



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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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण-२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६-२७ पासून लागू करण्याबाबत.

परिपत्रक

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २२ एप्रिल २०२६ रोजी संपन्न झालेल्या मा.विद्यापरिषद बैठकीतील विषय क्र.०८/६४-२०२६ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण-२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६-२७ पासून लागू करण्यास मा.विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी.एस्सी. तृतीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६-२७ पासून लागू करण्यात येत आहे.

01	B.Sc. III Year Botany	10	B.Sc. III Year Biochemistry
02	B.Sc. III Year Chemistry	11	B.Sc. III Year Agriculture Microbiology
03	B.Sc. III Year Mathematics	12	B.Sc. III Year Electronics
04	B.Sc. III Year Zoology	13	B.Sc. III Year Seed Technology
05	B.Sc. III Year Microbiology	14	B.Sc. III Year Horticulture
06	B.Sc. III Year Geology	15	B.Sc. III Year Analytical Chemistry
07	B.Sc. III Year Environment & Earth Science	16	B.Sc. III Year Agrochemical & Fertilizers
08	B.Sc. III Year Statistics	17	B.Sc. III Year Industrial Chemistry
09	B.Sc. III Year Dairy Science	18	B.Sc. III Year Industrial 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.

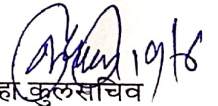
'ज्ञानतीर्थ' परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.:शे-१ / परिपत्रक / पदवी / बीएस्सी / २०२६-२७ / 60

दिनांक : १९.०६.२०२६




सहा कुलसचिव

शैक्षणिक (१-अभ्यासमंडळे) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :-

- १) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
- २) मा. प्र.कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ
- ३) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
- ४) मा. संचालक, परिक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
- ५) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.



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



**UNDERGRADUATE PROGRAMME OF
SCIENCE & TECHNOLOGY**

B.Sc. Third Year

BOTANY

(For Affiliated Colleges)

**Effective from Academic year 2026 – 2027
(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 Marathwada University, Nanded**

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

PREAMBLE

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 (V/SEC). 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 B.Sc. Botany offers knowledge of areas including Plant Systematics, Plant Tissue Culture, Basic Botany, Genetics, Ecology, Conservation biology, Physiology and Bioinformatics, Medicinal plants, Plant diseases management, Skill enhancement Coerces 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 aim 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. Instil 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 Mahavidyalaya, Nanded	7588151967
2	Dr. Babasaheb Shivmurti Surwase	Member	School of Life Sciences, S.R.T.M.U. Nanded	9075829767
3	Dr Vijay Tulshiram Gorgile	Member	Shahir Annabhau Sathe Mahavidyalaya, Mukhed	9421762073
4	Dr. Sudhakar V. Chate	Member	Shivaji College, Udgir	8421241300
5	Dr. Suresh Manoharrao Telang	Member	Yeshwant Mahavidyalaya, Nanded	9822174684
6	Dr. R. M. Kadam	Member	M. G. M. Ahmedpur, Tq. Ahmedpur, Dist. Latur.	9422657976
7	Dr. Sopan Dnyanoba Dhavale	Member	Shahir Annabhau Sathe Mahavidyalaya, Mukhed,	9423614703
8	Dr. Sanjay Marotrao Dalvi	Member	Shri Guru Buddhiswami Mahavidyalaya, Purna (Jn),	9921101210
9.	Dr. Prashant A. Gawande	Professor from other University	Sant Gadge Baba Amravati University, Amravati.	9403622568
10	Dr. Ambadas Sheshrao Kadam	Experts	DSM College Parbhani.	8329151172
11	Dr. Kanhaiya Ranganathrao Kadam	Experts	K.K. Herbal Industries, Gut No. 252, Naleshwar Road, Limbgaon, Nanded.	9420261080
12	Bindu Maurya	Experts	07, Mangal Pravesh building Polt. C-16 Sector-3 Airoli, Navi Mumbai.	9987591561
13	Shri Bhanudas Balajirao Pendkar	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.III Year

Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: **BOTANY** (Major)

