-2020

M.Sc. Program in Botany

(Faculty of Science)

Syllabus for Minor Course

To be implemented from Academic Year 2023-2024

Structure of Course

M.Sc. Botany syllabus						
Year	**Sem**	**Course Type**	**Course code**	**Course Name**	**Credits**	**Lectures or Practical**
First Year	**2**	**OJT**	**BOOTP 521**	**On Job Training**	**4**	**Practical**

- ✓ The students, as a part of their course, will be given opportunities to enroll for Field Project(s) or on job training.
- ✓ The student must undergo field work project which related to chemistry.
- ✓ The students must undergo industrial on job training/internship in the 2nd semester in any of the reputed industry, Government-sponsored Research & Development Organization, and reputed academic institution/foreign universities.

Program: MSc [Botany], 2023-24

Program Outcomes

PO-1: **Disciplinary knowledge and skill:** A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical fundamental concepts in all disciplines of botany. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related soft-wares for chemical analysis, characterization of materials and in separation technology.

PO-2: **Skilled communicator:** The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

PO-3: **Critical thinker and problem solver:** The course curriculum also includes components that can be helpful to graduate students to develop critical thinking and to design, carry out, record and analyze the results of physiological activities in plants. Students will be able to think and apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO-4: **Sense of inquiry:** It is expected that the course curriculum will develop an inquisitive characteristic among the students through appropriate questions, planning and reporting experimental investigation.

PO-5: **Team player:** The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

PO-6: **Skilled project manager:** The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about botany project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

PO-7: **Digitally literate:** The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, use of chemical simulation software and related computational work.

PO-8: **Ethical awareness:** A graduate student requires understanding and developing ethical awareness or reasoning which is adequately provided through the course curriculum. Students CO-2: To know how to handle the technical devices for presenting research works. can also create an awareness of the impact of chemistry on the environment, society, and also make development outside the scientific community.

PO-9: **Environmental Awareness:** As an inhabitant of this green planet a Chemistry graduate student should have many social responsibilities. The course curriculum is designed to teach a Chemistry graduate student to follow the green routes for the synthesis of chemical compounds and also find out new greener routes for sustainable development. The course also helps them to understand the causes of environmental pollution and thereby applying environmental friendly policies instead of environmentally hazard ones in every aspect.

PO-10: **Analytical skill development and job opportunity:** The course curriculum is designed in such a way that Chemistry graduate students can handle many botany based software, modern instruments and advanced technologies to synthesize, characterize and analyze the chemical compounds very skillfully. Such a wonderful practice in the graduate level will bring a good opportunity to the students for getting job in industries besides academic and administrative works.

P. D. E. A's

Prof. Ramkrishna More Arts, Commerce and Science College Akurdi Pune-411044

Affiliated to

Savitribai Phule Pune University

[SPPU]

NEP-2020 Implementation

Choice Based Credit System [CBCS]

Under

Autonomy

Guideline for

On Job Training

and

Internship Policy

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

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 favored destination. The internship policy detailed hereunder will apply to academic session 2023-2024 onwards.

1.1. 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.

1.2. Objective and Vision: Internships serve as pivotal educational and career development opportunities, offering handson 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.

1.3. 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	6th / 8th 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 4th or 6th Semester	4-8 weeks	Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship	8
Winters	After 3rd/ 5th Semester	2-4 weeks	Inter/ Intra Institutional Activities, Research Project, Community Engagement	2-4
Semester Integrated	6th / 8th Semester	can be part-time- duration can be as per HEI's discretion	Project work, Seminar (excluding credits for Advanced Courses)	2-4

