॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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Phone: (02462)215542 | E-mail: bos@srtmun.ac.in

विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Agriculture Microbiology	11	B.Sc. Physics
02	B.Sc. Botany	12	B.Sc. Seed Technology
03	B.Sc. Dairy Science	13	B.Sc. Horticulture
04	B.Sc. Electronics	14	B.Sc. Statistics
05	B.Sc. Environmental Science	15	B.Sc. Biochemistry
06	B.Sc. Fishery Science	16	B.Sc. Analytical Chemistry
07	B.Sc. Food Science	17	B.Sc. Agrochemical & Fertilizers
08	B.Sc. Geology	18	B.Sc. Industrial Chemistry
09	B.Sc./B.A. Mathematics	19	B.Sc. Industrial Microbiology
10	B.Sc. Microbiology		

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२५–२६/११६
दिनांक ०५.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.
१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

SWAMI RAMANAND TEERTHMARATHWADA UNIVERSITY, NANDED - 431 606 (MS)

UNDERGRADUATE PROGRAMME OF

SCIENCE & TECHNOLOGY

B.Sc. Second Year

BOTANY

(For Affiliated Colleges)

Effective from the Academic year 2025 – 2026

(As per NEP-2020)

Framed by

BOARD OF STUDIES IN BOTANY

S.R.T.M. University, Nanded - 431 606

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power***", is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve ***the 3Es, the equity, the efficiency*** and ***the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the cumulative grade point average (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the Choice Based Credit System (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high calibre graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of

interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the **Government of Maharashtra regarding NEP-2020**. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship program*** for science background students is praise worthy and certainly help the students to imbibe firsthand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil
Dean
Faculty of Science and Technology
Swami Ramanand Teerth MarathwadaUniversity, Nanded

From Desk of Chairman, Board of Studies of the Subject Botany

PREAMBLE

The B.Sc. Botany semester pattern course is running in different affiliated colleges of the S.R.T.M.U. Nanded. The program is designed to encourage and support the growing demands and challenging trends in the academic environment. Our training focuses on holistic development of students to face the competitive world. The course content has been designed on NEP-2020 pattern. The program consists of Major (C), Minor (M), Generic Electives (GE), Vocational and Skill Enhancement Course (VSEC). The course content of each theory paper is divided into four units by giving appropriate titles and subtitles. For each unit, total number of periods required, weightage of maximum marks and credits are mentioned. A list of practical exercises for laboratory course work based on theory papers to be completed in the academic year is also given. A list of selected reading material and a common skeleton question paper for all the theory papers of semester-I &II are also provided at the end of the syllabus.

The programme also inculcates various attributes at the Honours level. 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 new curriculum based on learning outcomes of BSc (Honours) Botany offers knowledge of areas including Plant Systematics, Plant Biotechnology, Resource Botany, Genetics, Ecology, Conservation biology, Physiology and Bioinformatics, Medicinal plants, Plant diseases management etc. The courses define clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills in the field of Botany. The course also offers 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 the bachelor-level program in Botany is developed keeping in view of the student-centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid a rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The addition of Generic Electives, Vocational and Skill Enhancement Courses aims to develop skills in plant sciences and practical experience in the students.

OBJECTIVES OF THE B. Sc. BOTANY PROGRAMME:

The Objectives of this program are:

1. Understand the scope and importance of discipline.

2. Instill a love and curiosity for nature through living plants.
3. To make students open-minded and curious, we try our best to nurture and develop scientific Attitude.
4. We make students fit for society by enabling them to work hard.
5. Make the students exposed to the diverse life forms.
6. Make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
7. Develop interest in Biological research.
8. Encourage students to research related topics.
9. Develop a thirst for protecting natural resources and the environment.
10. Develop the ability to use the knowledge acquired in various spheres of life to make our country self-reliant
11. Appreciate and apply ethical principles to biological science research and practice.

PROGRAM SPECIFIC OUTCOMES (PSO) OF B.Sc. BOTANY:

By the end of the program the students will be able to:

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history.

PO6: Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany..

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career.

PO13: The program enables the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

Dr. Saheb Laxmanrao Shinde
Chairman,
Board of Studies in Botany
Swami Ramanand Teerth Marathwada University,Nanded

Details of the Board of Studies Members in the subject Botany under the faculty of Science & Technology of S.R.T.M. University, Nanded

Sr No	Name of the Member	Designation	Address	Contact No.
1.	**Dr. Saheb Laxmanrao Shinde**	Chairman	Yeshwant Mahavidylaya, Nanded	7588151967
2	**Dr. Babasaheb ShivmurtiSurwase**	Member	School of Life Sciences, S.R.T.M.U. Nanded	9075829767
3	**Dr. B. D. Gachande**	Member	Science College, Nanded	8788727840
4	**Dr Vijay Tulshiram Gorgile**	Member	Shahir Annabhau Sathe Mahavidyalaya, Mkhed	9421762073
5	**Dr. Sudhakar V. Chate**	Member	Shivaji College, Udgir	8421241300
6	**Dr. Suresh Manoharrao Telang**	Member	Yeshwant Mahavidyalaya, Nanded	9822174684
7	**Dr. R. M. Kadam**	Member	M. G. M. Ahmedpur, Tq. Ahmedpur, Dist. Latur.	9422657976
8	**Dr. Sopan Dnyanoba Dhavale**	Member	Shahir Annabhau Sathe Mahavidyalaya, Mukhed,	9423614703
9.	**Dr. Sanjay Marotrao Dalvi**	Member	Shri Guru Buddhiswami Mahavidyalaya, Purna (Jn),	9921101210
10	**Dr. Prashant A. Gawande**	Professor from other University	Sant Gadge Baba Amravati University,Amravati.	9403622568
11	**Dr. Ambadas Sheshrao Kadam**	Experts	DSM College Parbhani.	8329151172
12	**Dr. Kanhaiya Ranganathrao Kadam**	Experts	K.K. Herbal Industries, Gut No. 252, Naleshwar Road, Limbgaon, Nanded.	9420261080
13	**Bindu Maurya**	Experts	07, Mangal Pravesh building Polt. C-16 Sector-3 Airoli, Navi Mumbai.	9987591561
14	**Shri Bhanudas BalajiraoPendkar**	Experts	K-Ferts Lab, W-4, MIDC Industrial Area, Nanded. Invitee Member	8888896710

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

Credit Framework for B.Sc.II Year

Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: BOTANY (Major) /Botany (Minor)

Year & Level	Semester	Major *(From the same Faculty)*	Minor 1 *(From the same Faculty)*	(Minor 2) *(From the same Faculty)*	Generic Elective (GE) (select from Basket 3 of *Faculties other than Science and Technology*)	Vocational & Skill Enhancement Course	Ability Enhancement Course (AEC) (Basket 4) Value Education Courses (VEC) / Indian Knowledge System (IKS) (Basket 5) *(Common across all faculties)*	Field Work / Project/Internship/ OJT/ Apprenticeship / Case Study Or Co-curricular Courses (CCC) (Basket 6 for CCC) *(Common across all faculties)*	Credits	Total Credits
1	2	3	4	5	6	7	8	9	10	11
2 (5.0)	III	SBOTCT1201 (2cr) SBOTCT1202 (2cr) SBOTCP1201 (2cr) SBOTCP1202 (2cr) 8 Credits	SBOTMT1201 (2Cr) SBOTMP1201 (2Cr) 4 Credits		SBOTGE1201 (2cr)	SBOTVC1201 2 Credits	ACEENG1201 (2cr) ACEMIL1201 (2Cr) 4 Credits	CCCXXX1201(2Cr) *(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness)* 2 Credits	22	88
	IV	SBOTCT1251 (2cr) SBOTCT1252 (2cr) SBOTCP1251 (2cr) SBOTCP1252 (2cr) 8 Credits	SBOTMT1251 (2Cr) SBOTMP1251 (2Cr) 4Credits		SBOTGE1251 (2cr)	SBOTVC1251 2 Credits	ACEENG1201 (2cr) ACEMIL1201 (2Cr) VECEVS1251 (2Cr) 6 Credits		22	
	Cum. Cr.	24	16	08	08	08	22	02	44	
Exit option: UG Diploma in Major Botany and Minor Botany on completion of 88 credits and additional 4 credits NSQF / internship in Botany										

B. Sc. Second Year Semester III*(Level 5)*

Teaching Scheme

	Course Code	CourseName	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SBOTCT1201	**Taxonomy of Angiosperms**	02	--	**04**	02	--
	SBOTCP1201	**Practical based on SBOTCT 1201**	-	02			04
	SBOTCT1202	**Cell Biology**	02	--	**04**	02	--
	SBOTCP1202	**Practical based on SBOTCT 1202**	-	02			04
Minor	SBOTMT1201	**Diversity of Cryptogams**	02	--	**04**	02	--
	SBOTMP1201	**Practical based on SBOTMT 1201**	-	02			04
Generic Electives *(from other Faculty)*	SBOTGE1201	**(Basket 3)**	02	--	**02**	02	--
Vocational Course (related to Major)	SBOTVC1201	**Biofertilizers Technology**	--	02	**02**	--	04
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	**ACEMIL1201**	**(MAR/HIN/URD /KAN/PAL)**	02	--	**02**	02	--
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	**CCCXXX1201**	Select from **Basket 5**	02	--	**02**	02	--
Total Credits			**14**	**08**	**22**	**14**	**16**

