Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Four Year Multidisciplinary Degree (Honors/Research) Programme with Multiple Entry and Exit option

Undergraduate Programme of Science &Technology

B.Sc. (Honors/Research) in Botany

Board of Studies

in

Botany

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

[UG II Year]

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** 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:24/03/2024

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** to be effective from the **Academic Year 2024-25.**

Date: ----------

Place: Latur

(Sadashiv N. Shinde)

Chairperson

Board of Studies in Botany

Rajarshi Shahu Mahavidyalaya, Latur

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Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Members of Board of Studies in Botany

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Shri Sadashiv N. Shinde**, Head, Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Chairperson	HoD
2	**Dr. B. S. Survase,** Director, School of Life Sciences, S.R.T.M.U. Nanded	Member	V.C. Nominee
3.	**Prof. Dr. A.S. Dhabe,** Head, Department of Botany, Dr. Babasaheb Ambedkar M. University, Aurangabad	Member	Expert from outside for Special Course
3	**Prof. Dr. A. B. Ade**, Head, Department of Botany, Savitribai Phule Pune University, Pune	Member	Academic Council Nominee
4	**Dr. V. S. Maske**, Head, Department of Botany, Bahirji Smarak Mahavidyalaya, Vasmat, Dist. Hingoli	Member	Academic Council Nominee
6	**Dr. S. H. Nile,** Senior Scientist, Zhejiang Chinese Medical University, Hanzhou Zhejans	Member	Expert from outside for Special Course
7	**Shri. Laxman Done**, Done's Mushrooms, Kumbhari, Dist. Latur	Member	Expert from Industry
8	**Prof. Dr. N. B. Gaikwad,** Department of Botany, Shivaji University, Kolhapur	Member	P. G. Alumni
9	**Dr. K. D. Savant,** Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomos)	Member	Faculty Member
10	**Shri D. R. Awad,** Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
11	**Ms. P. S. Maskepatil,** Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
12	**Ms. P. V. Kumbhar,** Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
14	**Ms. R. L. Shaikh,** Department of Botany,	Member	Faculty Member

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15	**Ms. P. B. Gore,** Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
16	**Ms. N. S. Kamble,** Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
17	**Dr. D. V. Vedpathak,** Department of Microbiology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
18	**Dr. D. G. Palke,** Head, Department of Chemistry, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member

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, Plant nanotechnology, 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, IIT-JAM and other 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, developing skills, 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 Ayurveda 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 faculties 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 Discipline Specific Elective (DSE) is partly 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.

(Sadashiv N. Shinde)
Chairperson
Board of Studies in Botany
Rajarshi Shahu Mahavidyalaya, Latur
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Shiv Chhatrapati Shikshan Sanstha's

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INDEX

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and 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	VSC/ SEC (VSEC)	AEC/ VEC	OJT,FP,CEP, RP	Credits per Sem.	Cum./ Cr. 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	DSM - I 04 Cr.	GE-III: 02 Cr.	SEC-III: 02 Cr.	AEC-I ENG: 02 Cr.	CC-II: 02 Cr. (NSS, NCC, Sports, Cultural)/ (SES-I)/ FP: 02 Cr.	22	44 Cr. UG Certificate
	IV	DSC-VII: 04 Cr. DSC-VIII: 04 Cr.	NA	DSM - II 04 Cr.	GE-IV: 02 Cr.	SEC-IV: 02 Cr.	AEC-II ENG: 02 Cr. VEC-II: 02 Cr.	CC-III: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-I: 02 Cr.	22	
	Cum. Cr.	16	-	-	08	04+04= 08	04+02 +02= 08	04	44	
Exit Option: Award of UG Certificate in Major with 44 Credits and Additional 04 Credits Core NSQF Course / Internship or continue with Major and Minor										

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	DSE	: Discipline Specific Elective (Major)
3.	DSM	: Discipline Specific Minor
4.	OE	: 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.	VEC	: Value Education Courses
12.	OJT	: On Job Training
13.	FP	: Field Projects
14.	CEP	: Fostering Social Responsibility & Community Engagement (FSRCE)
15.	CC	: Co-Curricular Courses
16.	RP	: Research Project/Dissertation
17.	SES	: Shahu Extension Services

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

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.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Programme Specific Outcomes (PSOs) for B.Sc. Botany(Honors/Research)	
PSO No.	After completion of this programme the students will be able to -
PSO 1	**Knowledge and Understanding of:** The range of plant diversity in terms of structure, function and environmental 1. The evaluation of plant diversity. 2. Plant classification and the flora of 3. Maharashtra. 4. The role of plants in the functioning of the global ecosystem. 5. Statistics as applied to biological data.
PSO 2	**Intellectual Skills:** 1. Think logically and organize tasks in to a structured form. 2. Assimilate knowledge and ideas through wide reading and thee 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- 1. Interpreting plant morphology and anatomy. 2. Identification of plants. 3. Vegetation analysis techniques. 4. Arrange 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 field work and lab analysis.
PSO 4	**Transferable Skills:** 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 heal the problems, disorders and disease so

	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.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

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 Landscaping	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**	

Curriculum

Major and VSC Courses

Semester - III

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)
Faculty of Science & Technology

(Subject: Botany)
(B.Sc. II: Semester III)

Course Type: DSC-V
Course Title: Morphology and Taxonomy of Angiosperms
Course Code: 201BOT3101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

The students will have to:

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

Course Outcomes:

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

CO1. Identify the taxon on the basis of morphological features.
CO2. Distinguish between taxonomy and systematics.
CO3. Correlate the reasons of hierarchial levels in the classifications.
CO4. Describe the reasons for preference to natural classification over artificial classification.
CO5. Describe the morphology of different angiosperm families.

Unit No.	Title of Unit & Contents	Hrs.
I	**Morphology of Angiosperms-I**	**10**
	1. Root: Definition, general characters and functions **2.** Types of Root: (tap root and adventitious) **3.** Modifications of Root (Tap Root: Storage & Respiratory purpose, Adventitious Storage & Mechanical Support) **4.** Stem: Definition, general characters and functions. **5.** Modifications of Stem (Aerial- stem tendril, Subaerial- runner, and Underground- rhizome) **6.** Leaf: Definition, structure of typical leaf (Hibiscus) and functions **7.** Types of leaf **8.** Phyllotaxy **9.** Venation **10.** Margin and Leaf apex	
	Unit Outcomes: UO 1. Describe the vegetative morphological features of plant.	

