

Shiv Chhatrapati Shikshan Sanstha's

**Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)**



Structure and Curriculum of

Undergraduate Programme of Science & Technology

B.Sc. (Honors/Research) in Botany

Approved by

Board of Studies

in

Botany

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2024

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Honors/Research /Degree) in Botany** Programme to be effective from the **Academic Year 2024-25**. It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 09/03/2024

Place: Latur

NEP Cell
Rajarshi Shahu Mahavidyalaya, Latur
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CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors/Research) in Botany** Programme to be effective from the **Academic Year 2024-25**.

Date: 09/03/2024

Place: Latur



(S. N. Shinde)

Chairperson

Board of Studies in Botany

Rajarshi Shahu Mahavidyalaya, Latur
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Rajarshi Shahu Mahavidyalaya, Latur
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Under the Faculty of Science and Technology

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17	Dr. D.G. Palke, Head, Department of Chemistry, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Member from same Faculty

From the Desk of the Chairperson...

The Department of Botany is established in 1971. It is one of the leading departments in the field of teaching and student centric activities. After Autonomy, in keeping pace with the advances in various aspects of plant sciences, the department has introduced the courses like Molecular Biology, Cell Biology, Plant Biotechnology, Bioinformatics, Genetics, Instrumentation in Botany, Pharmacognosy, Gardening and Landscaping, Plant Breeding, Biostatistics, Forensic Botany etc. The Department has academic autonomy and has been revising its curriculum regularly. The department has successfully implemented the Choice Based Credit System (CBCS) for grading the students. The Curriculum of the B.Sc. and M.Sc. has been designed by considering NET, SET, GATE and others competitive examinations.

Institution's Motto, *Aroha Tamaso Jyoti* (The Journey from Dark to Light), the Mission, *Pursuit of Excellence*, the Vision, to evolve as a World Class Dynamic Center of Higher Education, and the Core Values have been frequently reflected in the present curriculum.

The Higher Education System in India and all over the world has undergone paradigm shift in both qualitative and quantitative aspects. Its best example is National Education Policy (NEP-2020). The National Education Policy 2020 emphasizes on developing overall personality of students by incorporating Humanitarian and Constitutional values, creativity and critical thinking, harnessing innovation, use of modern technology and interaction with various stakeholders. It recognizes that the pedagogy should evolve to make education more experiential, holistic, integrated, learner-centric, flexible and developing skill, etc. to shape the student that can face the challenges of the future, the new policy also envisages the refinement and improvement in the Learning Outcome based Curriculum Framework.

Botany is one of the most fundamental branches of Life Sciences. It is the broad subject encompassing classical and modern systemic aspects of plant diversity as well as contemporary subjects like Molecular Biology, Bioinformatics, Biotechnology, etc. to foster comprehensive understanding about various aspects of plant sciences. The present learning outcome based curriculum framework for B. Sc. (Honors/Research) in Botany is designed to provide a focused learning outcome based syllabus at the Honors level providing structured teaching-learning experiences catering to needs of the students. The honors course in Botany will prepare the students both academically and in terms of employability. This program also inculcates various attributes like Problem solving, Research skills, Critical thinking etc. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability.

The course is upgraded keeping in mind the aspirations of the students, changing nature of the subject as well as the learning environment. Courses of Botany have been designed to incorporate recent advancements, techniques to upgrade the skills of students. The new structure is expected to enhance the level of understanding among students and maintain the standard of Honors Degree in Botany across the country. The efforts have been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process. This framework offers flexibility and innovation in syllabi designing and in methods adopted for teaching-learning process and learning assessment.

The new curriculum offers knowledge of wide areas in Botany including Diversity, Plant Systematics, Plant Biotechnology, Cell Biology, Genetics, Environmental Biology, Plant

Physiology, Bioinformatics, and Medicinal Plants. Plant disease management etc. This new syllabus has been prepared keeping in view the unique requirement of B.Sc. (Honors) Botany students. The contents of the syllabi have been drawn to accommodate the widening horizons of the Botany discipline and reflect the changing needs of the students. The semester wise course distribution and detailed syllabus for each course is appended with a list of suggested references.

The present structure comprises Discipline specific courses (DSC), Discipline Specific Electives (DSE), Discipline Specific Minor Course (DSM), Generic/Open Electives (GE/OE), Vocational Specific Course (VSC), Skill Enhancement Course (SEC), Ability Enhancement Course (AEC) etc. The discipline specific courses (DSC) are compulsory and the elective courses can be chosen from the given Basket. Except Ability Enhancement courses, all other courses, comprise theory and practicals.

The project work is specially emphasized in this structure. The project will mainly involve experimental work. The students will be asked their choice for project. The Generic Electives will be offered to the students of other departments of the college. The students will have the option to choose one generic elective from the given Basket. The generic elective comprises theory as well as practical. The students will also undertake one Vocational Specific Course (VSC) and one Skill Enhancement Course (SEC) of two credits each. The VSC and SEC also comprise theory and practicals. These courses will be chosen by the students from the concerned basket.

One generic elective is specified for Indian Knowledge Systems (IKS). Indian Knowledge Systems have a strong foundation in Indian Culture, Philosophy and Spirituality and have evolved through thousands of years. These knowledge systems include Ayurveda, Yoga etc. that are still applicable in the modern world in several ways.