B. Sc. Second Year Semester III*(Level 5)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SBOTCT1201	**Taxonomy of Angiosperms**	10	10	10	40	--	--	50
	SBOTCP1201	**Practical based on SBOTCT 1201**	--	--	--	--	20	30	50
	SBOTCT1202	**Cell Biology**	10	10	10	40	--	--	50
	SBOTCP1202	**Practical based on SBOTCT 1202**	--	--	--	--	20	30	50
Minor	SBOTMT1201	**Diversity of Cryptogams**	10	10	10	40	--	--	50
	SBOTMP1201	**Practical based on SBOTMT 1201**	--	--	--	--	20	30	50
Generic Electives	SBOTGE1201	**(Basket 3)**	10	10	10	40	--	--	50
Vocational Course	SBOTVC1201	**Biofertilizers Technology**	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	--	--	--	--	20	30	50
Ability Enhancement Course	ACEMIL1201	**(MAR/HIN/URD /KAN/PAL)**	--	--	--	--	20	30	50
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	CCCXXX1201	Select from **Basket 5**	10	10	10	40	--	--	50

B. Sc. Second Year Semester IV *(Level 5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SBOTCT1251	**Bryophytes and Pteridophytes**	02	--	**04**	02	--
	SBOTCP1251	**Practical based on SBOTCT 1251**	-	02			04
	SBOTCT1252	**Genetics and Plant Breeding**	02	--	**04**	02	--
	SBOTCP1252	**Practical based on SBOTCT 1252**	-	02			04
Minor	SBOTMT1251	**Diversity of Phanerogams**	02	--	**04**	02	--
	SBOTMP1251	**Practical based on SBOTMT 1251**	-	02			04
Generic Electives *(from other Faculty)*	SBOTGE1251	**(Basket 3)**	02	--	**02**	02	--
Vocational Course (related to Major)	SBOTVC1251	***Bio-pesticide and Pest Management***	--	02	**02**	--	04
Ability Enhancement Course	AECENG1251	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	**ACEMIL1251**	**(MAR/HIN/URD /KAN/PAL)**	02	--	**02**	02	--
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	**CCCXXX1251**	Select from **Basket 5**	02	--	**02**	02	--
Total Credits			**14**	**08**	**22**	**14**	**16**

B. Sc. Second Year Semester IV*(Level 5)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SBOTCT1251	**Bryophytes and Pteridophytes**	10	10	10	40	--	--	50
	SBOTCP1251	**Practical based on SBOTCT 1251**	--	--	--	--	20	30	50
	SBOTCT1252	**Genetics and Plant Breeding**	10	10	10	40	--	--	50
	SBOTCP1252	**Practical based on SBOTCT 1252**	--	--	--	--	20	30	50
Minor	SBOTMT1251	**Diversity of Phanerogams**	10	10	10	40	--	--	50
	SBOTMP1251	**Practical based on SBOTMT 1251**	--	--	--	--	20	30	50
Generic Electives	SBOTGE1251	**(Basket 3)**	10	10	10	40	--	--	50
Vocational Course (related to Major)	SBOTVC1251	***Bio-pesticide and Pest Management***	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	--	--	--	--	20	30	50
Ability Enhancement Course	**ACEMIL1201**	**(MAR/HIN/URD /KAN/PAL)**	--	--	--	--	20	30	50
(NCC/NSS/SPT(sports)/ CLS(Cultural Studies)/HWS(Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2 Credits**	**CCCXXX1201**	Select from **Basket 5**	10	10	10	40	--	--	50

Syllabus for B. Sc. Botany, Second Year

Semester – III

As Per National Education Policy- 2020

To be implemented from

Academic Year 2025-2026

National Education Policy 2020

B.Sc. Botany, II Year (Semester - III)

Major Core Theory Course

Course Code – SBOTCT1201

Title of the Course: TAXONOMY OF ANGIOSPERMS

[No. of Credits: 2 Credit] **[Total:30Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year level, for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution and morphology of flowering plants.
2. To study the types of classifications- artificial, natural and phylogenetic
3. To study the principles and rules of ICN and taxonomical terminology.
4. To study the various plant families and their economic importance.

Course outcomes:

1. The students understand the morphology, classification, and evolution of flowering plants.
2. The students differentiate between various families of flowering plants and their collection and preservation.
3. The students learn the utilization of flowering plants for human welfare.

Curriculum Details: SBOTCT 1201-Taxonomy of Angiosperms

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Introduction to Taxonomy**	**07**
	1.1	Aims and scope of Taxonomy; Identification, Nomenclature and Classification	
	1.2	Binomial nomenclature; Introduction to ICN	
	1.3	Introduction to herbarium, Technique in preparation of Herbarium, Important Herbaria of India; Introduction to Botanical Gardens, Important Botanical Gardens of India.	
	1.4	Types and use of Keys in plant identification (Punched card and Dichotomous Keys)	
2.0		**Classification of flowering plants**	**08**
	2.1	Taxonomic hierarchy; Concept of species (Morphological, Biological)	
	2.2	Types of classification-artificial, natural and phylogenetic.	
	2.3	Outline of Bentham and Hooker's System of Classification of Angiosperms with merits and demerits (up to family level with	

		reference to families mentioned in the syllabus).	
	2.4	Outline of Engler and Prantl's System of Classification of Angiosperms with merits and demerits.	
3.0		**Morphology of Flowering Plants**	
	3.1	Root: Definition, characters, types- tap root, fibrous root and adventitious roots (stilt, haustoria, pneumatophores, prop roots, aerial roots, coralloid roots) and functions of roots. Stem: Definition, characters, types, modifications and functions of stem (rhizome, tuber, bulb, stolon, offsets, tendril, cladode). Leaf: Definition, functions, types- Simple, Compound (unipinnate, bipinnate, tripinnate, unifoliate, bifoliate, trifoliate, multifoliate), Venation- definition, types (reticulate, parallel), Phyllotaxy (alternate, opposite, whorled)	
	3.2	Inflorescence: Definition, types- Racemose, Cymose, Solitary, special inflorescence (Verticillaster, Umbel, Cyathium, Hypanthodium). Flower: Definition, symmetry, actinomorphic, zygomorphic, types (hypogynous, epigynous, perigynous), calyx (polysepalous, gamosepalous), corolla (polypetalous, gamopetalous)	**08**
	3.3	Androecium (parts of as tamen), Gynoecium– structure of carpel, apocarpous, syncarpous, placentation (axile, parietal, marginal, basal)	
	3.4	Fruit: Definition, types- simple (dry, legume, fleshy, berry), aggregate (Eetaerio of berries), composite (sorosis and syconus).	
4.0		**Families of flowering plants (As per Bentham & Hooker's Classification)**	
	4.1	Study of systematic position, morphology and economic importance of Brassicaceae, Malvaceae and Fabaceae (Papilionaceae)	
	4.2	Study of systematic position, morphology and economic importance of Solanaceae and Lamiaceae.	**07**
	4.3	Study of systematic position, morphology and economic importance of Euphorbiaceae	
	4.4	Study of systematic position, morphology and economic importance of Poaceae.	
		Total	**30**

Text Books and Reference Books:

1. Bodke SS & NM Dhekle (2015) Angiosperms Structure and Development, Aruna Publication Latur.
2. Davis, P.H. and Heywood, V.M. (1965) Principles of Angiosperm Taxonomy.
3. Gamble, J.S. and Fisher, L.E.F. (1967) The Flora of the presidency of Madras (Vol. I –III)

Botanical Survey of India, Calcutta.
4. Heywood, V.H. (1967) Plant Taxonomy. Edward Arnold, Great Britain.
5. Hutchinson, J. (1973) The families of flowering plants. Oxford University Press, London.
6. Jeffery, C. An Introduction to Plant Taxonomy. J & A Churchill Ltd., London.
7. Kumar NC (1995) An introduction to Taxonomy of Angiosperms; Himalaya Publishing House, Mumbai
8. Lawrence, G.H.M. (1955) The Taxonomy of vascular plants (Vol. I-IV). Central Book Depot, Allahabad
9. Naik VN (1989) Taxonomy of Angiosperms; Tata MacGraw Hill, New Delhi.
10. O.P. Sharma (2017) Plant Taxonomy; Mc Graw Hill Learning
11. Pandey BP (2000) Taxonomy of Angiosperm; S. Chand & Co., New Delhi.
12. Pandey BP (2013) Taxonomy of Angiosperms; S. Chand Publication
13. Raychaudhuri, S.P 1991. (Ed.) Recent advances in Medicinal aromatic and spice cropsVol.1 Today & Tomorrow's printers and publishers, New Delhi.
14. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
15. Singh, V. and Jain, V.K. (1989) Taxonomy of Angiosperms. Rastogi Publication, Meerut.
16. Sivarajan, V.V. (1989) Introduction to principles of plant Taxonomy. Oxford and IBH, New Delhi.
17. Subramaniyam, N.S. (1995) Modern Plant Taxonomy. Vikas Publishing House, New Delhi.
18. Sutaria RN (1970) A text book of Systematic Botany; Khadayata Book Depot, Ahmedabad
19. Varma BK (2023) Introduction to Taxonomy of Angiosperms PHI Learning Ltd.
20. Vashista, P.C. (1990) – Taxonomy of Angiosperms – S. Chand & Co., New Delhi.