Unit No.	Title of Unit & Contents	Hrs.
	UO 2. To describe the Structure, function and classification of flowering plants.	
II	**Morphology of Angiosperms-II**	**10**
	1. Inflorescence: Definition, structure of typical inflorescence 2. Types of Inflorescence (Solitary, Racemose and Cymose). 3. Flower: Definition, structure of typical flower (Hibiscus), 4. Symmetry of Flower 5. Types of Flower based on position of floral whorls (Hypogynous, epigynous, perigynous) 6. Floral Formula 7. Floral Diagram 8. Fruit: Definition and structure of typical fruit 9. Types of Fruit	
	Unit Outcomes: UO 1 Describe the reproductive features of plant. UO 2 Describe the ability to identify and classify fruits based on their structures	
III	**Taxonomy of Angiosperms**	**12**
	1. Introduction 2. Scope and objectives of angiosperm taxonomy 3. Binomial nomenclature 4. Chemotaxonomy 5. Cytotaxonomy 6. Taxonomic ranks 7. Types of classification (Artificial, Natural and Phylogenetic) 8. Bentham & Hooker's system of classification with merits and demerits. 9. Palynology: Introduction, Scope and Significance.	
	Unit Outcomes: UO 1 Correlate the reasons of hierarchial levels in the classifications. UO 2 Distinguish between taxonomy and systematics. UO 3 Describe the reasons for preference to natural classification over artificial classification.	
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: UO 1. Describe vegetative twigs, distinguishing characters and Economic importance of plants.	

Unit No.	Title of Unit & Contents	Hrs.
	UO 2 To relate the reason that botanical taxonomy uses division, rather Than phylum. UO 3. Describe the morphology of different angiosperm families.	

Learning Resources:

1. A Text Book of Systematic Botany-Sutaria R. N. Khadayata Book Depot Ahmedabad, 1958
2. Angiosperms- Chopra G. L. Pradeep Publication, 1984
3. Introductory Taxonomy of Angiosperms-S. Sundara Rajan, Vikas Publication House 2003
4. Modern Plant Taxonomy- Subramanyam NS, Vikas Publication, 1999
5. Principles of Angiosperms Taxonomy-Davis P. H. and Heywood V. H. Oliver & Boyd Publication 1963
6. Taxonomy of Angiosperms-Pandey S N and Mishra S D, ANE books, 2008
7. Taxonomy of Angiosperms- B.P. Pandey, S. Chand Publication, 2001
8. Taxonomy of Angiosperms-Sambamurthy A V S, I.K. International Publishing House, 2005
9. Taxonomy of Angiosperms- V.N. Naik, Tata Mc Graw- Hill 1984
10. Taxonomy of Angiosperms-Vashishta P.C, R. Chand 1974

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Lab Course
Course Title: Lab Course-V (Based on DSC-V)
Course Code: 201BOT3103
Credits: 01 **Max.Marks: 50** **Hours: 30**

Learning Objectives:

The students will have to:

LO 1. Distinguish between taxonomy and Systematics.
LO 2. Describe the reason that classical taxonomy is a hierarchical scheme of classification.
LO 3. Classify the species based on their shared traits and lineage.
LO 4. 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-

CO 1. Identify the different types of roots and its modification.
CO 2. Explain different forms of stem and its modification.
CO 3. Describe the leaf, its types, Phyllotaxy and venation.
CO 4. Correlate the Inflorescence, Flower and Fruit of angiospermic families.

Practical No.	Unit
1	Root and its modifications.
2	Stem and its modifications.
3	Leaf: Types, Phyllotaxy and Venation.
4	Inflorescence
5	Flower
6	Determination of the shape of the pollen grains.
7	Pollen grains of some monocotyledonous plants.
8	Pollen grains of some dicotyledonous plants.
9-14	Description, identification and classification of the plants with floral Formulae and floral diagrams of their families (mentioned in theory syllabus)
15	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)

N.B.: Any Ten Practicals from above.

Learning Resources:

1. Angiosperm Taxonomy: A Practical Approach- V. Singh, Rastogi Publication, 2012.
2. A Manual of Angiosperm Taxonomy- A.K. Singh, Pointer Publication, 2015
3. Practical Angiosperm Taxonomy- S.P. Bhatnagar and B. Moitra, CBS Publishers, 2016.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: DSC- VI
Course Title: Economic Botany and Pharmacognosy

Course Code: 201BOT3102

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

The students will have to:

LO 1. Acquire good knowledge about economic importance of cereals, pulses, oil seed crops.
LO 2. Understand core concepts of Economic Botany and relate with environment, Population and ecosystem.
LO 3. Evaluate the methods of isolation of active constituents of medicinal plants.
LO 4. Develop critical understanding of the importance germplasm diversity.
LO 5. Remember Traditional and Indigenous systems of Medicine.

Course Outcomes:

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

CO 1. Describe the method of cultivation and economic importance plants.
CO 2. Identify, analyze and estimate active constituents of medicinal plants.
CO 3. Explain Traditional and Indigenous systems of Medicine.
CO 4. Understand core concepts of Economic Botany.
CO 5. understand of the importance germplasm diversity

Unit No.	Title of Unit & Contents	Hrs.
I	**Economic Botany-I**	**10**
	1. Origin, importance and domestication: a. Origin of Agriculture and ancient economic botany b. Vavilov's Centres of Origin and Diversity of crop plant domestication. c. Crop domestication and loss of Genetic diversity. 2. Germplasm augmentation and Conservation: a. History and importance of germplasm collection. b. Biotechnology in plant germplasm acquisition. c. Plant tissue culture in disease elimination	
	Unit Outcomes: UO 1. Understand core concepts of Economic Botany and relate with environment. UO 2. Develop critical understanding of the importance germplasm diversity	
II	**Economic Botany-II**	**10**
	Introduction: Botanical name, family, distinguishing characters (at least two), method of cultivation and economic importance of the following- 1. Cereals (Wheat)	