These courses offer skills to pursue research and teaching in the field of Botany and thus would produce best minds to meet the demands of society. This curriculum framework for B.Sc. (Honors) in Botany is developed keeping in view of the students centric learning Pedagogy, which is entirely outcome oriented. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is covered through Laboratory and Field works.

The major objective of this curriculum is to elevate the subject knowledge of the students, making them critical thinkers and able to solve problems and issues related to Botany logically and efficiently.



(S. N. Shinde)

Chairperson

Board of Studies in Botany

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Department of Botany
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Structure for Four Year Multidisciplinary Undergraduate Degree Programme in B. Sc Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/ OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT,FP,CEP, RP	Credit per Sem.	Cum./C r. per exit
		DSC	DSE							
1	2	3		4	5	6	7	8	9	10
II 5.0	III	DSC V: 04 Cr. DSC VI: 04 Cr.	NA	Minor I: 04 Cr.	GE-III: 02 Cr.	SEC-III: 02 Cr.	AEC- III Eng. : 02 Cr.	CC-I: 02 Cr. (SSC) Field Project: 02 Cr.	22	88 Cr. UG Diplom a
	IV	DSC VII: 04 Cr. DSC VIII: 04 Cr.	NA	Minor II: 04 Cr.	GE-IV: 02 Cr.	SEC-IV: 02 Cr.	AEC- IV Eng. : 02 Cr.	CC-II: 02 Cr. (SSC) Field Project: 02 Cr.	22	
	Cum. Cr.	16	-	08	04	04	04	08	44	
Exit Option: Award of UG Diploma in Major with 88 Credits and Additional 04 Credits Core NSQF Course/Internship or continue with Major and Minor										

Note :

A) Co-Curricular Courses (CC) includes –

1. Health and Wellness
2. Yoga education
3. Sports and fitness
4. Cultural activities
5. NSS
6. NCC
7. Fine Applied Visual Performing Arts
8. Study Tour
9. Publication of articles in newspaper / magazine.

B) Field Project concerned with Major



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Faculty of Science & Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in
Botany Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/OE	SEC (VSEC)	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE					
1	2	3		4	5	6	9	10
I 4.5	III	DSC V: 04 (03+01). Cr DSC VI: 03+01 Cr.	NA	Minor I: 04 (03+01) Cr.	GE-III: 02 Cr.	SEC-III: 02 Cr.	16	44 Cr. UG Certificate
	IV	DSCVII: 04 (03+01) Cr. DSC VIII 04 (03+01) Cr.	NA	Minor II: 04 (03+01) Cr.	GE-IV: 02 Cr.	SEC-IV: 02 Cr.	16	
	Cum. Cr.	16	-	08	04	04= 04	32	

Abbreviations:

1. DSC : Discipline Specific Core (Major)
2. DSE : Discipline Specific Elective (Major)
3. DSM : Discipline Specific Minor
4. GE/OE : Generic/Open Elective
5. VSEC : Vocational Skill and Skill Enhancement Course
6. VSC : Vocational Skill Courses
7. SEC : Skill Enhancement Course
8. AEC : Ability Enhancement Course
9. MIL : Modern Indian Languages
10. IKS : Indian Knowledge System
11. FSRCE : Fostering Social Responsibility & Community Engagement
12. VEC : Value Education Courses
13. OJT : On Job Training
14. FP : Field Projects
15. CEP : Community Engagement and Service
16. CC : Co-Curricular Courses
17. RP : Research Project/Dissertation
18. SES : Shahu Extension Services



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Department of Botany
B.Sc. (Honors/Research) Botany

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
II 5	III	201BOT3101 (DSC-V)	Morphology and Taxonomy of Angiosperms	03	45
		201BOT3103	Lab Course – V	01	30
		201BOT3102 (DSC-VI)	Economic Botany and Pharmacognosy	03	45
		201BOT3104	Lab Course – VI	01	30
		Minor	Plant Diversity	04	60
		GE-III	From Basket (Plant and Human Health)	04	60
		(SEC-III)	From Basket (Herbal Technology)	02	30
	Total Credits			26	
	IV	201BOT4101 (DSC-VII)	Environmental Biology; Gardening and Land Scaping	03	45
		201BOT4103	Lab Course – VII	01	30
		201BOT4102 (DSC-VIII)	Biotechnology and Plant Breeding	03	45
		201BOT4104	Lab Course – VIII	01	30
		Minor	Plant Recourses and its Utilization	04	60
		GE-IV	From Basket(Plant and Human Health)	04	60
		(SEC-IV)	From Basket (Herbal Technology)	02	30
	Total Credits			26	
Total Credits (Semester III & IV)				52	



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Programme Outcomes (POs) for B.Sc. Programme	
PO 1	Disciplinary Knowledge: Comprehensive knowledge of science subjects which constitute the graduate programme and execution of scientific knowledge in the specific area.
PO 2	Scientific Outlook: The qualities of a science graduate such as observation, precision, analytical mind, logical thinking, clarity of thought and expression and systematic approach.
PO 3	Self-Directed Life-long Learning: Ability to appear for various competitive examinations or choose the post graduate programme or other related programme of their choice.
PO 4	Research Skills: Functional knowledge and applications of instrumentation and laboratory techniques to do independent experiments, interpret the results and develop research ethos.
PO 5	Problem Solving Skills: Analytical and logical skills and critical thinking to extract information from qualitative and quantitative data, formulate and solve problems in a systematic and rational manner.
PO 6	Professional Competence and Ethics: Aptitude and skills to perform the jobs in diverse fields such as science, engineering, industries, survey, education, banking, development and planning, business, public service, self-business etc. with human rationale and moral values.