National Education Policy 2020

B.Sc. Botany, II Year (Semester - III)

Major Core Theory Course

Course Code – SBOTCT1202

Title of the Course: CELL BIOLOGY

[No. of Credits: 2 Credit] **[Total:30Hours]**

Course pre-requisite:

1. The course is offered for a student registered for second year undergraduate programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To know about the ultra-structure of a cell, cell wall, cell membrane, cell organelles and chromosomes, cell cycle and cell division.
2. To study in detail the structure of DNA and RNA and protein synthesis.
3. To acquire knowledge of cell and molecular biology.

Course outcomes:

1. Students understand ultra structure of a cell, cell wall, cell membrane, cell organelles and chromosomes, cell cycle and cell division.
2. The students understand in detail the structure of DNA and RNA and protein synthesis.
3. Students acquire knowledge of cell and molecular biology.

Curriculum details: SBOTCT 1202-Cell Biology

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Cell Structure and Function**	**07**
	1.1	Cell: the unit of life; Cell Theory (Schleiden and Schwann) ultra-structure of prokaryotic and eukaryotic cells	
	1.2	Ultra structure and functions of cell wall and cell membranes (Fluid Mosaic Model)	
	1.3	Ultra structure and functions of Golgi apparatus, endoplasmic reticulum, lysosomes and ribosomes.	
	1.4	Ultra structure and functions of nucleus.	
2.0		**Genetic Material**	**08**
	2.1	Chromosome: Morphology, structure and functions of typical chromosome; types of chromosomes (based on position of centromere)	
	2.2	Packaging of chromosome (formation of nucleosome, chromatin and chromosome)	
	2.3	Introduction to karyotype and ideogram	
	2.4	Structure and significance of giant chromosomes: polytene chromosome and lampbrush chromosome	
3.0		**Cell Cycle and Cell Division**	**08**

	3.1	Cell-cycle: G0 - G1 - S - G2 phase	
	3.2	Cell division: process and significance of mitosis	
	3.3	Process of meiosis-I	
	3.4	Significance of meiosis.	
4.0		**Nucleic Acids**	
	4.1	Nucleic Acids- Introduction, chemical composition, structure of DNA (Watson and Crick model)	**07**
	4.2	Replication of DNA (Meselson and Stahl expt.)	
	4.3	Structure, function and types of RNA (m-RNA, t-RNA & r-RNA).	
	4.4	Protein synthesis: genetic code, transcription, translation.	
		Total	**30**

Text Books and Reference Books:

1. Ariel. G. Loewy&Philip Siekevit Cell Structure & Function, Oxford& IBH Publishing Cor. Pvt. Ltd., Delhi
2. Arthur Giese Cell Physiology W.B. Saunderies Company,London.
3. Baig MMV, SS Ingle & SM Telang (2013) Fundamentals of Cell and Molecular Biology, Genetics and Plant Breeding (2013), Aruna Publications, Latur.
4. C. B. Powar - Cell Biology Himalaya PublishingHouse. Delhi
5. E.J. Ambrose &Dorothy M.Easty -Cell Biology Vikas Pub. Bombay.
6. Herbert Sterm &David L. Nanney - The Biology of Cells Willey EasternPvt. Ltd. New Delhi
7. J.A.S. Watson (2005) Crops: Varieties and Plant BreedingSatish Serial PublishingHouse.
8. Johnson Lewys - Cell Biology Sarup & SonsNew Delhi. – 110 002.
9. Jones A.D. and Wilbins, A.D. (1971) – Variation and adaptations in plant, species. Hieman& Co-Educational Books Ltd. London.
10. K.Sivarama Sastry, G. Padmanaban&C. Subramanayam- Text Book of Molecular Biology MacMillan India Ltd.Delhi.
11. K.Sivarama; G. Padmanaban&C. Subramanayam Sastry-Text Book of Molecular Biology MacMillan India Ltd.Delhi.
12. M.L. Gupta &M.L. Jangir - Cell Biology, Fundamentalsand Applications Student Edition India, Ltd. Jodhpur.
13. P.K. Gupta- Cytology Genetics & Evolution.Rastogi Publication,Meerut.
14. P.S. Verma&V.K. Agarwal -Cytology S.ChandNew Delhi.
15. P.S. Verma V.K. &Agarwal Cell Biology, Genetics, Molecular BiologyEvolution and EcologyS. Chand Publisher New Delhi.
16. R.W.Allard (2019) Principles of Plant Breeding Wiley Publications
17. S.Sundara Rajan - Introduction to Cell Biology Vikas Publishing House, Pvt. Ltd. Delhi.
18. S.C. Rastogi- Cell and Molecular Biology New Age International Publisher. New Delhi.
19. S.K. Gupta (2008) Plant Breeding Theory and Techniques Agrobios Publications
20. S.K. Gupta (2012) Practical Plant Breeding 2nd EditionAgrobios Publications

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B.Sc. Botany, II Year (Semester - III)

Major Practical Course

Course Code – SBOTCP 1201

Title of the Course: Practical based on SBOTCT 1201

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for second year undergraduate programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To develop skill and technique among the students to study morphology and classification of plants.
2. To study and impart knowledge about the occurrence, distribution, structure and life history Flowering plants.
3. To differentiate between families of flowering plants.

Course outcomes:

1. Students develop skill to study the flowering plants.
2. The students understand the morphology and classification of flowering plants.
3. The students learn the evolution of flowering plants and their utilization for human welfare.

Curriculum details: SBOTCP 1201: Practical based on SBOTCT 1201

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of morphology and types of roots (as mentioned in theory paper)	4
2.	Study of morphology and types of leaves (as mentioned in theory paper)	4
3.	Study of morphology, types and modifications of stems (as mentioned in theory paper)	4
4.	Study of types of inflorescences (as mentioned in theory paper)	4
5.	Study of morphology of flowers (as mentioned in theory paper)	4
6.	Study of types of fruits (as mentioned in theory paper)	4
7.	Study of vegetative and floral characters of Brassicaceae (Description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position according to Bentham & Hooker's system of classification)	4
8.	Study of vegetative and floral characters of Malvaceae (Description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position).	4
9.	Study of vegetative and floral characters of Fabaceae (Papilionaceae) (Description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position).	4

10.	Study of vegetative and floral characters of Solanaceae (Description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position).	4
11.	Study of vegetative and floral characters of Lamiaceae (Description, V.S flower, section of ovary, floral diagram, floral formula and systematic position).	4
12.	Study of vegetative and floral characters of Euphorbiaceae (Description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position).	4
13.	Study of vegetative and floral characters of Poaceae (Description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position).	4
14.	Preparation of Herbarium (Students will submit at least five Herbarium specimen in Practical exam.	4
15.	Excursion/ study tour. One long and two short (local) excursions are expected (Students should submit excursion/ field report in practical examination).	4
	Total	**60**

Text Books and Reference Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol II., Rastogi Publications, Meerut.
2. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
3. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company
4. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
5. O.P. Sharma (2017) Plant Taxonomy; Mc Graw Hill Learning
6. Gopinath Hait (2023) Field Manual for Plant Taxonomy; Global Net Publication
7. Swapnil Yadav (2022) Plant Systematics with Practical; Mahaveer publications.com
8. O.P. Sharma (2017) Plant Taxonomy; Mc Graw Hill Learning
9. Pandey BP (2000) Taxonomy of Angiosperm; S. Chand & Co., New Delhi.
10. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
11. Singh, V. and Jain, V.K. (1989) Taxonomy of Angiosperms. Rastogi Publication, Meerut.
12. Sivarajan, V.V. (1989) Introduction to principles of plant Taxonomy. Oxford and IBH, New Delhi.
13. Subramaniyam, N.S. (1995) Modern Plant Taxonomy. Vikas Publishing House, New Delhi.
14. Sutaria RN (1970) A text book of Systematic Botany; Khadayata Book Depot, Ahmedabad
15. Varma BK (2023) Introduction to Taxonomy of Angiosperms PHI Learning Ltd.
16. Vashista, P.C. (1990) – Taxonomy of Angiosperms – S. Chand & Co., New Delhi.

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B.Sc. Botany, II Year (Semester - III)

Major Practical Course

Course Code – SBOTCP1202

Title of the Course: Practical based on SBOTCT 1202

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for second year undergraduate programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To develop skill and technique among the students to study the structure and function of cell.
2. To study and impart knowledge about the chromosomes, cell division, karyotype and cell organelles.
3. To study the structure and functions of DNA and RNA

Course outcomes:

1. Students understand the structure and function of cell and cell organelles.
2. The students understand the morphology and behavior of genetic material.
3. The students learn the nature and function of genetic material.