Unit No.	Title of Unit & Contents	Hrs.
	2. Pulses (Pigeon pea) 3. Oil yielding plants (Soybean) 4. Timber yielding plants (Teak) 5. Medicinal plants (Aloe) 6. Fiber yielding plants (Cotton) 7. Cotton processing 8. Soya milk production 9. Starch processing 10. Rubber production	
	Unit Outcomes: UO 1. Acquire good knowledge about economic importance of cereals, pulses, oil seed crops. UO 2. Understand core concepts of Economic Botany and relate with environment, Population and ecosystem.	
III	**Introduction To Pharmacognosy**	**11**
	1. History of Pharmacognosy 2. Definition and scope of Pharmacognosy 3. Traditional and alternative systems of medicine 4. Indigenous systems of Medicine (Ayurveda, Siddha, Unani) 5. Classification of crude drugs. 6. Concept of active principle (Five examples)	
	Unit Outcomes: UO 1. Identify, analyze and estimate active constituents of medicinal plants. UO 2. 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 *Adhatoda* (Leaf drug).	
	Unit Outcomes: UO 1.Describe Ayurvedic Principles and formulations. UO 2.Evaluate to Design and Develop Ayurvedic Drugs.	

Learning Resources:

1. A Text Book of Pharmacognosy- Ghani A. ,AFI Publication second edition 2020
2. Bhaishyaja kalpana-Vaidya S.S. and Dole. V.A, Proficient Publishing House 2022
3. Economic Botany- Pandey B. P, S.Chand publication,1987

4. Economic Botany- Hill A.W, McGraw-Hill, 1981
5. Economic Botany- Albert, F.H. McGraw-Hill, 1937
6. Pharmacognosy- Trease and Evans, W B Saunders Co Ltd, 1934
7. Pharmacognosy- Kokate C.K. Purohit A.P. and Gokhale S.B.,Nirali prakashan 21st edition 2002
8. Pharmacognosy-Trease G.E. and Evans. W.C.· Tyler V.E Brady,W B Saunders Co Ltd 16th edition 2009
9. Pharmacognosy-Shah and Qadry, Nirali prakashan, 1973
10. Practical Pharmacognosy- Kokate C.K.,Vallabh Prakashan 5th edition 2022
11. Textbook of Economic Botany- Verma ,V.ANE Books publication, 1984
12. Text book of Pharmacognosy- M. Ali.,CBS Publication 2019

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Lab Course
Course Title: Lab Course VI (Based on DSC-VI)
Course Code: 201BOT3104
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives:

The students will have to:

LO 1. Analyse the nutritional value and economic importance of cereals, pulses, oil seed crops.
LO 2. Know the chemistry of active constituents of medicinal plants.
LO 3. Understand the methods of isolation of active constituents of medicinal plants.
LO 4. Study the methods of preparation of Ayurvedic formulations.

Course outcomes:

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

CO 1. Easily distinguish between cereals and pulse crops.
CO 2. Perform cultivation practices in field.
CO 3. Describe and recognize different adulteration in food product.
CO 4. 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.
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.
5	Botanical name, family, distinguishing characters (at least two), method of Cultivation and economic importance of Aloe.
6-7	Histochemical tests of foods to ring tissue in pigeon pea, Wheat, lignin and Cellulose.
8	Extraction of pectic substance.
9-10	Extraction of Tannin.
11-12	Preparation of Ayurvedic formulations (asper syllabus)
13	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc.is compulsory)

N.B.: Any Ten Practicals from above.

Learning Resources:

1. A Manual of Economic Botany- R.K. Sinha, Central Publishing House- 2010
2. Economic Botany: A Practical Approach- A.K. Singh, Pointer Publications, 2012
3. Practical Economic Botany- S.C. Santra, New Central Book Agency, 2018

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Minor- I
Course Title: Plant Diversity
Course Code: 201BOT3201
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

The students will have to:

LO 1. Get familiar with Cryptogamic Botany.
LO 2. Study different types of spore in Pteridophytes.
LO 3. Understand the Morphology of Angiosperms.
LO 4. Distinguish the life cycles of Cryptogams and Gymnosperms.

Course Outcomes:

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

CO 1. Distinguish between reproductive stages of cryptogams.
CO 2. Examine the morphology and life cycles of certain genera of Cryptogams and Gymnosperms.
CO 3. Analyze the morphology of Angiosperms.
CO 4. 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. 3. Economic importance of bacteria. 4. Characters, classification and general account of major classes of fungi. 5. economic importance of Fungi. 6. General account, habit, structure and methods of reproduction in Aspergillus. 7. Lichens: Occurrence, general structure, nutrition 8. Economic importance of Lichens.	
	Unit Outcomes: UO 1. Illustrate classification of microorganisms. UO 2. Correlate significance of Bacteria, Fungi and lichens.	
II	**Algae and Bryophytes**	**11**
	1. General characters and Classification of Algae. 2. Occurrence, structure of thallus and mode of reproduction in *Oedogonium* 3. Economic Importance of Algae. 4. General characters and Classification of Bryophytes. 5. Occurrence, structure of thallus and mode of reproduction in *Riccia.*	

Unit No.	Title of Unit & Contents	Hrs.
	6. Economic Importance of Bryophytes.	
	Unit Outcomes: UO1. Correlate significance of Algae & Bryophytes. UO2. Learn the life cycles of Algae & Bryophytes.	
III	**Pteridophytes and Gymnosperms**	**11**
	1. General characters and Classification of Pteridophytes. 2. Occurrence, structure of thallus and mode of reproduction in *Azolla.* 3. Economic Importance of Pteridophytes. 4. General characters and Classification of Gymnosperms. 5. Occurrence, structure of thallus and mode of reproduction in *Ephedra.* 6. Economic Importance of Gymnosperms	
	Unit Outcomes: UO 1.Understand the Evolutionary Progression of Pteridophytes & Gymnosperms. UO 2.Compare and contrast the life cycles of Pteridophytes & 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	
	Unit Outcomes: UO 1.Analyze the Morphology of Angiospermic Plants. UO 2. Illustrate classification of Angiosperms.	