Year & Level	Sem ester	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)	FieldProject/ Case Study/ OJT/	Credits	Total Credits
1	2	3		4	5	6	7	8	9	10	11
3 (5.5)	V	SBOTCT 1301 (3cr) SBOTCT 1302 (3cr) SBOTIK 1303 (2cr) SBOTCP 1301 (2cr) SBOTCP 1302 (2cr) 12 Credits	Major Elective SBOTET 1301 (2cr) SBOTEP 1301 (2cr) 04 Credits	--	--	--	SBOTVC1301 02 Credits	--	FP/CS SBOTFP1301 Or SBOTCS1301 04 Credits	22	132
	VI	SBOTCT1351 (3cr) SBOTCT1352 (3cr) SBOTCT 1353 (2cr) SBOTCP1351 (2cr) SBOTCP1352 (2cr) 12 Credits	Major Elective SBOTET 1351 (2cr) SBOTEP 1351 (2cr) 04 Credits	--	--	--	SBOTVC1351 02 Credits	--	OJT SBOTOT1351 04 Credits	22	
	Cum. Cr.	56		16	08	08	08+4=12	22	08+2=10	44	
<p>Exit option: UG Diploma in Major <u>Botany</u> and Minor <u>Botany</u> on completion of 88 credits and additional 4 credits NSQF / internship in Botany</p>											



B. Sc. Third Year Semester V (Level 5.5)

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SBOTCT 1301	Plant Physiology	03	--	12	03	--
	SBOTCT 1302	Plant Histology Anatomy and Embryology	03	--		03	--
	SBOTIK 1303	Indian Botanical Heritage (IKS)	02	--		02	--
	SBOTCP 1301	Practical Based on SBOTCT 1301	-	02		--	04
	SBOTCP 1302	Practical Based on SBOTCT 1302		02		--	04
Elective	SBOTET 1301	Plant Systematics-I OR	02	--	02	02	--
	SBOTET 1302	Plant Pathology-I OR					
	SBOTEP 1301	Practical Based on SBOTET 1301	--	02	02	--	04
	SBOTEP 1302	Practical Based on SBOTET 1302					
Vocational Course	SBOTVC1301	Biocompost Technology	--	02	02	--	04
Field Project/ Case Study/ OJT	SBOTFP1301 Or SBOTCS1301	Field Project/ Case Study	--	04	04	--	08
Total Credits 22			10	12	22	10	24



B. Sc. Third Year Semester V (Level 5.5)

Examination Scheme

[40% Continuous Assessment (CA) and 60% 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 (7+8) / Col (9+10) (11)	
			Continuous Assessment (CA)			ESA	CA (9)	ESA (10)		
			Test (4)	Assignment, Presentation, Viva, Quiz, Open Book (5)	Attendance (6)	Total (4+5+6) (7)				Total (8)
Major	SBOTCT 1301	Plant Physiology	15	09	06	30	45	--	--	75
	SBOTCT 1302	Plant Histology Anatomy and Embryology	15	09	06	30	45	--	--	75
	SBOTIK 1303	Indian Botanical Heritage (IKS)	10	06	04	20	30	--	--	50
	SBOTCP 1301	Practical Based on SBOTCT 1301	--	--	--	--	--	20	30	50
	SBOTCP 1302	Practical Based on SBOTCT 1302	--	--	--	--	--	20	30	50
Elective	SBOTET 1301	Plant Systematics-I OR	10	06	04	20	30	--	--	50
	SBOTET 1302	Plant Pathology-I OR								
	SBOTEP 1301	Practical Based on SBOTET 1301 OR	--	--	--	--	--	20	30	50
	SBOTEP 1302	Practical Based on SBOTET 1302 OR	--	--	--	--	--	20	30	50
Vocational Course	SBOTVC1301	Biocompost Technology	--	--	--	--	--	20	30	50
Field Project/ Case Study/ OJT	SBOTFP1301 Or SBOTCS1301	Field Project/ Case Study	--	--	--	--	--	40	60	100



B. Sc. Third Year Semester VI (Level 5.5)

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SBOTCT 1351	Plant Metabolism and Biochemistry	03	--	12	03	--
	SBOTCT 1352	Gymnosperm and Paleobotany	03	--		03	--
	SBOTCT 1353	Plant Resource Utilization	02	--		02	--
	SBOTCP 1351	Practical Based on SBOTCT 1351	-	02		--	04
	SBOTCP 1352	Practical Based on SBOTCT 1352		02		--	04
Elective	SBOTET 1351	Plant Systematics-II OR	02	--	02	02	--
	SBOTEP 1352	Plant Pathology-II OR					
	SBOTEP 1351	Practical Based on SBOTET 1351 OR	--	02	02	--	04
	SBOTET 1352	Practical Based on SBOTET 1352 OR					
Vocational Course	SBOTVC1351	Nursery Management	--	02	02	--	04
Field Project/ Case Study/ OJT	SBOTOT1351	OJT	--	04	04	--	08
Total Credits 22			10	12	22	10	24