Curriculum details: SBOTCP 1202: Practical based on SBOTCT 1202

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Preparation of chromosomal stains:- 2% acetocarmine and 2% aceto-orcein	4
2.	Study of ultra-structure of cell organelles with the help of photocopies/slides: Golgi apparatus, endoplasmic reticulum, lysosomes and ribosomes.	4
3.	Study of polytene chromosome with the help of photocopies/ slides	4
4.	Study of lampbrush chromosome with the help of photocopies/ slides	4
5.	Preparation of squash and study of mitosis (Onion/ Garlic root tips) and mitotic index (Two practicals)	8
6.	Preparation of smear and study of meiosis (Onion buds/ Rheo buds) (Three practicals)	12
7.	Study of karyotype and ideogram from photocopies of Onion/ *Aloe* plant material	4
8.	Study of DNA structure (Watson and Crick Model) with the help of Photocopies/ Models.	4
9.	Study of Types of RNA with the help of photocopies/models.	4
10.	Preparation of wool models of mitosis and meiosis (Students will submit the wool models in practical exam)	4
11.	Visit to a DNA library.	4

12.	Visit to forensic laboratory and Gene bank	4
	Total	**60**

Text Books and Reference Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
2. Baig MMV, SS Ingle & SM Telang (2013) Fundamentals of Cell and Molecular Biology, Genetics and Plant Breeding (2013), Aruna Publications, Latur.
3. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
4. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company
5. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
6. P.S. Verma V.K. & Agarwal Cell Biology, Genetics, Molecular Biology Evolution and Ecology S. Chand Publisher New Delhi.
7. P.K. Gupta- Cytology Genetics & Evolution. Rastogi Publication, Meerut.
8. S. Sundara Rajan - Introduction to Cell Biology Vikas Publishing House, Pvt. Ltd. Delhi.
9. C. B. Powar - Cell Biology Himalaya Publishing House. Delhi
10. Johnson Lewys - Cell Biology Sarup & Sons New Delhi. – 110 002.
11. P.S. Verma & V.K. Agarwal -Cytology S. Chand New Delhi.
12. S.K. Gupta (2008) Plant Breeding Theory and Techniques Agrobios Publications
13. S.K. Gupta (2012) Practical Plant Breeding 2nd Edition Agrobios Publications
14. R.W.Allard (2019) Principles of Plant Breeding Wiley Publications

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B.Sc. Botany, II Year (Semester - III)

Minor Theory Course

Course Code – SBOTMT1201

Title of the Course: DIVERSITY OF CRYPTOGAMS

[No. of Credits: 2 Credit] **[Total:30Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as Minor subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of cryptogamic plants.
2. To understand the evolution of plants from aquatic to terrestrial habitats and adaptations to conquer the land.

Course outcomes:

1. Students understand the morphology, structure and importance Bryophytes and Pteridophytes.
2. Students learn the evolutionary trends in plants and how they progressed from water to land; from gametophytes to sporophytes.
3. Students are acquainted with development of vasculature in the plants.

Curriculum details: SBOTMT1201: Diversity of Cryptogams

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Bryophytes – I**	**08**
	1.1	General characters of Bryophytes	
	1.2	Classification of Bryophytes (N.S. Parihar)	
	1.3	Systematic position, occurrence, thallus structure (external and internal) of *Riccia*	
	1.4	Reproduction in Riccia; graphic life cycle of *Riccia*	
2.0		**Bryophytes – II**	**07**
	2.1	Systematic position and occurrence of *Funaria*	
	2.2	Thallus structure (external and internal) of *Funaria*	
	2.3	Reproduction in *Funaria*; graphic life cycle of *Funaria*	
	2.4	Economic Importance of Bryophytes	
3.0		**Pteridophytes – I**	**08**
	3.1	General characters of Pteridophytes	
	3.2	Classification of Pteridophytes (K. R. Sporne, 1964)	
	3.3	Systematic position, occurrence, sporophyte structure (external and internal) of *Equisetum*	
	3.4	Reproduction in *Equisetum*; Graphic life cycle of *Equisetum*	
4.0		**Pteridophytes – II**	**07**

	4.1	Systematic position and occurrence of *Marsilea*	
	4.2	Sporophyte structure (external and internal- T.S.of petiole and rhizome) of *Marsilea*	
	4.3	Reproduction in *Marsilea*; graphic life cycle of *Marsilea*	
	4.4	Economic Importance of Pteridophytes	
		Total	**30**

TextBooks and References Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
2. Bower F.O. (1988) Primitive Land Plants Vol-I & II Arihant Publishers, Jaipur.
3. Patil M.B. (2016) Microbes and Cryptogams, Aruna Prakashan, Latur.
4. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
5. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company.
6. Pandey B.P. (2000) College Botany Vol-I (Algae, Fungi, Bryophytes) S. Chand & Co. New Delhi.
7. Pandey B.P. (2000) College Botany Vol-II (Pteridophyta, Gymnosperms, Paleobotany) S. Chand & Co. New Delhi.
8. Pandey S.N.,P.S. Trivedi and S.P. Mishra A Text Book of Botany Vol-I & II Vikas Publishing House, New Delhi.
9. Parihar N.S. (1965) An Introduction to Embryophyta Vol-I Bryophyta Central Book Depot, Allahabad.
10. Parihar, N. S (1972). An Introduction to Embryophyta-I: Bryophyta. Central Book Depot, Allahabad
11. Puri P. (1980) Bryophyta Atmaram & Sons. New Delhi.
12. Rajan S. Sundra (1995) College Botany Vol-I & II Himalaya Publication House.
13. Rashid A (1999) An Introduction to Pteridophyta. Vikas Publishing Co., New Delhi.
14. Saxena A.K. & Sarabhai R.P. (1968) Text Book of Botany Vol-II Ratan Prakashan Mandir, Agra.
15. Saxena A.K.& Sarabhai R.P. (1968) Text Book of Botany Vol-I Ratan Prakashan Mandir, Agra.
16. Sharma O.P. (1992) A Text Book of Pteridophytes McMillan (India) Ltd
17. Smith G.M. (1971) Cryptogamic Botany Vol-II Bryophytes and Pteridophytes Tata McGraw Hill Publishing Co. New Delhi.
18. Sporne K.R. (1976) The Morphology of Pteridophytes B.I. Publication, Bombay.
19. Sundara Rajan. S (1994) Introduction to Pteridophyta. New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi.
20. Vashishta B.R. (1990) Botany for Degree Students Part-III Bryophyta S. Chand & Co. New Delhi.
21. Vashishta P.C. (1988) Botany for Degree Students -Pteridophyta S. Chand & Co. New Delhi.
22. Vashishta P.C. (1991) Botany for Degree Students Part-V Vascular Cryptogams (Pteridophyta) S. Chand & Co. New Delhi.
23. Vashishta, B. R. *et al*. (2014). Botany for Degree Students – Bryophytes. S. Chand and Co.Ltd., New Delhi.
24. Vashishta, B. R. *et al*. (2014). Botany for Degree Students – Pteridophytes. S. Chand and Co.Ltd., New Delhi.
25. Watson, E. V. (1971). The Structure and Life of Bryophytes. B.I. Publns, New Delhi.

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B.Sc. Botany, II Year (Semester - III)

Minor Practical Course

Course Code – SBOTMP1201

Title of the Course: Practical based on SBOTMT 1201

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as minor subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of cryptogamic plants.
2. To understand the evolution of plants from aquatic to terrestrial habitats and adaptations to conquer the land.

Course outcomes:

1. Students understand the morphology, structure and importance Bryophytes and Pteridophytes.
2. Students learn the evolutionary trends in plants and how they progressed from water to land; from gametophytes to sporophytes.
3. Students are acquainted with development of vasculature in the plants.

Curriculum details: SBOTMP 1201: Practical based on SBOTMT 1201

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of identification, systematic position, thallus structure (external) of *Riccia*	4
2.	Study of internal structure of *Riccia* (T.S. of thallus)	4
3.	Study of antheridium, archegonium and sporophyte of *Riccia* with the help permanent slides.	4
4.	Study of identification, systematic position, thallus structure (external) of *Funaria*	4
5.	Study of internal structure of *Funaria* (T.S. of thallus)	4
6.	Study of antheridium, archegonium and capsule of *Funaria* with the help permanent slides.	4
7.	Study of identification, systematic position, thallus structure (external) of *Equisetum*	4
8.	Study of internal structure of *Equisetum* (T.S. of aerial stem)	4
9.	Study of L.S. of cone of *Equisetum* with the help of permanent slides.	4
10.	Study of identification, systematic position, thallus structure (external) of *Marsilea*	4
11.	Study of internal structure of *Marsilea* (T.S. of petiole and rhizome) (Two	8

	practicals)	
12.	Study of sporocarp of *Marsilea*.	4
14.	Excursion/ study tour for specimen collection.	4
15.	Excursion/ study long tour.	4
	Total	**60**

Text Books and Reference Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
2. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
3. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company
4. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
5. Sporne K.R. (1976) The Morphology of Pteridophytes B.I. Publication, Bombay.
6. Sundara Rajan. S (1994) Introduction to Pteridophyta. New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi.
7. Vashishta B.R. (1990) Botany for Degree Students Part-III Bryophyta S. Chand & Co. New Delhi.
8. Vashishta P.C. (1988) Botany for Degree Students -Pteridophyta S. Chand & Co. New Delhi.
9. Vashishta P.C. (1991) Botany for Degree Students Part-V Vascular Cryptogams (Pteridophyta) S. Chand & Co. New Delhi.
10. Vashishta, B. R. *et al*. (2014). Botany for Degree Students – Bryophytes. S. Chand and Co.Ltd., New Delhi.
11. Vashishta, B. R. *et al*. (2014). Botany for Degree Students – Pteridophytes. S. Chand and Co.Ltd., New Delhi.

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B.Sc. Botany, II Year (Semester - III)

Generic Elective Course

Course Code – SBOTGE 1201

Title of the Course: PLANTS AND HUMAN WELFARE-I

[No. of Credits: 2 Credit] **[Total:30 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences
2. The students should have basic knowledge of plant science.

Course objectives:

1. To inculcate concepts of economically important plants.
2. To understand economically important of plants.
3. To increase employability of the students.

Course outcomes:

1. Understanding the economically important plants.
2. Understanding the potential of plants for human welfare
3. Understanding the role of plants in human health.