Learning Resources:

1. An introduction to Paleobotany- Arnold, C.A. (1972)-Mc Graw Hill Book Company Inc.
2. An Introduction to Pteridophyta- Parihar, N. S.(1959)-Central Book Depot,1962
3. An introduction to Pteridophytes. - Rashid, A. (1978) Vikas Publishing House(P)Ltd., 1999
4. Biology and Morphology of Pteridophytes- Parihar N. S. Central Book Depot,Allahabad.1996
5. Comparative morphology of vascular plants- Eames, A. J. and E. M. Giffard - Madrono West American Journal of Botany (1960)
6. Gymnosperms-Vashishta P.C., A. R. Sinha, Anil Kumar,S.Chand-PublishingHouse-2006
7. Indian Fossil Pteridophytes- Surange, K.R. (1968)-Alexander Doweld,1966
8. Morphology of Gymnosperms-J.M.& Chamberlain C. J. (1978):Central Book Depot, Allahabad.
9. Morphology of Pteridophytes- Sporne, K. R.(1966),HutchinsonUniversityLibrary,1962
10. Morphology of Vascular plants- Bierhorst, D.W. Mac Millan Co.; First Edition (January1,1971)
11. Principles of Paleobotany- Darroh, W.C. (1968)-Chronica Botanica Company,1939
12. Pteridophytes and Gymnosperms-K. U. Kramer, P. S. Green , Springer Verlag, NewYork

13. Pteridophytes- Vashishta P.C, S. Chand-PublishingHouse-2006
14. The Gymnosperms (Fossils& Living)- Kakkar, R.K. and Kakkar, B.R. (1995) Central Publishing House, Allahabad
15. The Gymnosperms- Biswas, C & Johri, B. N.(2004),Narosa Publishing House,New Delhi. Coulter.
16. The Phylogeny and Classification offerns Jermy- A.G.(1973)-Academic Press In (1 December 1973)
17. https://cbaj.in/index.php/index
18. https://www.mygreatlearning.com/blog/what-isartificialintelligence/#WhatisArtificialIntelligence
19. 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)

(Subject: Botany)

Course Type: Lab Course
Course Title: Based on Minor-I (Plant Diversity)
Course Code: 201BOT3202
Credits:01 **Max. Marks:50** **Lectures:30 Hrs**

Learning Objectives:

The students will have to:

LO 1. Study the external features of Aspergillus, Oedogonium, Riccia, Azolla and Ephedra.
LO 2. Identify the types of Lichens.
LO 3. Learn the morphology of root, stem and leaf of Angiosperms.
LO 4. Study the morphology Inflorescence and flower.

Course Outcomes:

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

CO 1. Correlates the external features of Aspergillus, Oedogonium, Riccia, Azolla and Ephedra.
CO 2. Identify the types of Lichens.
CO 3. Explain morphology of root, stem and leaf of Angiosperms.
CO 4. Evaluate the morphology Inflorescence and flower.

Practical No.	Unit
1	Compound Microscope
2	Forms of Bacteria.
3	External features and classification of Aspergillus.
4	External features and classification of *Oedogonium.*
5	Types of Lichens(Crustose, Foliose and Fructicose).
6	External features and classification of *Riccia.*
7	External features and classification of *Azolla.*
8	External, internal features and classification of *Riccia.*
9	External, internal features and classification of *Ephedra.*
10	Root and its modifications
11	Stem and its modifications
12	Leaf
13	Inflorescence
14	Flower
15	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc is compulsory)

N.B.: Any Ten Practicals from above.

Learning Resources:

1. Plant Systematics: A Practical Approach- V. Singh and A. K. Pandey, Rastogi publication, 2018.
2. Practical Plant Diversity- S.C. Santra, New Central Book Agency-2017.

Semester - IV

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: DSC-VII
Course Title: Environmental Biology and Gardening & Landscaping
Course Code: 201BOT4101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

The students will have to:

LO 1. Provide an understanding for the fate and impact of pollution on organic life.

LO 2. Characterize the biological impacts of toxins and contaminants on organic life.

LO 3. Critically evaluate environmental issues and their impact.

LO 4. Understand the methods of gardening.

LO 5. Understand the interactions between organisms and their environment.

LO 6. Know aesthetic importance of garden.

Course Outcomes:

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

CO 1. Describe the methods of gardening.

CO 2. Explain the effect of pollution on living beings.

CO 3. Evaluate environmental issues and their impact.

CO 4. Describe the different ecosystems and their role.

Unit No.	Title of Unit & Contents	Hrs
I	**Environmental Biology-I**	**12**
	1. Ecology– Definition and Scope **2.** Structure of Ecosystem (Abiotic and Biotic) **3.** Types of Ecosystem (Pond ecosystem and Forest ecosystem) **4.** Ecological Pyramids and Energy flow **5.** Food chain and Food web **6.** Morphological and Anatomical adaptations of plants to water stress conditions. i. Hydrophytes–Lotus petiole, Hydrilla stem ii Xerophytes– Nerium leaf, Casurina stem	
	Unit Outcomes: UO 1.Describe the different ecosystems and their role. UO 2. Understand the interactions between organisms and their environment.	
II	**Environmental Biology-II**	**10**

Unit No.	Title of Unit & Contents	Hrs
	1. Global Environmental Problems- Ozone depletion, UV, Greenhouse effect and acid rain due to anthropogenic activities. **2.** Pollution: Causes, effects and control measures of: i. Water pollution ii. Soil pollution iii Air pollution **3.** A forestation and deforestation **4.** Chipko movement	
	UO 1. Understand the effect of pollution on living beings UO 2. Evaluate environmental issues and their impact.	
III	**Gardening**	**13**
	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. UO 2.Understand basic gardening techniques and benefits of gardening.	
IV	**Land Scape Designs**	**10**
	1. Land scape 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 flower beds and their designs **6.** Preparation of Bonsai and Flower Arrangement	
	Unit Outcomes: UO1.Develop different flower beds and their designs. UO2. Understand design principles and selecting appropriate plant materials.	