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Programme Specific Outcomes (PSOs) for B.Sc. Botany (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Knowledge and Understanding of: <ol style="list-style-type: none"> 1. The range of plant diversity in terms of structure, function and environmental relationships. 2. The evaluation of plant diversity. 3. Plant classification and the flora of Maharashtra. 4. The role of plants in the functioning of the global ecosystem. 5. Statistics as applied to biological data.
PSO 2	Intellectual Skills: <ol style="list-style-type: none"> 1. Think logically and organize tasks into a structured form. 2. Assimilate knowledge and ideas through wide reading and the e-resources. 3. Transfer appropriate knowledge and methods within the subject. 4. Construct and test hypothesis. 5. Plan, conduct and write a report on an independent project.
PSO 3	Practical Skills: Students learn following skills through field and laboratory work- <ol style="list-style-type: none"> 1. Interpreting plant morphology and anatomy. 2. Identification of plants. 3. Vegetation analysis techniques. 4. A range of physiochemical analysis of plant materials. 5. Analyze data using appropriate statistical methods and computer programs. 6. Plant pathology to be added for sharing of fieldwork and lab analysis.
PSO 4	Transferable Skills: <ol style="list-style-type: none"> 1. Use of IT (word-processing, use of internet, statistical packages and databases). 2. Communication of scientific ideas in writing and orally. 3. Ability to work as part of a team, function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. 4. Ability to use library resources. 5. Time management. 6. Career planning.
PSO 5	Scientific Knowledge: Apply the knowledge of life sciences and fundamental processes of plants.
PSO 6	Problem Analysis: Identify the taxonomic position of plants and analyze non reported plants with substantiated conclusions
PSO 7	Design/Development of Solutions:

	Design solutions from medicinal plants for health problems, disorders and diseases of human beings and estimate the phytochemical content which meet the specified need to public health.
PSO 8	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide valid conclusions.
PSO 9	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for Biochemical estimation, Molecular Biology, Biotechnology, cellular and physiological activities of plants with an understanding of the applications and limitations.
PSO 10	The Botanist and Society: Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, ethical principles, legal and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice and need of sustainability.
PSO 11	Communication: Communicate effectively on complex engineering activities with the engineering community and 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.

Semester - III



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Department of Botany

Course Type : DSC-V

Course Title : Morphology and Taxonomy of Angiosperms

Course Code : 201BOT3101

Credits : 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives:

- LO1 Describe the function of classification.
- LO2 Distinguish between Taxonomy and Systematics.
- LO3 Describe the reasons for preferring natural classifications over artificial classifications.
- LO4 Describe the reason that classical taxonomy is hierarchical scheme of classification.
- LO5 Relate the reason that botanical taxonomy uses "division", rather than "phylum".

Course Outcomes:

After completion of course, the student will be able to-

- CO1 Identify the taxa on the basis of morphological features.
- CO2 Distinguish between taxonomy and systematics.
- CO3 Correlate the reasons of hierarchical levels in the classifications.
- CO4 Describe the reasons for preference to natural classification over artificial classification

Unit No.	Title of Unit & Contents	Hrs.
I	MORPHOLOGY OF ANGIOSPERMS-I	10
	1. Root: Definition, characters, types (taproot and adventitious) and functions 2. Stem: Definition, characters, modifications (stem tendril, runner, and rhizome) and functions. 3. Leaf: Definition, structure of typical leaf (Hibiscus), Types of leaf apex and Margin, Types, Phyllotaxy and Venation, Functions Unit Outcomes: UO1 Describe the vegetative morphological features of plant	
II	MORPHOLOGY OF ANGIOSPERMS-II	10
	1. Inflorescence: Definition, structure of typical inflorescence Types- Solitary, Racemose and Cymose. 2. Flower: Definition, structure of typical flower (Hibiscus), symmetry and types (hypogynous, epigynous, perigynous) 3. Fruit: Definition and its Types Unit Outcomes: UO1 Describe the reproductive morphological features of plant	
III	TAXONOMY OF ANGIOSPERMS	12
	1. Introduction 2. Scope and objectives of angiosperm taxonomy 3. Binomial nomenclature	

Unit No.	Title of Unit & Contents	Hrs.
	4. Chemotaxonomy and Cytotaxonomy 5. Taxonomic ranks 6. Types of classification (Artificial, Natural and Phylogenetic) 7. Bentham & Hooker's system of classification with merits and demerits UO1 Correlate the reasons of hierarchical levels in the classifications.	
IV	STUDY OF FAMILIES	13
	Distribution, vegetative morphology (habitat, habit, root, stem, leaf), Reproductive morphology (inflorescence, flower, pollination, fruit) Floral Formula, Floral Diagram, Systematic position (as per Bentham & Hooker system) Distinguishing characters and Economic importance of plants (at least two) of the following families: i Brassicaceae ii Fabaceae iii Solanaceae iv Lamiaceae v Euphorbiaceae vi Poaceae Unit Outcomes: UO1 Describe vegetative twigs, distinguishing characters and Economic importance of plants.	