CURRICULUMDETAILS: SBOTGE 1201: Plants and Human Welfare-I

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Cereal and Millet Plants**	**07**
	1.1	Botanical description, nutritional value and uses of Wheat and Jowar	
	1.2	Botanical description, nutritional value and uses of Maize	
	1.3	Botanical description, nutritional value and uses of Rice	
		Botanical description, nutritional value and uses of Bajra	
2.0		**Pulses and Oil Yielding Plants**	**08**
	2.1	Botanical description, nutritional value and uses of Pulses- Tur, Chana (*Cicer*)	
	2.2	Botanical description, nutritional value and uses of Pulses-Green Gram, Black Gram	
	2.3	Botanical description, nutritional value and uses of Oil yielding plants- Groundnut, Soyabean	
	2.4	Botanical description, nutritional value and uses of Oil yielding plants- Safflower and Sunflower	
3.0		**Vegetable Plants-I**	**07**
	3.1	Botanical description, nutritional value and uses of earth vegetables- Radish and Carrot	
	3.2	Botanical description, nutritional value and uses of earth vegetables- Beetroot	
	3.3	Botanical description, nutritional value and uses of earth vegetables- Onion	
	3.4	Botanical description, nutritional value and uses of earth vegetables- Potato and Sweet potato	

4.0		**Vegetable Plants-II**	
	4.1	Botanical description, nutritional value and uses of leafy vegetables- Spinach, Methi and Cabbage,	**08**
		Botanical description, nutritional value and uses of flower vegetables- Cauliflower and Broccoli	
	4.3	Botanical description, nutritional valueand uses of Fruit vegetables- Bhendi, Pumpkin and Karela	
	4.4	Botanical description, nutritional value and uses of Fruit vegetables- Brinjal, Tomato and Shevga (Drum-stick)	
		Total	**30**

Text Books and Reference Books:

1. Pandey B.P. (1999) Economic Botany S. Chand Publishing House.
2. O.P. Sharma (2020) Economic Botany, Pragati Prakashan Meerut
3. S. L. Kocchar (2016) Economic Botany: A Comprehensive Study, Cambridge India.
4. R. L. Prasad (2022) Essentials of Economic Botany, Medtech Publications.
5. Sudipa Nag (Mandal) and Alokesh Das Subrata Mandal (2021) Handbook of Economic Botany, New Delhi Publishers.
6. V. Singh, Dr. P.C. Pande and D.K. Jain (2018) ECONOMIC BOTANY (B-56) Rastogi Publications
7. Sammbamurty and Subramanyam (2018) A Textbook of Modern Economic Botany, CBS Publishers
8. Verma V (2009) Text Book of Economic Botany, Ane Books Prit Ltd.

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B.Sc. Botany, II Year (Semester - III)

Vocational Course

Course Code – SBOTVC1201

Title of the Course: BIOFERTILIZER TECHNOLOGY

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1.This course is offered to students registered for the Undergraduate Second Year Programme in the Faculty of Science and Technology who have undergone preliminary training in the field of Plant Science at the Undergraduate First Year level for entry level core courses in Botany as a skill enhancement course.

Course objectives:

1. To inculcate concepts of biofertilizers.
2. To understand techniques in biofertilizers preparation.
3. To increase employability of the students.
4. To improve the soil quality by promoting the biofertilizers.

Course outcomes:

1. Understanding the role of organic farming.
2. Understanding the potential of biofertilizers as an alternative to chemical fertilizers
3. Role of biofertilizers in protecting the environment and managing the waste.

CURRICULUMDETAILS: SBOTVC 1201: Biofertilizer Technology

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Introduction to Importance, applications, classification of biofertilizers; The major microorganisms used as biofertilizer: A- Nitrogen fixing biofertilizers (*Rhizobium*, Cyanobacteria, *Azospirillium*, *Azolla*, *Azotobacter*), B- Phosphate solubilizing biofertilizer, C- Phosphate mobilizing biofertilizer (Mycorrhiza), D- Silicate and Zinc solubilizing biofertilizer, E- Plant Growth Promoting Rhizobacteria (PGPR); Role of biofertilizers in soil fertility and Agriculture.	16
2.	Isolation of *Rhizobium* from root nodules of leguminous plants and mass production of *Rhizobium*	4
3.	Preparation of carrier based *Rhizobium* biofertilizer	4
4.	Methods of application of *Rhizobium* biofertilizer	4
5.	Isolation of *Azotobacter* from soil and mass production of *Azotobacter*	4
6.	Preparation of carrier based *Azotobacter* biofertilizer	4
7.	Methods of application of *Azotobacter* biofertilizer	4
8.	Isolation of *Azospirillum* from rhizospheric soil of cereal crops and mass production of *Azospirillum*	4

9.	Preparation of carrier based *Azospirillum* biofertilizer	4
10.	Methods of application of *Azospirillum* biofertilizer	4
11.	Isolation of Phosphate Solubilizing Bacteria from rhizospheric soil and mass production of Phosphate Solubilizing Bacteria	4
12.	Preparation of carrier based Phosphate Solubilizing Bacteria biofertilizer & methods of application of Phosphate Solubilizing Bacteria biofertilizer	4
	Total	**60**

Text Books and Reference Books:

1. "Biofertilizers for Sustainable Agriculture" by A K Sharma Agrobios (2002)
2. "Fertilizer Technology and Management" by Mishra Brahma I K International Publishing House Pvt. Ltd (012)
3. "Handbook of Microbial Biofertilizers" by M K Rai International Book Distributing Co (2006)
4. "The Complete Technology Book on Bio-Fertilizer and Organic Farming" by NIIR Board of Consultants & Engineers PA (2007)
5. "The Fertilizer Encyclopedia" by Vasant Gowarikar Wiley; 1st edition (January 2009)
6. Dr. Sueo Machi Forum for Nuclear Cooperation in Asia Biofertilizer Project Group, to Manual on Biofertilizer Production and Application. Published by Japan Atomic Industrial Forum (JAIF) (2006).
7. Hari Muraleedharan, S. Seshadri, and K. Perumal, A Booklet on Biofertilizer (Phosphobacteria), Shri AMM Murugappa Chettiar Research center Chennai, (2010)
8. Jeyarajan R, Nakkeeran S (2000). Exploitation of microorganisms and viruses as biocontrol agents for crop disease mangement. *In:* Biocontrol Potential and their Exploitation in Sustainable agriculture,(Ed. Upadhyay et al.,) Kluwer Academic/ Plenum Publishers, USA pp. 95-116. http://dx.doi.org/10.1007/978-1-4615-4209-4_8
9. Krishnendu Acharya , Surjit Sen and Manjula Rai (2019) Biofertilizers and Biopesticides, Techno World.
10. 'Microbes As Bio-Fertilizers And Their Production Technology' by Prof. Suresh Borkar WPI Publishing; (2015)
11. Nduka Okaforand Benedict C. Okeke, Modern IndustrialMicrobiology and Biotechnology 2nd edition, CRC Press, Taylor & Francis Group, (2018).

Semester – IV

B.Sc. II Year

Botany

As Per National Education Policy- 2020

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B.Sc. Botany, II Year (Semester - IV)

Major Core Theory Course

Course Code – SBOTCT1251

Title of the Course: BRYOPHYTES AND PTERIDOPHYTES

[No. of Credits: 2 Credit] **[Total:30Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at first year undergraduate level for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life
2. history Bryophytes and Pteridophytes
3. To understand the evolution of plants from aquatic to terrestrial habitats and adaptations to conquer the land.

Course outcomes:

1. Students understand the morphology, structure and importance Bryophytes and Pteridophytes
2. Students learn the evolutionary trends in plants and how they progressed from water to land; from gametophytes to sporophytes.
3. Students are acquainted with development of vasculature in the plants.

CURRICULUMDETAILS: SBOTCT 1251: Bryophytes and Pteridophytes

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Bryophytes - I**	**07**
	1.1	General characters of Bryophytes	
	1.2	Classification of Bryophytes (N.S. Parihar)	
	1.3	Systematic position, occurrence, thallus structure (external and internal); reproduction and graphic life cycle with alternation of generations of *Marchantia*	
	1.4	Systematic position, occurrence, thallus structure (external and internal); Reproduction and graphic life cycle with alternation of generations of *Riccia*	
2.0		**Bryophytes - II**	**08**
	2.1	Systematic position, occurrence, thallus structure (external and internal); reproduction and graphic life cycle with alternation of generations of *Anthoceros*	
	2.2	Systematic position, occurrence, thallus structure (external and internal) of *Funaria*	
	2.3	Reproduction and graphic life cycle with alternation of generations of *Funaria*	
	2.4	Economic Importance of Bryophytes	

3.0		**Pteridophytes - I**	**07**
	3.1	General characters of pteridophytes	
	3.2	Classification of pteridophytes (K. R. Sporne, 1964)	
	3.3	Systematic position, occurrence, sporophyte structure (external and internal) and reproduction in *Lycopodium*	
	3.4	Systematic position, occurrence, sporophyte structure (external and internal) and reproduction in *Selaginella*	
4.0		**Pteridophytes - II**	**08**
	4.1	Systematic position, occurrence, sporophyte structure (external and internal); reproduction and graphic life cycle with alternation of generations of *Equisetum*	
	4.2	Systematic position, occurrence, sporophyte structure (external and internal); reproduction and graphic life cycle with alternation of generations of *Marsilea*	
	4.3	Heterospory and seed habit	
	4.4	Economic importance of pteridophytes	
		Total	**30**