B. Sc. Third Year Semester VI (Level 5.5)

Examination Scheme

[40% Continuous Assessment (CA) and 60% 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)	CourseName (3)	Theory				Practical		Total Col (7+8) / Col (9+10) (11)	
			Continuous Assessment (CA)			ESA	CA (9)	ESA (10)		
			Test (4)	Assignment, Presentation, Viva, Quiz, Open Book (5)	Attendance (6)	Total (4+5+6) (7)				Total (8)
Major	SBOTCT 1351	Plant Metabolism and Biochemistry	15	09	06	30	45	--	--	75
	SBOTCT 1352	Gymnosperm and Paleobotany	15	09	06	30	45	--	--	75
	SBOTCT1353	Plant Resource Utilization	10	06	04	20	30	--	--	50
	SBOTCP 1351	Practical Based on SBOTCT 1351	--	--	--	--	--	20	30	50
	SBOTCP 1352	Practical Based on SBOTCT 1352	--	--	--	--	--	20	30	50
Elective	SBOTET 1351	Plant Systematics-II OR	10	06	04	20	30	--	--	50
	SBOTEP 1352	Plant Pathology-II OR								
	SBOTEP 1351	Practical Based on SBOTET 1351 OR	--	--	--	--	--	20	30	50
	SBOTET 1352	Practical Based on SBOTET 1352 OR	--	--	--	--	--	20	30	50
Vocational Course	SBOTVC1351	Nursery Management	--	--	--	--	--	20	30	50
Field Project/ Case Study/ OJT	SBOTOT1351	OJT	--	--	--	--	--	40	60	100

Syllabus for B. Sc. Botany
Third Year
Semester – V
As Per National Education Policy- 2020

To be implemented from
Academic Year 2026-2027

National Education Policy 2020
B.Sc. Botany, III Year (Semester - V)
Major Core Theory Course
Course Code – SBOTCT1301

Title of the Course: PLANT PHYSIOLOGY

[No. of Credits: 3 Credit]

[Total:45 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course Objectives:

- To make students realize how plants function, namely the importance of water, minerals, hormones, and light in plant growth and development; understand transport mechanisms and translocation in the phloem, applications of plant physiology.
- To acquaint the students with the types and their functions of different biomolecules and secondary metabolites
- To know the role of different plant growth regulators in plant physiology.

Course Outcomes:

- Students will gain the knowledge of water and nutrient uptake, movement in plants, role of mineral elements, translocation of sugars, role of various plant growth regulators, phytochrome in plants.
- Students will learn different types of biomolecules and secondary metabolites
- Students will learn the flowering physiology, vernalization and seed dormancy in plants.

Curriculum Details: SBOTCT 1301-Plant Physiology

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		PLANT WATER RELATIONS	12
	1.1	Scope and Importance of Plant Physiology; Physical and Chemical Properties of water.	
	1.2	Phenomenon and Importance of Diffusion, DP, DPD; Osmosis-OP, Exostosis, Endosmosis; Plasmolysis; Imbibition; Concept of Water Potential.	
	1.3	Mechanism of water absorption by root: active and passive absorption; Ascent of sap: Introduction and mechanism (transpiration pull theory)	
	1.4	Transpiration: Definition, types of stomata, structure of stomata, mechanism of opening and closing of stomata (starch-sugar theory and K ⁺ pump theory), guttation, antitranspirants. Significance of transpiration.	
2.0		MINERAL NUTRITION AND SOLUTE TRANSPORT	11
	2.1	Major and Minor elements: Introduction, source, deficiency symptoms and their role.	