Learning Resources

1. A text book of Plant Ecology-Ambasht R.S., N.K. Ambasht, CBS Publishers, 2022
2. Air Pollution Vol I -A.C. Stern, Academic Press Inc. 1968
3. Ecology and Environment-Sharma, P.D. Rastogi Publications 2011
4. Ecology-Michael P.N. CBS HB 2016
5. Environmental Chemistry-A.K. De, New Age International Publication 2003
6. Environmental Impact Assessment-Larry Canter, McGraw-Hil,1996

7. Environmental management-Biswarup Muhkerjee V.Vikas Publishing House,2000
8. Environmetal Biology-Biswarup Muhkerjee, Tata McGraw-Hill,1997
9. Fundamentals of Ecology- Dash M.C. McGraw-Hill Edu. Pvt Ltd, 1993.
10. Fundamentals of Ecology-E. P. Odum, Cengage India Pvt. Ltd., 2017
11. Global Environmenatal Issues Frances, H- Willey- Blackwell, 2nd edition, 2012
12. Indoor Gardening-S. C. Dey, Agrobios,2010
13. Manual of Field Ecology- R. Mishra & G.S. Puri, Scientific Publishers,2021
14. Modern Concepts of Ecology- H.D. Kumar, Vikas Publication
15. Modern Concepts of Ecology- Kumar H.D. Vikas Publishing House, 1992
16. Nursery and Landscaping-Veena Amarnath ,Agrobios Publisher,2007
17. Pollution Biology-Hyne, University of Toronto Press,1974

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Lab Course
Course Title: Lab Course–VII (Based on DSC-VII)
Course Code: 201BOT4103
Credits: 01 **Max.Marks: 50** **Hours: 30**

Leaning Objectives:

The students will have to:

LO 1. Improve and conserve natural resources by reducing soil erosion.
LO 2. Study of morphological and anatomical adaptations in hydrophytes & Xerophytes.
LO 3. Understand the distribution of biotic and abiotic factors of living things in the Environment.
LO 4. Understand how pH influences soil health.
LO 5. Correlate the morphological and anatomical adaptations of different plant groups.

Course outcomes:

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

CO 1. Identify morphological characters of plant.
CO 2. Manage the crops in different oil by identify the soil pH, water holding capacity of soil etc.
CO 3. Identify the different species of plant in some proper area i.e. diversity of plant.
CO 4. Improve the gardens by different method.

Practical No.	Unit
1	Study of morphological and anatomical adaptations in hydrophytes–Lotus petiole.
2	Study of morphological and anatomical adaptations in xerophytes– Nerium.
3	Determination of water holding capacity of different soils.
4	Estimation of salinity of different water samples.
5	Study of vegetation by quadrate method.
6	Determination of pH of different soils by pH paper/pH meter.
7	Comparison of Bulk Density, Porosity and rate of infiltration of water in soil of different habitats.
8	Identification of the trees, shrubs and other herbaceous vegetation.
9	Garden tools and implements.
10	Different types of pots.
11	Procedure of potting.
12	Preparation of Bonsai.
13	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc.is compulsory)

N.B.: Any Ten Practicals from above.

Learning Resources:

1. Environmental Biology- P.D. Sharma, Rastogi Publication, 2019
2. Gardening for Beginners- K.C. Sahoo, Agrobios India, 2018
3. Practical Environmental Biology- S.C. Santra, New Central Book Agency, 2017
4. Practical Gardening- R.K. Singh, International Book Distributing Co. 2015

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: DSC-VIII
Course Title: Plant Breeding and Biotechnology
Course Code: 201BOT4102
Credits: 02 **Max.Marks: 50** **Lectures: 45 Hrs.**

Learning Objectives:

The students will have to:

LO 1. Understand different methods of plant breeding.

LO 2. Know about techniques in genetic engineering.

LO 3. Acquire good knowledge about plant tissue culture.

LO 4. Know the methods of isolation of protoplasts and its fusion.

Course Outcomes:

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

CO 1. Describe the importance of GMO.

CO 2. Explain different methods of plant breeding.

CO 3. Perform the experiment independently on isolation of protoplasts and its fusion.

CO 4. 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 a. Plant introduction and acclimatization b. Mass Selection c. Pureline selection d. Clonal selection e. Pedigree selection	
	Unit Outcomes: UO 1. Evaluate different methods of plant breeding UO 2. Uderstand development of improved varieties with enhanced characteristics for agronomic benefits.	
II	**Plant Breeding-II 10**	**10**

Unit No.	Title of Unit & Contents	Hrs
	1. Hybridization: Definition, Scope and Application 2. Types of Hybridization 3. Heterosis and hybrid vigor 4. Mutation breeding 5. Polyploidy 6. Breeding in cotton	
	Unit Outcomes: UO1.Explain different techniques of plant breeding. UO2. Analyse the new crop varieties with desirable traits and techniques used for improving yield and disease resistance	
III	**Biotechnology– I 13**	**13**
	1. Genetic Engineering i. Definition, scope and importance ii.Tools: a. Restriction Endonucleases b. Vectors: plasmids, cosmids c. Technique of r-DNA d. Genomic and c-DNA libraries 2. Agrobacterium mediated gene transfer: (Biology of *Agrobacterium*, Ti - plasmid and *Agrobacterium* mediated transfer technique) Transgenic plants	
	Unit Outcome: UO 1. Apply skill in genetic engineering. UO 2. Describe the importance of GMO.	
IV	**Biotechnology– II 12**	**12**
	1. Tissue culture: a. Introduction b. Concept of Totipotency of cell c. Basic aspects of tissue culture laboratory 2. Technique of tissue culture a. Callus culture, differentiation &morphogenesis b. Applications of Tissue culture c. Micropropagation d. Production of secondary metabolites e. Somatic hybridization f. Anther culture and production of haploids	
	Unit Outcomes: UO 1.Explain different techniques of plant biotechnology UO 2. Describe disease free planting material and crop improvement	

Learning Resources:

1. Advances in Plant Breeding-Vol 1 and 2, Mandal, A. K., Ganguli, P. K., Banerjee. Sankari

Prasad Banarjee,1991

2. Biotechnology an Expanding Horizons- B. D. Singh, Med Tech Sciencepress, 2021
3. Biotechnology- Verma S.K., 6th edition S. Chand Publication, 2007
4. Plant Breeding: Mendelian to Molecular Approaches-Jain H.K .and Kharwal M.C.(2003)
5. Plant Breeding: Principles and Methods-7thedition Singh B.D., S. Chand Publication (2005)
6. Plant Breeding: Theory and Practice 2ndedition-Chopra, V. L. (2000). New Delhi.
7. Plant Breeding-H.K. Chowdhari, Oxford & IBH Publisher, 1966
8. Principles and Practices of Plant Breeding- Sharma, J.R. Tata McGraw Hill, 1994
9. Principles of plant breeding -Allard, R.W. John Wiely & Sons in New York (1960).