TextBooks and References Books:

1. Bower F.O. (1988) Primitive Land Plants Vol-I & II Arihant Publishers, Jaipur.
2. Patil M. B. (2016) Microbes and Cryptogams, Aruna Prakashan, Latur
3. Pandey B. P. (2019) Modern Practical Botany Vol. I, II S. Chand and Company.
4. Pandey B.P. (2000) College Botany Vol-I,II (Algae, Fungi, Bryophytes) S. Chand & Co. New Delhi.
5. Pandey S.N., P.S. Trivedi and S.P. Mishra A Text Book of Botany Vol-I & II Vikas Publishing House, New Delhi.
6. Parihar N.S. (1965) An Introduction to Embryophyta Vol-I,II Bryophyta Central Book Depot, Allahabad.
7. Puri P. (1980) Bryophyta Atmaram & Sons. New Delhi.
8. Rajan S. Sundra (1995) College Botany Vol-I & II Himalaya Publication House.
9. Rashid A (1999) An Introduction to Pteridophyta. Vikas Publishing Co., New Delhi.
10. Saxena A.K. & Sarabhai R.P. (1968) Text Book of Botany Vol-II Ratan Prakashan Mandir, Agra.
11. Sharma O.P. (1992) A Text Book of Pteridophytes Tata McGraw Hill Publishing Co. New Delhi.
12. Sharma O.P. (1992) A Text Book of Thallophytes Tata McGraw Hill Publishing Co. New Delhi.
13. Smith G.M. (1971) Cryptogamic Botany Vol-II Bryophytes and Pteridophytes Tata McGraw Hill Publishing Co. New Delhi.
14. Sporne K.R. (1976) The Morphology of Pteridophytes B.I. Publication, Bombay.
15. Sundara Rajan. S (1994) Introduction to Pteridophyta. New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi.
16. Vashishta, B. R. *et al.* (2014). Botany for Degree Students – Bryophytes. S. Chand and Co.Ltd., New Delhi.
17. Vashishta, B. R. *et al.* (2014). Botany for Degree Students – Pteridophytes. S. Chand and Co.Ltd., New Delhi.
18. Watson, E. V. (1971). The Structure and Life of Bryophytes. B.I. Publns, New Delhi.

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B.Sc. Botany, II Year (Semester - IV)

Major Core Theory Course

Course Code – SBOTCT1252

Title of the Course: GENETICS AND PLANT BREEDING

[No. of Credits: 2 Credit] **[Total:30Hours]**

Course pre-requisite:

1. The course is offered for a student registered for second year undergraduate programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To know about the heredity and variation, Mendelian genetics and gene interactions.
1. To study sex determination, linkage, sex linked inheritance and genetic variations.
2. To study various crop improvement methods in plant breeding.

Course outcomes:

1. Students understand heredity and variation, Mendelian genetics and gene interactions.
2. The students understand sex-determination, linkage, sex linked inheritance and genetic variations.
3. Students know about crop improvement methods in plant breeding.

CURRICULUMDETAILS: SBOTCT 1252: Genetics and Plant Breeding

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Mendelian Genetics**	**07**
	1.1	Mendelian inheritance: Mendel's Laws of inheritance. Explanation and examples of monohybrid cross, dihybrid cross- back cross and test cross.	
	1.2	Gene interactions: Non- Epistatic- inheritance of combshape in domestic foals (9:3:3:1). Epistatic:- Dominant Epistasis (12:3:1), Recessive Epistasis (9:3:4), Supplementary genes- Cumulative effect (9:6:1), Duplicate Dominant genes (15: 1), Duplicate Recessive genes (9:7).	
	1.3	Sex determination: Chromosomal theory of sex determination, sex determination in man (XX-XY), birds (ZW-ZZ method)	
	1.4	Sex Determination in insects (XO-XX) and Plants (*Melandrium* and *Asparasgus*)	
2.0		**Sex-Linked Inheritance**	**08**
	2.1	Linkage: Coupling and repulsion hypothesis; linkage in Maize and Drosophila	
	2.2	Crossing over: Mechanism of crossing over; Cytological theories of crossing over; Crossing over in *Drosophila* and absence of crossing over in male *Drosophila*	

	2.3	Sex linked inheritance: Definition, classification (x-linked, y-linked and xy-linked), Sex-linked inheritance in *Drosophila* (white eye colour), Man (Hemophilia, colour-blindness and holandric gene-hypertrichosis)	
	2.4	Extra nuclear inheritance: Characteristic features of Cytoplasmic Inheritance; Examples of extranuclear inheritance: -Mitochondrial DNA, Chloroplast DNA, Cytoplasmic Male Sterility (CMS) in maize (as an example of extranuclear inheritance)	
3.0		**Genetic Variations (Chromosomal Aberrations)**	**07**
	3.1	Chromosomal aberrations: - Structural: Deletions, Duplications, Translocations and Inversions.	
	3.2	Numerical: Aneuploidy (Monosomy, Nullisomy & Trisomy) Euploidy (Monoploidy, Haploidy and Polyploidy).	
	3.3	Autoployploidy and Allopolyploidy (with reference to *Raphanobrassica* and Hexaploid wheat).	
	3.4	Syndromes in human i) Down's syndrome ii) Klinefelter's syndrome iii) Turner's syndrome, iv) Patau's syndrome v). Edward's syndrome	
4.0		**Introductory Plant Breeding**	**08**
	4.1	Introduction and objectives of plant breeding	
	4.2	Methods of plant breeding:- Selection-Mass selection, pure line selection and clonal selection	
	4.3	Hybridization: definition, objectives, various steps in hybridization (with reference to Cotton) and applications of hybridization.	
	4.4	Mutational breeding: objectives, procedure and applications of Mutational breeding (with reference to groundnut)	
		Total	**30**

Reference and Text Books:

1. Baig MMV, SS Ingle & SM Telang (2013) Fundamentals of Cell and Molecular Biology, Genetics and Plant Breeding, Aruna Publications, Latur.
2. Brown T A, Genetics: A Molecular Approach, 3rd Edition, Garland Science Publication
3. Cooper, G. M., Hausman, R. E., & Hausman, R. E. (2007). The cell: a molecular approach (Vol. 4). Washington, DC: ASM press.
4. Gupta P K (2022) Genetics, 5th Edition, Rastogi Publications.
5. Gupta, P.K. (2010). Cytogenetics. Rastogi Publications, Meerut, India.
6. K.Sivarama Sastry, G. Padmanaban & C. Subramanayam- Text Book of Molecular Biology MacMillan India Ltd. Delhi.
7. K.Sivarama; G. Padmanaban&C. Subramanayam Sastry-Text Book of Molecular Biology MacMillan India Ltd.Delhi.
8. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
9. M.L. Gupta & M.L. Jangir - Cell Biology, Fundamentals and Applications Student Edition India, Ltd. Jodhpur.
10. P.K. Gupta- Cytology Genetics & Evolution. Rastogi Publication, Meerut.
11. P.S. Verma & V.K. Agarwal -Cytology S. Chand New Delhi.
12. P.S. Verma V.K. & Agarwal Cell Biology, Genetics, Molecular Biology Evolution and Ecology S.

Chand Publisher New Delhi.
13. Peter j Russell(2016) Genetics: A Molecular Approach, 3rd Edition by, Pearson India.
14. Roberts, K., Alberts, B., Johnson, A., Walter, P., & Hunt, T. (2002). Molecular biology of the cell. New York: Garland Science.
15. Russell, P. J., Hertz, P. E., McMillan, B., & Benington, J. (2020). Biology: the dynamic science. Cengage Learning.
16. Singh, S. P., & Tomar, B. S. (2008). Cell biology. Rastogi Publications, Meerut, India.
17. Snustad and Simmons, Principles of Genetics, 6th Edition, 2015 John Wiley Publications
18. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons.
19. Veer Bala Rastogi (2019) Genetics 4th Edition. Medtech Publications.
20. Veerakumari. L. (2019). Bioinstrumentation. MJP Publishers, Chennai-600005.
21. Verma P.S. and Agarwal V.K,Genetics, 9th Edition, S.Chand and co
22. William S. Klug (Author), Michael R. Cummings (Author), Charlotte A. Spencer, Concepts of Genetics, 11th Edition ,2019 Pearson Publication

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B.Sc. Botany, II Year (Semester - IV)

Major Practical Course

Course Code – SBOTCP1251

Title of the Course: Practical based on SBOTCT 1251

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at first year undergraduate level for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life
2. history Bryophytes and Pteridophytes
3. To understand the evolution of plants from aquatic to terrestrial habitats and adaptations to conquer the land.

Course outcomes:

1. Students understand the morphology, structure and importance Bryophytes and Pteridophytes
2. Students learn the evolutionary trends in plants and how they progressed from water to land; from gametophytes to sporophytes.
3. Students are acquainted with development of vasculature in the plants.