Learning Resources:

1. A Text Book of Systematic Botany- Sutaria R N
2. Taxonomy of Angiosperms- Pandey S N and Mishra S D
3. Taxonomy of Angiosperms- Sambamurthy A V S
4. Taxonomy of Angiosperms- Vashishta P.C
5. Modern Plant Taxonomy- Subramanyam N S
6. Principles of Angiosperms Taxonomy- Davis P. H. and Heywood V.H.
7. Angiosperms-Chopra G.L
8. Taxonomy of Angiosperms- Kumarsen Annie
9. Introductory Taxonomy of Angiosperms- S. Sundara Rajan



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Course Type : Lab Course

Course Title : Lab Course (Based on DSC-V)

Course Code : 201BOT3103

Credits : 01

Max. Marks: 50

Hours: 30

Learning Objectives

- LO1 To distinguish between taxonomy and Systematics.
- LO2 To describe the reason that classical taxonomy is a hierarchical scheme of classification.
- LO3 To classify the species based on their shared traits and lineage.
- LO4 To provide classification system based on natural affinities of organisms as far as possible.

Course outcomes

After completion of course, the student will be able to-

- CO1 Identify the different types of roots and its modification.
- CO2 Explain different forms of stem and its modification.
- CO3 Describe the leaf, its types, Phyllotaxy and venation.
- CO4 Correlate the Inflorescence, Flower and Fruit of angiospermic families.

Practical No.	Unit
1	Study of Root and its modifications
2	Study of Stem and its modifications
3	Study of Leaf
4	Study of Inflorescence
5	Study of flower
8-13	Description, identification and classification of the plants with floral formulae and floral diagrams of their families (mentioned in theory syllabus)
14	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)

N.B.: Any Ten Practicals from above.



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Course Type : DSC-VI

Course Title : Economic Botany and Pharmacognosy

Course Code : 201BOT3102

Credits : 03

Max. Marks: 75

Lectures: 45 Hrs.

Learning Objectives

- LO1 To acquire good knowledge about economic importance of cereals, pulses, oilseed crops.
- LO2 To learn about chemistry of active constituents of medicinal plants.
- LO3 To understand methods of isolation of active constituents of medicinal plants.
- LO4 To identify and estimate of active constituents of medicinal plants.

Course outcomes

After completion of course, the student will be able to-

- CO1 Describe the method of cultivation and economic importance plants.
- CO2 Identify, analyze and estimate active constituents of medicinal plants
- CO3 Explain Traditional and Indigenous systems of Medicine.
- CO4 Describe Ayurvedic Principles and formulations.

Unit No.	Title of Unit & Contents	Hrs.
I	ECONOMIC BOTANY-I	10
	Introduction: Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of the following- 1. Cereals (Wheat) 2. Pulses (Pigeon pea) 3. Fiber yielding plants (Cotton) 4. Cotton processing 5. Rubber production	
	Unit Outcome: UO1 Describe the method of cultivation and economic importance plants	
II	ECONOMIC BOTANY-II	10
	Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of the following- 1. Oil yielding plants (Soybean, Sunflower) 2. Soya milk production 3. Starch processing 4. Timber yielding plants (Teak, Neem) 5. Medicinal plants (Aloe, Withania)	
	Unit Outcome: UO1 Describe the method of cultivation and economic importance plants	
III	INTRODUCTION TO PHARMACOLOGY	11
	1. History, definition and scope of Pharmacology 2. Traditional and alternative systems of medicine 3. Indigenous systems of Medicine (Ayurveda, Siddha, Unani)	

Unit No.	Title of Unit & Contents	Hrs.
	4. Classification of crude drugs.	
	5. Concept of active principle (Five examples)	
	Unit Outcomes: UO1 Identify, analyze and estimate active constituents of medicinal plants UO2 Explain Traditional and Indigenous systems of Medicine	
IV	AYURVEDIC PHARMACY	14
	1. Introduction	
	2. Tridosha concept	
	3. Ayurvedic principles- Ras, Guna, Vipaka, Virya, Prabhava.	
	4. Ayurvedic formulations – Asava, Arishta, Kvatha, Churna, Ksharas, Leha, Vatika, Taila, Bhasma.	
	5. Drug adulteration	
	6. Study of drugs w.r.t. occurrence, distribution, morphological characters, Constituents and uses of <i>Adhatoda</i> (Leaf drug).	
	Unit Outcome: UO1 Describe Ayurvedic Principles and formulations	

Learning Resources:

1. Economic Botany- Pandey B. P (1987)
2. Text book of Economic Botany- Verma V. (1984)
3. Economic Botany- Hill A.W (1981)
4. Economic Botany- Albert, F.H.
5. Economic Botany- Hill, A.F
6. Pharmacognosy-Trease and Evans
7. Pharmacognosy- Shah and Qadry
8. A Text Book of Pharmacognosy - Ghani A
9. Text book of Pharmacognosy- M. Ali.
10. Practical Pharmacognosy- Kokate C.K.,
11. Pharmacognosy- Kokate C.K. Purohit A.P. and Gokhale S.B.
12. Pharmacognosy-Trease G.E. and Evans. W.C. · Tyler V.E Brady
13. Bhaishyajakalpana- Vaidya S.S. and Dole. V. A



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Course Type : Lab Course VI

Course Title : Lab Course (Based on DSC-VI)

Course Code : 201BOT3104

Credits : 01

Max. Marks: 50

Hours: 30

Learning Objectives:

- LO1 To learn the nutritional value and economic importance of cereals, pulses, oilseed crops.
- LO2 To know the chemistry of active constituents of medicinal plants.
- LO3 To understand the methods of isolation of active constituents of medicinal plants.
- LO4 To study the methods of preparation of Ayurvedic formulations.