Course Type: Lab Course
Course Title: Lab Course– (Based on DSC-VIII)
Course Code: 201BOT4104
Credits:01 **Max.Marks:50** **Hours: 30**

Learning Objectives:

The students will have to:

LO 1 Understand the plant breeding principles.

LO 2 Understand the principles of mutation breeding and its role in crop improvement

LO 3 Know the wide hybridization and its application in crop improvement.

LO 4 Understand the composition of MS media, its application in plant growth & Development.

Course outcomes:

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

CO 1. Understand different plant breeding methods.

CO 2. Improve the crop varieties.

CO 3. Understand Plant Biotechnology Techniques.

CO 4. Perform techniques of hybridization.

Practical No.	Unit
1-3	Colchicine treatment to induce Polyploidy 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 M1 and M2 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.

Learning Resources:

1. Lab Manual for Biotechnology, Dr. Nobel k. kuria,Notion Press ,2020.
2. Experimental Biotechnology, Sunit Dutta,Ashok Kumar Chaudhry.
3. Practical Manual for Biotechnology, Ritu Mahajan,Jitendra Sharma ,R. K. Sharma,Vayu Education of India,2020.
4. Practical Manual for Genetics and Plant Breeding,Bineeta Singh

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Minor-II
Course Title: Taxonomy, Anatomy and Embryology of Angiosperms
Course Code: 201BOT4201
Credits: 03 **Max. Marks: 75** **Lectures:45 Hrs.**

Learning Objectives:

The students will have to:

LO 1 Study the Identification, Classification of Nomenclature Angiosperms

LO 2 Learn the Taxonomic hierarchy

LO 3 Study the internal organization of plant parts

LO 4 Study the reproduction in Angiosperms

Course Outcomes:

After completion of course, the student will able to-

CO 1 Describe the Identification, Classification of Nomenclature Angiosperms

CO 2 Correlates the Taxonomic hierarchy.

CO 3 Analyse the internal organization of plant parts.

CO 4 Explain the process of fertilization in Angiosperms.

Unit No.	Title of Unit & Contents	Hrs
I	**Taxonomy**	**10**
	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	
	Unit Outcomes: UO 1. Learn the Taxonomic hierarchy. UO 2. Understand the principles of Taxonomy,including Characterization, Identification, Nomenclature and Classification	
II	**Taxonomy-II**	**10**

Unit No.	Title of Unit & Contents	Hrs
	i. Caesalpiniaceae ii. Apocynaceae iii. Amarantacae iv. Liliaceae v. Cannaceae	
	Unit Outcomes: UO 1. Understand the systematic Position and Morphological Characters. UO 2. Know the Economic Importance of Angiospermic Families.	
III	**Anatomy**	**13**
	1. Study of tissues 2. Anatomy of dicot root(Sunflower). 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).	
	UO 1. Study the internal organization of plant parts UO 2. Understand the organization of Vascular Bundles, Epidermis and other Tissue layers.	
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.	
	UO 1. Explain the process of fertilization in Angiosperms. UO 2. Understand the concept of Microsporogenesis and Megasporogenesis.	

Learning Resources:

1. A Text Book of Systematic Botany-Sutaria R. N. Khadayata Book Depot Ahmedabad, 1958
2. Angiosperms- Chopra G. L. Pradeep Publication, 1984
3. Introductory Taxonomy of Angiosperms-S. Sundara Rajan, Vikas Publication House 2003
4. Modern Plant Taxonomy-Subramanyam NS, Vikas Publication, 1999
5. Principles of Angiosperms Taxonomy-Davis P. H. and Heywood V. H. Oliver & Boyd

Publication 1963

6. Taxonomy of Angiosperms- B.P. Pandey, S. Chand Publication, 2001
7. Taxonomy of Angiosperms- V.N. Naik, Tata Mc Graw- Hill 1984
8. Taxonomy of Angiosperms-Pandey S N and Mishra S D, ANE books, 2008
9. Taxonomy of Angiosperms-Sambamurthy A V S, I.K. International Publishing House, 2005
10. Taxonomy of Angiosperms-Vashishta P.C, R. Chand 1974

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Lab Course
Course Title: Lab Course based on Minor-II
Course Code: 201BOT4202
Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. Learn the types of tissue.
LO 2. Classify the angiospermic plants.
LO 3. Study the internal structure of leaf and stem.
LO 4. Know the embryological structures.

Course outcomes:

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

CO 1. Evaluate the internal structure of stem and leaf.
CO 2. Analyse the types of tissue.
CO 3. Identify, classify the angiospermic plants
CO 4. 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 Caesalpiniaceae
13	Study of family Apocynaceae
14	Study of family Amarantacae
15	Study of family Liliaceae
16	Study of family Cannaceae
17	Botanical excursions (oneshort, one long excursion and visit to Research laboratory,Field etc.is compulsory)

Learning Resources:

1. Angiosperm Taxonomy: A Practical Approach- V. Singh, Rastogi Publication, 2012.
2. A Manual of Angiosperm Taxonomy- A.K. Singh, Pointer Publication, 2015
3. Practical Angiosperm Taxonomy- S.P. Bhatnagar and B. Moitra, CBS Publishers, 2016.

Open Elective Courses Offered by the Department

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: OE
Course Title: Plant and Human Health
Course Code:
Credits:03 **Max. Marks: 75** **Lectures: 45Hrs.**

Learning Objectives:

The students will have to:

LO 1. Study the Origin, Morphology, Post-harvest processing and uses of Cereals and Fruits.