CURRICULUMDETAILS: SBOTCP 1251: Practical based on SBOTCT 1251

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of identification, systematic position, thallus structure (external and internal) of *Riccia*	4
2.	Study of antheridium, archegonium and sporophyte of *Riccia* with the help of permanent slides.	4
	Study of identification, systematic position, thallus structure (external and internal) of *Marchantia*; Study of Antheridium, archegonium and sporophyte of *Marchantia* with the help of permanent slides.	
3.	Study of identification, systematic position and thallus structure (external and internal) of *Anthoceros*	4
4.	Study of Antheridium, archegonium and sporophyte of *Anthoceros* with the help of permanent slides.	4
5.	Study of identification, systematic position and thallus structure (external and internal) of *Funaria*	4
6.	Study of antheridium, archegonium and capsule of *Funaria* with the help of permanent slides.	4

7.	Study of identification, systematic position and thallus structure (external and internal) of *Lycopodium*	4
8.	Study of gametophyte, antheridia, archegonia and strobilus of *Lycopodium* with the help of permanent slides	4
9.	Study of identification, systematic position and thallus structure (external and internal- T.S. of stem and leaf) of *Selaginella;* Study of strobilus of *Selaginella* with the help of permanent slides.	4
10.	Study of identification, systematic position and thallus structure (external) of *Equisetum*	4
11.	Study of internal structure of *Equisetum* (T.S. of aerial stem); L.S. of cone of *Equisetum* with the help of permanent slides.	4
12.	Study of identification, systematic position and thallus structure (external and internal structure of *Marsilea* (T.S. of petiole and T.S. of Rhizome).	4
13.	Study of sporocarp of *Marsilea*.	4
14.	Excursion/ study tour for collection of Bryophytes and Pteridophytes from the field. (The students will submit this collection of plants in the practical exam)	4
15.	Excursion/ study tour (long)	4
	Total	**60**

Text Books and Reference Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
2. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
3. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company
4. Rajan S. Sundra (1995) College Botany Vol-I & II Himalaya Publication House.
5. Rashid A (1999). An Introduction to Pteridophyta. Vikas Publishing Co., New Delhi.
6. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
7. Saxena A.K. & Sarabhai R.P. (1968) Text Book of Botany Vol-II Ratan Prakashan Mandir, Agra.
8. Saxena A.K.& Sarabhai R.P. (1968) Text Book of Botany Vol-I Ratan Prakashan Mandir, Agra.
9. Sharma O.P. (1992) A Text Book of Pteridophytes Tata McGraw Hill Publishing Co. New Delhi.
10. Smith G.M. (1971) Cryptogamic Botany Vol-II Bryophytes and Pteridophytes Tata McGraw Hill Publishing Co. New Delhi.
11. Sporne K.R. (1976) The Morphology of Pteridophytes B.I. Publication, Bombay.
12. Sundara Rajan. S (1994) Introduction to Pteridophyta. New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi.
13. Vashishta, B. R. *et al*. (2014). Botany for Degree Students – Bryophytes. S. Chand and Co.Ltd., New Delhi.

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B.Sc. Botany, II Year (Semester - IV)

Major Practical Course

Course Code – SBOTCP1252

Title of the Course: Practical based on SBOTCT 1252

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for second year undergraduate programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year for entry level core courses in Botany as major subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To know about the heredity and variation, Mendelian genetics and gene interactions.
2. To study sex determination, linkage, sex linked inheritance and genetic variations.
3. To study various crop improvement methods in plant breeding.

Course outcomes:

1. Students understand heredity and variation, Mendelian genetics and gene interactions.
2. The students understand sex-determination, linkage, sex-linked inheritance and genetic variations.
3. Students know about crop improvement methods in plant breeding.

CURRICULUMDETAILS: SBOTCP 1252: Practical based on SBOTCT 1252

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Problems based on Mendel's monohybrid cross.	4
2.	Problems based on test cross and back cross.	4
3.	Problems based on Mendel's dihybrid cross.	4
4.	Problems based on non-epistatic gene interaction: - Inheritance of comb shape in domestic fowls.	4
5.	Problems based on epistatic gene interactions- 9:7 and 9:3:4 ratios	4
6.	Problems based on epistatic gene interactions- 12:3:1 and 15:1 ratios.	4
7.	Problems based on sex-linked inheritance in Man (based on theory syllabus).	8
8.	Problems based on sex-linked inheritance in Drosophila (based on theory syllabus).	4
9.	Study of - Down's syndrome and Klinefelter's syndrome using photocopies	4
10.	Study of Turner's, Papau's and Edward's syndrome using photocopies.	4
11.	Perform hybridization experiment in any locally available flowering plant- emasculation, pollination and bagging.	4
12.	Demonstration of mutational breeding (with reference to Groundnut)	4
13.	Visit to any Agricultural University to study plant breeding experiments.	4
14.	Excursion/ study tour (long).	4
	Total	**60**

Text Books and Reference Books:

1. Baig MMV, SS Ingle & SM Telang (2013) Fundamentals of Cell and Molecular Biology, Genetics and Plant Breeding, Aruna Publications, Latur.
2. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
3. Gupta, P.K. (2010). Cytogenetics. Rastogi Publications, Meerut, India.
4. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
5. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
6. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company
7. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
8. Veer Bala Rastogi (2019) Genetics 4th Edition. Medtech Publications.
9. Verma P.S. and Agarwal V.K,Genetics, 9th Edition, S.Chand and co

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B.Sc. Botany, II Year (Semester - IV)

Minor Theory Course

Course Code – SBOTMT1251

Title of the Course: DIVERSITY OF PHANEROGAMS

[No. of Credits: 2 Credit] **[Total:30Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year level for entry level core courses in Botany as minor subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of Phanerogams.
2. To study the evolution and distribution of seed plants.

Course outcomes:

1. Students understand the classification, morphology and anatomy of seed plants
2. Students learn the about process of evolution of seed plants.
3. Students know the importance of Gymnosperms and Angiosperms for human welfare.

CURRICULUMDETAILS: SBOTMT 1251: Diversity of Phanerogams

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Gymnosperms - I**	
	1.1	General characters of Gymnosperms	
	1.2	Classification of Gymnosperms (K. R. Sporne, 1964)	**08**
	1.3	Morphology of vegetative structures, anatomy of stem (primary and secondary growth) and anatomy of leaf of *Cycas*	
	1.4	Reproductive structures and life cycle (developmental stages are not expected) and economic importance of *Cycas*	
2.0		**Gymnosperms - II**	
	2.1	Morphology of vegetative structures of *Pinus*.	
	2.2	Anatomy of stem (primary and secondary growth) and anatomy of leaf of *Pinus*;	**07**
	2.3	Reproductive structures and life cycle (developmental stages are not expected) of *Pinus*	
	2.4	Economic importance of *Pinus*	
3.0		**Angiosperms - I**	
	3.1	Aims and scope of Taxonomy; Binomial nomenclature	**07**

	3.1	Types of classification-artificial, natural and phylogenetic.	
	3.2	Outline of Bentham and Hooker's System of Classification of Angiosperms with merits and demerits.	
	3.3	Root: Definition, characters, types (tap root and adventitious) and functions. Stem: Definition, characters and functions. Leaf: Definition, functions, types- simple (*Hibiscus*), compound (unipinnate, bipinnate, tripinnate, unifoliate, bifoliate, trifoliate, multifoliate), venation- definition, types (reticulate, parallel).	
	3.4	Inflorescence: Definition, types- Racemose (characters), Cymose (characters). Flower: Definition, symmetry-actinomorphic, zygomorphic, types (hypogynous, epigynous, perigynous). Structure of typical flower (*Hibiscus*): calyx (polysepalous, gamosepalous), corolla (polypetalous, gamopetalous).	
4.0		**Angiosperms - II**	
	4.1	Structure of typical flower (*Hibiscus*): androecium (parts of a stamen), gynoecium –structure of carpel, apocarpous, syncarpous, placentation (axile, parietal, marginal, basal)	
	4.2	Fruit: Definition, forms- simple (dry, legume, fleshy, berry), aggregate (etaerio of berries), composite (sorosis).	**08**
	4.3	Systematic position and distinguishing characters of family Fabaceae and Solanaceae	
	4.4	Systematic position and distinguishing characters of family Poaceae	
		Total	**30**

TextBooks and References Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
2. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol II., Rastogi Publications, Meerut.
3. Chamberlain, C. J. (1957). Gymnosperms Structure and Evolution. University Chicago Press, New York.
4. Chopra G.W & Verma Y (1998) Gymnosperms. Pradeep Publications, Jalandhar.
5. Hutchinson, J. (1973) The families of flowering plants. Oxford University Press, London.
6. Kumar NC (1995) An introduction to Taxonomy of Angiosperms; Himalaya Publishing House, Mumbai
7. Naik VN (1989) Taxonomy of Angiosperms; Tata MacGraw Hill, New Delhi.
8. O.P. Sharma (2017) Plant Taxonomy; Mc Graw Hill Learning
9. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
10. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company.
11. Pandey B.P. (2000) College Botany Vol-II (Pteridophyta, Gymnosperms, Paleobotany) S. Chand & Co. New Delhi.
12. Pandey B.P. Text book of Botany Gymnosperms S. Chand & Co. Ltd. New Delhi.
13. Pandey BP (2000) Taxonomy of Angiosperm; S. Chand & Co., New Delhi.
14. Pandey BP (2013) Taxonomy of Angiosperms; S. Chand Publication
15. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
16. Sharma O.P (1997) Gymnosperms. Pragati Prakashan, Meerut, India.