Course outcomes:

After completion of course, the student will be able to-

- CO1 Easily distinguish between cereals and pulse crops.
- CO2 Perform cultivation practices in field.
- CO3 Describe and recognize different adulteration in food product.
- CO4 Isolate the active components of plants by different methods.

Practical No.	Unit
1	Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of Wheat and pigeon pea
2	Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of Soybean and Sunflower
3	Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of Cotton
4	Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of Neem and Teak
5	Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of Aloe and Withania
6-7	Histochemical tests of food storing tissue in pigeon pea, Wheat, lignin and cellulose
8	Extraction of pectic substance
9-10	Extraction of Tannin
11-12	Preparation of Ayurvedic formulations (as per syllabus)
13	Histochemical tests of food storing tissue in pigeon pea, Wheat, lignin and cellulose

14	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)
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N.B.: Any Ten Practicals from above.



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Course Type : DSM-I

Course Title : Plant Diversity

Course Code : 201BOT3201

Credits : 03

Max. Marks:75

Lectures: 45 Hrs.

Learning Objectives:

- LO1 To become familiar with Cryptogamic Botany.
- LO2 To study different types of spore in Pteridophytes.
- LO3 To learn the morphology of Angiosperms.
- LO4 To learn the life cycles of Cryptogams and Gymnosperms.

Course Outcomes:

After completion of the course, students will be able to-

- CO1 Distinguish between reproductive stages of cryptogams.
- CO2 Examine the morphology and life cycles of certain genera of Cryptogams and Gymnosperms.
- CO3 Analyze the morphology of Angiosperms.
- CO4 Correlate significance of bacteria, algae, bryophytes and fungi with human welfare.

Unit No.	Title of Unit & Contents	Hrs.
I	MICROBES	12
	1. General account, distribution and classification of microorganisms, 2. Structure, types, nutrition, reproduction and economic importance of bacteria. 3. Characters, economic importance, classification and general account of major classes of fungi. 4. General account, habit, structure and methods of reproduction in <i>Aspergillus</i> . 5. Lichens: Occurrence, general structure, nutrition and economic importance.	
II	ALGAE AND BRYOPHYTES	11
	1. General characters and Classification of Algae. 2. Occurrence, structure of thallus and mode of reproduction in <i>Oedogonium</i> 3. Economic Importance of Algae. 4. General characters and Classification of Bryophytes. 5. Occurrence, structure of thallus and mode of reproduction in <i>Riccia</i> 6. Economic Importance of Bryophytes	
III	PTERIDOPHYTES AND GYMNOSPERMS 12Hrs	11

Unit No.	Title of Unit & Contents	Hrs.
	1. General characters and Classification of Pteridophytes. 2. Occurrence, structure of thallus and mode of reproduction in <i>Azolla</i> 3. Economic Importance of Pteridophytes. 4. General characters and Classification of Gymnosperms. 5. Occurrence, structure of thallus and mode of reproduction in <i>Ephedra</i> . 6. Economic Importance of Gymnosperms	
IV	ANGIOSPERMS	11
	1. General characters and Classification of Angiosperms. 2. Morphology of root and its types 3. Morphology of stem and its types 4. Morphology of leaf and its types. 5. Inflorescence and its types. 6. Morphology of typical flower	

Learning Resources:

1. Morphology of Vascular plants- Bierhorst, D.W. MacMillan Co.; First Edition (January 1, 1971)
2. Comparative morphology of vascular plants- Eames, A. J. and E. M. Giffard - Madroño; a West American Journal of Botany (1960)
3. An introduction to Pteridophytes. - Rashid, A. (1978) Vikas Publishing House (P) Ltd., 1999
4. Morphology of Pteridophytes- Sporne, K.R. (1966), Hutchinson University Library, 1962
5. The Phylogeny and Classification of ferns Jermy- A. G. (1973)- Academic Press Inc (1 December 1973)
6. Botany for Degree Students – Pteridophytes- Vashishta, B.R. (1996) S. Chand Publishing, 2006
7. An Introduction to Pteridophyta- Parihar, N.S. (1959) - Central Book Depot, 1962
8. An introduction to Paleobotany- Arnold, C.A. (1972) - McGraw Hill Book Company Inc.
9. Principles of Paleobotany- Darroh, W.C. (1968) - Chronica Botanica Company, 1939
10. Indian Fossil Pteridophytes- Surange, K.R. (1968)- Alexander Doweld, 1966
11. Pteridophytes and Gymnosperms-K.U.Kramer, P.S.Green, Springer Verlag, New York
12. The Gymnosperms- Biswas, C &Johri, B.N. (2004), Narosa Publishing House, New Delhi.Coulter

13. Morphology of Gymnosperms- J.M. & Chamberlain C.J. (1978): Central Book Depot, Allahabad.
14. The Gymnosperms (Fossils& Living)- Kakkar, R.K.andKakkar, B.R. (1995) Central Publishing House, Allahabad.
15. Gymnosperms- Vashishta P.C., A.R. Sinha, Anil Kumar, S.Chand-Publishing House-2006
16. Pteridophytes- Vashishta P.C, S. Chand- Publishing House-2006
17. Biology and Morphology of Pteridophytes- Parihar N.S. Central Book Depot, Allahabad.1996
18. <https://cbaj.in/index.php/index>
19. <https://www.mygreatlearning.com/blog/what-is-artificialintelligence/#WhatisArtificialIntelligence>
20. <https://i0.wp.com/innspub.net/wp-content/uploads/2022/05/JBES-2021-V19.webp?resize=224%2C300&ssl=1>



Shiv Chhatrapati Shikshan Sanstha's
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Botany

Course Type : Lab Course I

Course Title : Lab Course (Based on DSM-I) (Plant Diversity)

Course Code : 201BOT3202

Credits : 01

Max. Marks:50

Lectures: 30 Hrs.