LO 2. Learn the Cultivation tapping and process of natural rubber.

LO 3. Know the edible and non-edible oil yielding plants.

LO 4. Study the Drugs yielding plants.

Course Outcomes:

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

CO 1. Explain the Origin, Morphology, Post-harvest processing and uses of Cereals and Fruits.

CO 2. Correlates the Cultivation and processing of natural rubber, Fibers and Beverages.

CO 3. Interprets the edible and non-edible oil yielding plants.

CO 4. Describe the Drugs yielding plants.

Unit No.	Title of Unit & Contents	Hrs
I	**Cereals and Pulses**	**12**
	Origin of cultivated plants, Concept of center of origin, Their importance with reference to Vavilov's work. Examples of Measure plant introduction, crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant biodiversity and their conservation 1. **Cereals:** Wheat and Rice (Origin, Morphology, Post-harvest processing and uses) 2. Brief accounts of Millets and their nutritional value. 3. **Pulses**: General account (including pulses grown in Maharashtra: Red gram, Green gram, Chick pea) importance to man and ecosystem	
	UO 1. Explain Origin, Morphology, Post-harvest processing and uses of Cereals and Pulses. UO 2. Know the cultivation practices.	
II	**Cash crops, Spices and Fruits**	**12**

Unit No.	Title of Unit & Contents	Hrs
	1. **Cash crops:** Sugarcane, Morphology, processing of products and by products of sugarcane industry. 2. Natural Rubber-Cultivation tapping and processing. 3. **Spices:** Fennel, Clove, Black pepper and Cardamom, their family and parts used, economic importance with special reference to Maharashtra. 4. **Fruits**: Mango, Grapes and Citrus(Origin, Morphology, Cultivation, processing and uses)	
	UO 1.Describe Origin, Morphology, Cultivation, processing and uses Cash crops, Spices and Fruits. UO 2. Know the cultivation practices.	
III	**Oils and Fats**	**12**
	1. Oil and Fats: Groundnut, Safflower, Sunflower and Mustard: General Description, classification, extraction, their uses and health implications; (Botanical Name, Family and uses). **2.** Non-edible oil yielding trees: Neem, importance as biofuel and application. **3. Essential Oil:** Sandal wood oil, Rosa oil and eucalyptus oil: General account, Extraction methods of oil, Economic importance.	
	UO 1.Describe the Extraction methods of oil and Economic importance. UO 2. Know the edible and non-edible oil yielding plants.	
IV	**Fibers, Drugs yielding plants and Beverages**	**12**
	1. **Fibers:** Cotton and Jute: Classification based on the origin of fibers (Origin, Morphology, Cultivation, processing and uses). 2. **Drugs yielding plants:** Cinchona, Digitalis, Aloe vera and Cannabis. 3. Therapeutic and habit- forming drugs and special reference to **Beverages**: Tea, Coffee(Morphology, processing and uses)	
	UO 1. Correlates the Cultivation and processing of natural rubber, Fibers and Beverages. UO 2. Describe the Drugs yielding plants.	

Learning Resources:

1. Economic Botany- Pandey B. P, S.Chand publication,1987
2. Economic Botany- Hill A.W, McGraw-Hill, 1981
3. Economic Botany- Albert, F.H. McGraw-Hill, 1937

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Lab Course
Course Title: Lab Course (Based on GE)
Course Code:
Credits:01 **Max.Marks:50** **Hours: 30**

Learning Objectives:

The students will have to:

LO 1. Study the Origin, Morphology, Post-harvest processing and uses of Cereals and Fruits.
LO 2. Describe the Cultivation tapping and process of natural rubber.
LO 3. To know the edible and non-edible oil yielding plants.
LO 4. To study the Drugs yielding plants.

Course Outcomes:

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

CO 1. Explain the Origin, Morphology, Post-harvest processing and uses of Cereals and Fruits
CO 2. Correlates the Cultivation and processing of natural rubber, Fibers and Beverages
CO 3. Interprets the edible and non-edible oil yielding plants.
CO 4. Describe the Drugs yielding plants

Practical No.	
1	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Wheat
2	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Rice
3	Botanical name, family, Morphology, distinguishing characters, Post- harvest processing and economic importance of Green gram
4	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Red gram
5	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of chickpea
6	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Sugarcane
7	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of fennel.
8	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of clove.
9	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Black pepper and Cardamom.
10	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Cotton.
11	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Jute.
12	Extraction of essential oil.
13	Botanical name, family, Morphology, distinguishing characters, Post-Harvest processing and economic importance of Tea, Coffee

15	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)

N.B.: Any Ten Practicals from above

Learning Resources:

1. A Manual of Economic Botany- R.K. Sinha, Central Publishing House- 2010
2. Economic Botany: A Practical Approach- A.K. Singh, Pointer Publications, 2012
3. Practical Economic Botany- S.C. Santra, New Central Book Agency, 2018

Skill Enhancement Courses Offered by the Department

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: SEC
Course Title: Herbal Technology
Course Code:
Credits:02 **Max.Marks:50** **Hours: 30**

Learning Objectives:

The students will have to:

LO 1. Know raw material as source of herbal drugs from cultivation to herbal drug product.

LO 2. Know the guidelines of WHO and ICH for evaluation of herbal drugs.

LO 3. Analyze herbal cosmetics, natural sweeteners, nutraceuticals properties.

LO 4. Understand and utilize herbal resources for various purposes.

Course outcomes:

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

CO 1. Know raw material as source of herbal drugs from cultivation to herbal drug product.

CO 2. Know the WHO and ICH guidelines for evaluation of herbal drugs

CO 3. Correlate the herbal cosmetics, natural sweeteners, nutraceuticals.

CO 4. Appreciate patenting of herbal drugs, GMP.