17. Singh, V. and Jain, V.K. (1989) Taxonomy of Angiosperms. Rastogi Publication, Meerut.
18. Sivarajan, V.V. (1989) Introduction to principles of plant Taxonomy. Oxford and IBH, New Delhi.
19. Sporne, K. R. (1974). The Morphology of Gymnosperm. B.I. Publications, New Delhi.
20. Subramaniyam, N.S. (1995) Modern Plant Taxonomy. Vikas Publishing House, New Delhi.
21. Sutaria RN (1970) A text book of Systematic Botany; Khadayata Book Depot, Ahmedabad
22. Varma BK (2023) Introduction to Taxonomy of Angiosperms PHI Learning Ltd.
23. Vashishta, B. R. *et al*. (2014). Botany for Degree Students – Gymnosperms. S. Chand and Co.Ltd., New Delhi.
24. Vashista, P.C. (1990) – Taxonomy of Angiosperms – S. Chand & Co., New Delhi.

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B.Sc. Botany, II Year (Semester - IV)

Minor Practical Course

Course Code – SBOTMP1251

Title of the Course: Practical based on SBOTMT 1251

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year level for entry level core courses in Botany as minor subject.
2. The students should have basic knowledge of plant science.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of phanerogams
2. To study the evolution and distribution of seed plants.

Course outcomes:

1. Students understand the classification, morphology and anatomy seed plants
2. Students learn the about process of evolution of seed plants.
3. Students know the importance of Gymnosperms and Angiosperms for human welfare.

CURRICULUMDETAILS: SBOTMP 1251: Practical based on SBOTMT 1251

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of Identification, systematic position and morphology (external) of *Cycas*	4
2.	Study of internal structure of *Cycas* (T.S. of leaflet and T.S. of stem)	4
3.	Study of male cone and female cone of *Cycas*	4
4.	Study of identification, systematic position and morphology (long shoot, dwarf shoot) of *Pinus*	4
5.	Study of internal structure of *Pinus* (T.S. of needle and T.S. of stem)	4
6.	Study of male cone and female cone of *Pinus*	4
7.	Study of morphology and types of roots (as per theory paper); morphology of stem (as per theory paper)	4
8.	Study of morphology of leaves ((as per theory paper)	4
9.	Study of types of inflorescences (as mentioned in theory paper)	4
10.	Study of morphology of flowers (as per theory paper)	4
11.	Systematic position and distinguishing characters of family Fabaceae	4
12.	Systematic position and distinguishing characters of family Solanaceae	4
13.	Systematic position and distinguishing characters of family Poaceae	4
14.	Excursion/ study tour for specimen collection	4
15.	Excursion/ study long tour.	4

	Total	**60**

Text Books and Reference Books:

1. Bendre and Kumar (1997). A Textbook of Practical Botany, Vol I., Rastogi Publications, Meerut.
2. Pandey B. P. (2019) Modern Practical Botany Vol. I, S. Chand and Company.
3. Pandey B. P. (2019) Modern Practical Botany Vol. II, S. Chand and Company
4. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai

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B.Sc. Botany, II Year (Semester - IV)

Generic Elective Course

Course Code – SBOTGE 1251

Title of the Course: PLANTS AND HUMAN WELFARE-II

[No. of Credits: 2 Credit] **[Total:30 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences
2. The students should have basic knowledge of plant science.

Course objectives:

1. To inculcate concepts of economically important plants.
2. To understand economically importance of plants.
3. To increase employability of the students.

Course outcomes:

1. Understanding the economically important plants.
2. Understanding the potential of plants for human welfare
3. Understanding the role of plants in human health.

CURRICULUMDETAILS: SBOTGE 1251: Plants and Human Welfare-II

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Fruit Plants**	**07**
	1.1	Botanical description, nutritional value and uses of Watermelon, Muskmelon	
	1.2	Botanical description, nutritional value and uses of Mango, Banana, Papaya	
	1.3	Botanical description, nutritional value and uses of Grapes, Apples, Custard apple and Pomegranate	
	1.4	Botanical description, nutritional value and uses of Citrus fruits (Lemon, Santra, Mausami)	
2.0		**Spices and Fiber Plants**	**8**
	2.1	Botanical description, nutritional value and uses of Spices plants- Coriander, Cumin.	
	2.2	Botanical description, nutritional value and uses of Spices plants- Black Pepper, Cardamom and Cinnamon	
	2.3	Botanical description, nutritional value and uses of Spices plants- Turmeric, Ginger and Garlic.	
	2.4	Botanical description, and uses of Fibre plants- Cotton, Sun-hemp and Jute	
3.0		**Beverage and Timber Plants**	**07**
	3.1	Botanical description, nutritional value and uses of Beverage plant-Tea	
	3.2	Botanical description, nutritional value and uses of Beverage plant- coffee	
	3.3	Botanical description, and uses of Timber plant- Teak	

	3.4	Botanical description, and uses of Timber plant- Neem and Babul	
4.0		**Industrially Important Plants**	**08**
	4.1	Botanical description and uses of Sugarcane and Bamboo plants	
	4.2	Botanical description and uses of Tobacco plant	
	4.3	Botanical description and uses of Coconut and castor oil plant (*Ricinus*)	
	4.4	Botanical description and uses of Indian Rubber plant (*Ficus*)	
		Total	**30**

Text Books and Reference Books:

1. Pandey B.P. (1999) Economic Botany S. Chand Publishing House.
2. O.P. Sharma (2020) Economic Botany, Pragati Prakashan Meerut
3. S. L. Kocchar (2016) Economic Botany : A Comprehensive Study, Cambridge India.
4. R. L. Prasad (2022) Essentials of Economic Botany, Medtech Publications.
5. Sudipa Nag (Mandal) and Alokesh Das Subrata Mandal (2021) Handbook of Economic Botany, New Delhi Publishers.
6. V. Singh, Dr. P.C. Pande and D.K. Jain (2018) Economic Botany (B-56) Rastogi Publications
7. Sammbamurty and Subramanyam (2018) A Textbook of Modern Economic Botany , CBS Publishers
8. Verma V (2009) Text Book of Economic Botany, Ane Books Prit Ltd.

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B.Sc. Botany, II Year (Semester - IV)

Vocational Course

Course Code – SBOTVC1251

Title of the Course: BIO-PESTICIDE AND PEST MANAGEMENT

[No. of Credits: 2 Credit] **[Total:60 Hours]**

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year programme in the Faculty of Science and Technology who had primary training in the field of plant sciences at undergraduate first year level for entry level core courses in Botany as Skill Enhancement Course.
2. The students should have basic knowledge of plant science, microbes and environment.

Course objectives:

1. To inculcate concepts of *Bio-pesticide and Pest Management.*
2. To understand techniques in *Bio-pesticide preparation*.
3. To increase employability of the students.
4. To improve the soil quality by promoting the bio-pesticide.

Course outcomes:

1. Understanding the role of organic farming.
2. Understanding the potential of Bio-pesticide as an alternative to chemical pesticide
3. Role of bio-pesticidein protecting the environment and managing the waste.

CURRICULUMDETAILS: SBOTVC 1251: Bio-pesticide and Pest Management

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Introduction, Advatages of biopesticides, Types of biopesticides (Microbial Pesticides: *Bacillus thuringiensis, Agrobacterium radiobacter* (Agrocin), *Pseudomonas fluorescens* (Phenazine), *Trichoderma*).	4
2.	Plant-incorporated-protectants (PIPs); Botanical pesticides (Neemoil, Rotenone and Tobacco suspension)	4
3.	Biochemical pesticides; Biotic agents/Natural enemies (Predators, Parasitoids)	4
4.	Active ingredients of biopesticides, advantages over chemical pesticides, availability of biopesticides in the market, bioavailability and environmental safety.	4
5.	Commercialization of biopesticide, regulatory barriers, economic effects. Environmental monitoring agencies including (PCB, NGT, FDA, WHO) and their guidelines.	4
6.	Integrated pest management, biological pest control, natural methods, pest predators, importance of pest management.	4
7.	Physical, chemical, biological, genetic, natural and cultural methods for pest control, seed treatments, soil application, foliar spray, BT crops.	4

8.	Biopesticide formulations, wettable powders, dry formulations, dustable powders, granules, water dispersible granules, emulsion, suspension, etc.	4
9.	Method of applications of pesticide formulations, seed treatment, foliar spray, seedling dipping, powdered spray, quantity and quality of biopesticide formulation and uses.	4
10.	Application of biopesticides, importance of biopesticides, need of biopesticide, development and regulation, benefits to growers and consumers.	4
11.	Visit and record the data of various pesticide shops in market	4
12.	Survey of the availability of pesticides and biopesticides.	4
13.	Visit to the agriculture field and interaction with the farmers to get their views on biopesticides	4
14	Survey the use of pesticides, their types and frequency of application per Crop.	4
15	Visit to the Krishi Vikas Kendra to collect the information about the uses of pesticide and biopesticides.	4
	Total	**60**

Text Books and Reference Books:

1. G. K. Ghosh, Biopesticide & Integrated Pest Management. APH Publishing, New Delhi, 2000
2. Nick Birch and Travis Glare. Biopesticides for Sustainable Agriculture. Burleigh Dodds Science Publishing Limited
3. Matthews GA, Bateman RP, Miller PCH (2014) Pesticide Application Methods (4th Edition), Chapter 16. Wiley, UK.
4. Copping, Leonard G (2009). The Manual of Biocontrol Agents: A World Compendium. BCPC.
5. Dent, Dr. Michael (2020). Biostimulants and Biopesticides 2021-2031: Technologies Markets and Forecasts. IDTechEx
6. Canan Usta (2013). Microorganisms in Biological Pest Control - A Review (Bacterial Toxin Application and Effect of Environmental Factors). Current Progress in Biological Research, Marina Silva-Opps,

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