Learning Objectives:

LO1 To study the external features of *Aspergillus*, *Oedogonium*, *Riccia*, *Azolla* and *Ephedra*

LO2 To identify the types of Lichens.

LO3 To learn the morphology of root, stem and leaf of Angiosperms

LO4 To study the morphology Inflorescence and flower.

Course Outcomes:

After completion of course, the student will be able to-

CO1 Correlates the external features of *Aspergillus*, *Oedogonium*, *Riccia*, *Azolla* and *Ephedra*

CO2 Identify the types of Lichens.

CO3 Explain morphology of root, stem and leaf of Angiosperms

CO4 Evaluate the morphology Inflorescence and flower.

Practical No.	Unit
1	Study compound Microscope
2	Study forms of Bacteria.
3	Study external features and classification of <i>Aspergillus</i> .
4	Study external features and classification of <i>Oedogonium</i> .
5	Study types of Lichens (Crustose, Foliose and Fruticose).
6	Study external features and classification of <i>Riccia</i> .
7	Study external features and classification of <i>Azolla</i> .
8	Study external, internal features and classification of <i>Riccia</i> .
9	Study external, internal features and classification of <i>Ephedra</i> .
10	Study of Root and its modifications
11	Study of Stem and its modifications
12	Study of Leaf
13	Study of Inflorescence
14	Study of flower
15	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc is compulsory)

Semester - IV



Shiv Chhatrapati Shikshan Sanstha's
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(Autonomous)
Department of Botany

Course Type : DSC-VII

Course Title : Environmental Biology and Gardening & Land scaping

Course Code : 201BOT4101

Credits : 03

Max. Marks:75

Lectures: 45 Hrs.

Learning Objectives:

- LO1 To provide an understanding for the fate and impact of pollution on “organic life”.
- LO2 To characterize the biological impacts of toxins and contaminants on “organic life”.
- LO3 To critically evaluate environmental issues and their impact.
- LO4 To learn an understanding of the methods of gardening.
- LO5 To understand the technique potting.
- LO6 To know aesthetic importance of garden

Course Outcomes:

After completion of course, the student will be able to-

- CO1 Describe the methods of gardening.
- CO2 Explain the effect pollution on living beings.
- CO3 Evaluate environmental issues and their impact.
- CO4 Describe the different ecosystems and their role

Unit No.	Title of Unit & Contents	Hrs.
I	ENVIRONMENTAL BIOLOGY-I	12
	<ul style="list-style-type: none">1. Ecology – Definition and Scope2. Structure of ecosystem (Abiotic and Biotic)3. Types of ecosystem (Pond ecosystem and Forest ecosystem)4. Ecological pyramids and energy flow5. Food chain and Food web6. Morphological and anatomical adaptations of plants to water stress conditions<ul style="list-style-type: none">i. Hydrophytes –Lotus leaf (petiole), Hydrillaii. Xerophytes – Nerium leaf, Casurina stem	
	Unit Outcomes: UO1 Describe the different ecosystems and their role	
II	ENVIRONMENTAL BIOLOGY-II	10
	<ul style="list-style-type: none">1. Pollution: Causes, effects and control measures of:<ul style="list-style-type: none">i. Water pollutionii. Soil pollutioniii. Air pollution2. Aforestation and deforestation3. Chipko movement	

	Unit Outcomes: UO1 Explain the effect pollution on living beings	
III	GARDENING	13
	<ol style="list-style-type: none"> 1. Scope and objectives of gardening 2. Style of gardens: Formal, Informal 3. Types of gardens: English, Mughal, Hindu-Buddhist and Japanese 4. Components of garden 5. Pots and container 6. Essentials of pot culture 7. Potting compost 8. Potting 	
	Unit Outcome: UO 1. Describe the methods of gardening.	
IV	LANDSCAPE DESIGNS	10
	<ol style="list-style-type: none"> 1. Landscape Design: Definition, Landscape elements of construction 2. Computer application in landscape 3. Hedges for gardens & farms 4. Lawns & Grasses: Planting methods, maintenance and pest management 5. Development of flowerbeds and their designs 6. Preparation of Bonsai and Flower Arrangement 	
	Unit Outcomes: UO1 Develop different flowerbeds and their designs	

Learning Resources

1. A text book of Plant Ecology-Ambasht R.S.
2. Fundamentals of Ecology- Dash M.C.
3. Ecology- Michael S.
4. Ecology and Environment- Sharma, P.D.
5. Modern Concepts of Ecology- Kumar H.D.
6. Fundamentals of Ecology- E.P. Odum
7. Environmental Chemistry- A.K. De
8. Environmental Biology- Biswarup Mukherjee
9. Modern Concepts of Ecology- H.D.Kumar
10. Environmental Science- Turk and Turk
11. Manual of Field Ecology- R. Mishra
12. Plant Ecology- Ambhast
13. Air Pollution Vol I - A.C. Stern
14. Environmental Impact Assessment- Larry Canter
15. Environmental management - Biswarup Mukherjee V.
16. Pollution Biology- Hyne
17. Nursery and Landscaping - VeenaAmarnath
18. Indoor Gardening- S.C.Day
19. Gardening- Parimal Mehra



Shiv Chhatrapati Shikshan Sanstha's
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Botany

Course Type : Lab Course VII

Course Title : Lab Course (Based on DSC-VII)

Course Code : 201BOT4103

Credits : 01

Max. Marks: 50

Hours: 30

Learning Objectives:

LO1 To improve and conserve natural resources by reducing soil erosion.