Unit No.	Title of Unit & Contents	Hrs
I	**Herbs as raw materials**	**12**
	Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials and Processing of herbal raw material Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides /Bioinsecticides. Indian Systems of Medicine a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.	
	UO 1. Know raw material as source of herbal drugs from cultivation to herbal drug product.	
II	**Nutraceuticals**	**12**

Unit No.	Title of Unit & Contents	Hrs
	1. General aspects, Market, growth, scope and types of products available in the market. 2. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable Bowel syndrome and various Gastro intestinal diseases. 3. Study of following herbs as health food: Alfa alfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina 4. Herbal- Drug and Herb- Food Interactions: General introduction to interaction and classification. 5. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginko biloba, Ginseng, Garlic, Pepper & Ephedra.	
	UO 1. Know the guidelines of WHO and ICH for evaluation of herbal drugs.	
III	**Herbal Cosmetics**	**12**
	1. Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skincare, hair care and oral hygiene products. 2. Herbal Excipients–Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. 3. Herbal formulations Conventional herbal formulations like syrups, Mixtures and tablets and Novel dosage forms like phytosomes	
	UO 1. Understand and utilize herbal resources for various purposes.	
IV	**Evaluation of Drugs**	**12**
	1. WHO & ICH guide lines for the assessment of herbal drugs Stability testing of herbal drugs. 2. Patenting and Regulatory requirements of natural products: a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma& Neem. 3. Herbal drugs industry: Present scope and future prospects.	
	UO 1. Appreciate patenting of herbal drugs, GMP.	

Learning Resources:

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohitand Gokhale
4. Essential of Pharmacognosy by Dr. S. H. Ansari

5. Pharmacognosy & Phytochemistry by V. D. Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

(Subject: Botany)

Course Type: Lab Course
Course Title: Lab Course (Based on SEC)
Course Code:
Credits:01 **Max.Marks:50** **Hours: 30**

Learning Objectives:

The students will have to:

LO 1. Know raw material as source of herbal drugs from cultivation to herbal drug product.
LO 2. Know the guidelines of WHO and ICH for evaluation of herbal drugs.
LO 3. Analyze herbal cosmetics, natural sweeteners, nutraceuticals properties.
LO 4. Understand and utilize herbal resources for various purposes.

Course outcomes:

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

CO 1. Know raw material as source of herbal drugs from cultivation to herbal drug product.
CO 2. Know the WHO and ICH guidelines for evaluation of herbal drugs
CO 3. Correlate the herbal cosmetics, natural sweeteners, nutraceuticals.
CO 4. Appreciate patenting of herbal drugs, GMP.

Learning Recourses:

1. Handbook of Herbal Technology- S.C. Mandal & A.K. Mandal, International Book distributing Co., 2010
2. Herbal Drug Technology- V. Singh & A.K. Sinha, Rastogi Publication, 2012
3. Practical Herbal drug technology- P.K. Goyal, R.K. Chauvan, CBS Publisher, 2018
4. Practical manual on Herbal drug technology- Dilprit Singh, Balak Das Kurmi, Brillion Publishing, 2022

N.B.: Any Ten Practicals from above.

Practical No.	Unit
1	To perform preliminary phytochemical screening of crude drugs.
2	Determination of the alcohol content of Asava and Arista.
3	Evaluation of excipients of natural origin.
4	Incorporation of prepared and standardized extract in cosmetic formulations Of creams, lotions and their evaluation.
5	Incorporation of prepared and standardized extract in cosmetic formulations Of soup and shampoos and their evaluation.
6	Incorporation of prepared and standardized extract in formulations like syrups, mixtures and their evaluation as per Pharmacopoeias requirements.
7	Incorporation of prepared and standardized extract in formulations like Tablets and their evaluation as per Pharmacopoeias requirements.
8	Monograph analysis of herbal drugs from recent Pharmacopoeias.
9	Determination of Aldehyde content.
10	Determination of Phenol content.
11	Botanical excursions (one short, one long excursion and visit to Research laboratory, Field etc. is compulsory)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG Second Year (Semester III / IV)

Basket I: Open Elective (OE)

(GEs offered to the Science and Technology students in Sem.-III/IV)

Sr. No.	BoS Proposing OE	Course Title	Credits	Hrs.
1.	Commerce	Digital Marketing	2	30
2	Commerce	Introduction to Personal Taxation	2	30
3	Commerce	Fundamentals of Accounting	2	30
4	Hindi	Rojgar Abhimulak Hindi	2	30
5	English	English Proficiency Course	2	30
6	Geography	Fundamentals of GIS & RS	2	30

Note: Student can choose any one OE from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG Second Year (Semester III / IV)

Basket II: Skill Enhancement Courses (SEC)

(SEC offered to the Commerce and Management students in Sem.-III/IV)

Sr. No.	BoS Proposing SEC	Course Title	Credits	Hrs.
1	Commerce	Financial Management	2	30
2	Analytical Chemistry	Skills In Chemistry	2	30
3	Commerce	Wealth Management	2	30
4	Biotechnology	Good Laboratory Practices	2	30
5	Biotechnology	Dairy Technology	2	30
6	Botany	Herbal Technology	2	30
7	Information technology	Software Development Techniques	2	30
8	Information technology	Information Security	2	30
9	Computer Science	Web Development using WordPress	2	30
10	Electronics	Internet of Things	2	30
11	English	English for Careers	2	30
12	Geography	Disaster Management	2	30
13	Commerce	Business Law	2	30
14	Microbiology	Production of Bio fertilizers	2	30
15	Physics	Applied Optics	2	30
16	Political Science	Political Journalism	2	30
17	Chemistry	Chemistry of Biomolecules	2	30
18	Mathematics	Essential Statistics for Data Science	2	30
19	Information Technology	Android App Development	2	30
20	English	English for Competitive Examinations	2	30

Note: Student can choose any one SEC from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

UG Second Year

Basket III: Ability Enhancement Courses (AEC)

(AEC offered to the Science & Technology students in Sem.-III/IV)

Sr. No.	BoS Proposing AEC	Course Title	Credits	Hrs.
1.	English	English Communication	2	30
2.	English	English for Professionals	2	30

Note: Student can choose any one AEC from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Extra Credit Activities

Sr. No.	Course Title	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

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. 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:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. 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:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. 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.
4. 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.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. 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.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

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/SEC (Science & Technology)	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