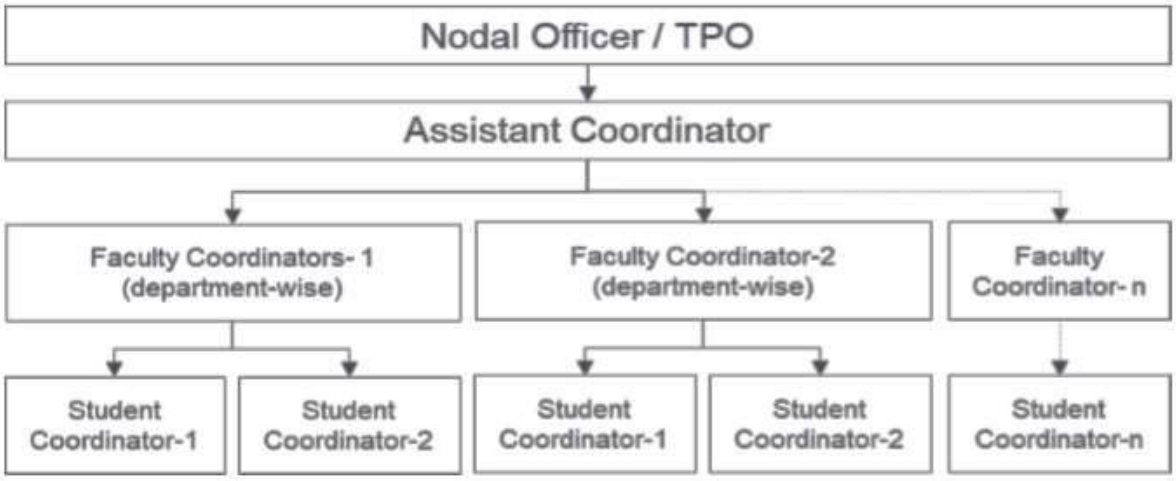
* Internship/Apprenticeship: 8 Credits + Field Projects/Community Engagement: 4-6 Credits For M.A., M.Sc., M.Com. and all professional PG degree courses, the indicative requirement regarding Internship duration and credits is as follows:

Internship	Schedule	Du	s	Credits
Summers	After 2nd Semester	4-6 weeks	GO/MSME/ Rural Internship/ Innovation / Entrepreneurship	4
Semester Integrated	3rd & 4th 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

2.1. **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.

2.2. 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 counselor 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 onboarding 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 students 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

3.1. 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.

3.2. 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

3.3. 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 de-registered 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			
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:

CGPA:

HEI Name: <bachelor's degree> Year Degree / Specialization:

CGPA:

Internship / Work Experience

Organization **Year**

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 behavior
- 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	Satisf-actory	Good	Excellent
Behaviors				
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				
Analyzes 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

Question Paper Pattern-NEP MSc-I

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.			
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.**	Note or Describe type questions	6 Marks
	B. Solve the following any two of the following i. ii. iii.	Problem type or tricky reasoning type question	4 marks
Question-3	**A. Solve any two of the following** **i.** **ii.** **iii.**	Write Note / Differentiate type questions	6 Marks
	B. Solve the following any two of the following i. ii. iii.	Problem type or Justification type question	4 marks
Question-4	**A. Solve any one of the following** i. **ii.**	Application type or Derive equation or Justification type question	5 Marks
	B. Solve any two of the following i. **ii.** **iii.**	Explain or demonstration type questions	5 marks

Pattern for 4 credit paper

Time – 3 h 70 Marks 4 Credit

1. Figures to right to indicate full marks
2. Answer to two sections should be written on separate answer books.

Section-I

Question-1 **A] Solve any 5 of the following (Define, reasoning, short problem, etc) [5]**

i)
ii)
iii)
iv)
v)
vi)
vii)

Question-2 **A] Answer any two the following [6]**

i)
ii)
iii)

Question-2 **B] Answer the following (Problem type) [4]**

i)

Question-3 **A] Answer any two the following (Explain/reasoning type) [6]**

i)
ii)
iii)

Question-3 **B] Answer the following [4]**

i) Tricky explanation / reasoning / problem type

Question-4 **A] Answer any one the following (Notes) [5]**

i)
ii)

Question-4 **B] Answer any two the following [5]**

i)
ii)
iii)

External Practical Examination:

1) Student should produce certified hard copy of project / practical journal at the time of examination.

2) One experiment to be performed by a candidate for 35 marks; Time – 4 hours

a) 30 marks will be allotted for practical work

b) 5 marks for oral.

3) Project Examination: Project will be jointly evaluated by examines appointed to the practical exam. Project evaluation should be done as per guideline given in syllabus.