LO2 To reduce noise and environmental Pollution.

LO3 To understand the distribution of biotic and abiotic factors of living things in the Environment.

Course outcomes:

After completion of course, the student will be able to-

CO1 Identify morphological characters of plant.

CO2 Manage the crops in different soil by identify the soil pH, water holding capacity of soil etc.

CO3 Identify the different species of plant in some proper area i.e. diversity of plant.

CO4 Improve the gardens by different method.

Practical No.	Unit
1	Study of morphological and anatomical adaptations in hydrophytes – <i>Lotus petiole</i>
2	Study of morphological and anatomical adaptations in xerophytes – <i>Nerium</i>
3	Determination of water holding capacity of different soils
4	Estimation of salinity of different water samples
5	Study of vegetation by quadrat method
6	Determination of pH of different soils by pH paper/ pH meter
7	Garden tools and implements
8	Different types of pots
9	Procedure of potting
10	Preparation of Bonsai
11	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)

N.B.: Any Ten Practicals from above.



Shiv Chhatrapati Shikshan Sanstha's
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Department of Botany

Course Type : DSC-VIII

Course Title : Plant Breeding and Biotechnology

Course Code : 201BOT4102

Credits : 02

Max. Marks: 50

Lectures: 45 Hrs.

Learning Objectives:

- LO1 To understand different methods of plant breeding.
- LO2 To learn about techniques in genetic engineering.
- LO3 To acquire good knowledge about plant tissue culture.
- LO4 To know the methods of isolation of protoplasts and its fusion.

Course Outcomes:

After completion of course, the student will be able to-

- CO1 Describe the importance of GMO.
- CO2 Explain different methods of plant breeding.
- CO3 Perform the experiment independently on isolation of protoplasts and its fusion.
- CO4 Develop skill in genetic engineering.

Unit No.	Title of Unit & Contents	Hrs.
I	PLANT BREEDING-I	10
	1. Definition, Aims and Objectives 2. Centers of origin 3. Methods of Plant Breeding i. Plant introduction and acclimatization ii. Mass Selection iii. Pure line selection iv. Clonal selection v. Pedigree selection Unit Outcomes: UO1 Explain different methods of plant breeding	
II	PLANT BREEDING-II.	10
	1. Hybridization 2. Heterosis and hybrid vigor 3. Mutation breeding 4. Polyploidy 5. Breeding in cotton Unit Outcomes: UO1 Explain different techniques of plant breeding.	
III	BIOTECHNOLOGY – I	13
	1 Genetic Engineering:	

	i. Definition, scope and importance ii. Tools: a) Restriction Endonucleases b) Vectors: plasmids, cosmids iii. Technique of r-DNA iv. Genomic and c-DNA libraries 2. Agrobacterium mediated gene transfer: (Biology of <i>Agrobacterium</i> , Ti - plasmid and <i>Agrobacterium</i> mediated transfer technique) 3. Transgenic plants	
	Unit Outcome: UO1 Develop skill in genetic engineering.	
IV	BIOTECHNOLOGY – II	12
	1. Tissue culture: i. Introduction ii. Concept of Totipotency of cell iii. Basic aspects of tissue culture laboratory iv. Technique of tissue culture v. Callus culture, differentiation & morphogenesis 2. Applications of Tissue culture i. Micropropagation ii. Production of secondary metabolites iii. Somatic hybridization iv. Anther culture and production of haploids	
	Unit Outcomes: UO1 Explain different techniques of plant biotechnology.	

Learning Resources:

1. Plant Breeding: Principles and Methods- 7th edition Singh, B.D. (2005)
2. Principles of plant breeding-Allard, R.W. (1960).
3. Plant Breeding: Theory and Practice 2nd edition-Chopra, V.L. (2000). New Delhi.
4. Plant Breeding: Mendalian to Molecular Approaches-Jain, H. K. and Kharwal, M.C. (2003)
5. Advances in Plant Breeding-Vol 1 and 2, Mandal, A.K., Ganguli, P.K., Banerjee,
6. Principles and Practices of Plant Breeding -Sharma, J. R
7. Plant Breeding-H.K. Chowdhari
8. Biotechnology An Expanding Horizons -B.D.Singh
9. Biotechnology -Verma S.K.



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Department of Botany

Course Type : Lab Course

Course Title : Lab Course (Based on DSC-VIII)

Course Code : 201BOT4104

Credits : 01

Max. Marks: 50

Hours: 30

Learning Objectives:

LO1 To learn the practical skills of plant adaptations.

LO2 To study methods of water holding capacity of different soils.

LO3 To study the Vegetation analysis techniques.

LO4 To study causes, effects and control measures of Pollution.

Course outcomes:

After completion of course, the student will be able to-

CO1 Evaluate the role of plants in the functional ecosystem.

CO2 Examine the Vegetation analysis techniques.

CO3 Correlate the morphological and anatomical adaptations of different plant groups.

CO4 Characterize the salinity of different water samples

Practical No.	Unit
1-3	Colchicine treatment to induce tetraploidy in onion root cells.
4-5	Demonstration of techniques of hybridization (emasculation, pollination, tagging and bagging).
6-7	Effect of physical or chemical mutagens on crop plants (photographs) of M_1 and M_2 population.
8-9	Preparation and sterilization of the MS medium, slant preparation and inoculation.
10-11	Demonstration of techniques in callus culture and somatic hybridization
12-13	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)

N.B.: Any Ten Practicals from above.



Shiv Chhatrapati Shikshan Sanstha's
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Department of Botany

Course Type : DSM-II

Course Title : Taxonomy, Anatomy and Embryology of Angiosperms

Course Code : 201BOT4201

Credits : 03

Max. Marks:75

Lectures: 45 Hrs.

Learning Objectives:

LO1 To study the Identification, Classification of Nomenclature Angiosperms

LO2 To learn the Taxonomic hierarchy

LO3 To study the internal organization of plant parts

LO4 To study the reproduction in Angiosperms

Course Outcomes:

After completion of course, the student will be able to-

CO1 Describe the Identification, Classification of Nomenclature Angiosperms

CO2 Correlates the Taxonomic hierarchy.

CO3 Analyse the internal organization of plant parts.

CO4 Explain the process of fertilization in Angiosperms.

Unit No.	Title of Unit & Contents	Hrs.
I	Taxonomy-I	10
	<p>Introduction to plant taxonomy Identification, Classification, Nomenclature. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Taxonomic hierarchy: Ranks, categories and taxonomic groups Botanical nomenclature: Principles and rules (ICN); ranks and names; binominal system, Classification System -. Bentham and Hooker</p> <p>Unit Outcomes: To lean the Taxonomic hierarchy</p>	
II	Taxonomy-II	10
	<p>i. Caesalpiniaceae ii. Apocynaceae iii. Amarantaceae iv. Liliaceae v. Cannaceae</p> <p>Unit Outcomes:</p>	
III	Anatomy	13
	<p>1. Study of tissues. 2. Anatomy of dicot root (Sunflower).</p>	

	3. Anatomy of monocot root (Maize). 4. Anatomy of dicot Stem (Sunflower). 5. Anatomy of monocot Stem (Maize). 6. Anatomy of dicot Leaf (Sunflower). 7. Anatomy of monocot Leaf (Maize).	
	UO1 To study the internal organization of plant parts	
IV	Embryology of Angiosperms	12
	1. Structure of a Microsporangium (T.S. of anther). 2. Development of male gametophyte (Microgametogenesis). 3. Structure of a Megasporangium 4. Development of female gametophyte (monosporic type). 5. Fertilization and Post fertilization changes. 6. Endosperm and its types.	
	UO1 Explain the process of fertilization in Angiosperms	



Shiv Chhatrapati Shikshan Sanstha's
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Department of Botany

Course Type : Lab Course II

Course Title : Lab Course (Based on DSM-II)

Course Code : 201BOT4202

Credits : 01

Max. Marks:50

Lectures: 30 Hrs.

Learning Objectives:

- LO1 To learn the types of tissue.
- LO2 To classify the angiospermic plants.
- LO3 To study the internal structure of leaf and stem.
- LO4 To know the embryological structures.

Course outcomes:

After completion of the course, students will be able to-

- CO1 Evaluate the internal structure of stem and leaf.
- CO2 Analyse the types of tissue.
- CO3 Identify, classify the angiospermic plants
- CO4 Prepare the double stained permanent slides of stem

Practical No.	Name of the Experiment
1	Study of meristematic tissues with the help of Permanent slides / Charts
2	Study of simple tissues with the help of Permanent slides / Charts
3	Study of Complex tissues with the help of Permanent slides/Charts
4	Study of secretory tissues with the help of Permanent slides/Charts
5	Study of T.S. of Anther
6	Study of typical ovule and types of ovule with the help of Permanent slides /charts/photocopies.
7	Study of Leaf anatomy of dicot.
8	Study of Leaf anatomy of dicot.
9	Preparation of double stained permanent slides of Sunflower Stem.
10	Preparation of double stained permanent slides of Maize Stem.
11	Study of types Endosperms with the help of Permanent slides / Charts/photo
12	Study of family Caesalpinaceae
13	Study of family Apocynaceae
14	Study of family Amarantaceae
15	Study of family Liliaceae
16	Study of family Cannaceae
17	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)



Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG First Year

Extra Credit Activities

Sr. No.	Course Title	Course Code	Credits	Hours T/P
1	MOOCs		Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses		Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken English Courses		Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

- All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
- Maximum 04 extra credits in each academic year will be allotted.
- These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

- Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
- The student must successfully complete the course. These credits must be approved by the Course Coordinators.
- Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

- The respective documents should be submitted within 10 days after completion of Semester End Examination.
- No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
- The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/activities conducted or attended within the college.
- All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
- Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
- Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.



Rajarshi Shahu Mahavidyalaya, Latur
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Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
DSC/DSE/GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/OJT/FP	50	-	-	-	-	05	20	-	25	50
VSC/SEC/AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks

(S. N. Shinde)

Chairperson
Board of Studies in Botany
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)