2.2	Foliar nutrition; Concept of hydroponic technique.	
2.3	Mineral salt absorption: Introduction, mechanism of passive absorption (ion exchange theory) and active absorption (carrier concept theory)	
2.4	Translocation of organic solutes: Introduction, mechanism of translocation (Munch-Mass Flow hypothesis)	
3.0	PHYTOCHROMES AND SENSORY PHOTOBIOLOGY	
3.1	Phytochromes: Properties of Phytochromes; Red and far-red light responses on photomorphogenesis; Photo-morphogenesis: Photo receptors, phytochrome, crypto-chrome	10
3.2	Phenomenon of Photoperiodism (LDP, SDP and DNP); Introduction and mechanism of Vernalization and Devernalization.	
3.3	Seed germination: Introduction, types and mechanism of seed germination; Seed dormancy: Introduction, causes of seed dormancy and methods of breaking seed dormancy.	
3.4	Plant Movement: Introduction and types of plants movement.	
4.0	HORMONAL PHYSIOLOGY	
4.1	Introduction, phases of growth, measurement of growth (Arc indicator and Pfeiffer's auxanometer), factors affecting growth; Introduction and classification of Plant Growth Regulators.	12
4.2	Plant Growth Promoters: Chemical nature and practical applications of Auxins, Gibberellins, Cytokinins.	
4.3	Plant Growth Inhibitors: Chemical nature and practical applications of, Abscisic Acid and Ethylene. Circadian Rhythms in plants.	
4.4	Introduction to Senescence and Abscission; Role of hormones in fruit ripening.	
	Total	45

Text Books and Reference Books:

1. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
2. Kochhar, S.L., Gujral, S.K. (2017). Plant Physiology: Theory and Applications. New Delhi, Delhi: Foundation Books, Cambridge University Press India Pvt, Ltd.
3. Lincoln Taiz and Eduardo Zeiger, 2002. Plant Physiology 2nd edition, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.
4. Lincoln Taiz and Eduardo Zeiger. Plant Physiology 5th Edition. Sunderland, Massachusetts, USA, 2010.
5. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nded). Springer Verlag, New York, USA.
6. Noggle G.R. and Fritz G. J., 1986 Introductory Plant Physiology Prentice Hall.
7. India. Private Ltd. Delhi, 1992. Performance, in Cultivation, MacMillan Education. Sydney, Australia, 1999.
8. Raven, P.H., Evert, R.F. and Eichhorn, S. Biology of Plants (5th edition). Worth, New York, 1992. RGS. Plant Physiology. MacMillan Publishing Co., New Delhi, 1972.
9. Salisbury, C. B and Ross C.W. Plant Physiology, CBS Publication and Distributions, Delhi, 1986.
10. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development, 6th edition. New York, NY: Oxford University Press, Sinauer Associates.
11. Jain V. K (2022) Fundamentals of Plant Physiology S. Chand Publication New Delhi.
12. Pande S. N and Sinha B. K. (2010) Plant Physiology Vikas Publication

National Education Policy 2020
B.Sc. Botany, III Year (Semester - V)
Major Core Practical Course
Course Code – SBOTCP 1301

Title of the Course: Practical Based on SBOTCT 1301

[No. of Credits: 2 Credit]

[Total: 60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To acquire laboratory skills of performing plant physiology practicals
- To get practical knowledge of process like osmosis, diffusion, imbibition & seed germination.
- To understand mineral requirement for plant growth.

Course outcomes:

- Students will understand how to perform plant physiology practicals.
- They will practically understand importance of different minerals for the growth of plants.
- Will get knowledge about seed germination and different water dependent plant processes.

Curriculum details: SBOTCP 1301: Practical Based on SBOTCT 1301

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	To demonstrate movement of water through xylem (ringing experiment)	4
2.	To determine the water potential of potato tuber	4
3.	To determine the osmotic potential of vacuolar sap by plasmolysis method	4
4.	To study the effect of temperature on permeability of plasma membrane (Beet root) by using colorimeter or spectrophotometer.	4
5.	To study the effect of different organic solvents on permeability of plasma membrane (Beet root) by using colorimeter or spectrophotometer.	4
6.	To study the effect of concentration of different organic solvents on permeability of plasma membrane (Beet root) by using colorimeter or spectrophotometer.	4
7.	Determination of percentage of seed germination of any available seed material by suitable technique.	4
8.	Study and microscopic observation of different stomata.	4
9.	Study of imbibition of seed.	4
10.	To study the mineral deficiency symptoms of Major elements in at least two locally available plants	4
11.	To study the mineral deficiency symptoms of Minor elements in at least two locally available plants	4

12.	To study the effect of different concentration of auxin (IAA) on the germination and seedling growth of Cicer (chickpea) seeds.	4
13.	Demonstration of osmosis by potato osmoscope.	4
14	Demonstration of transpiration by bell jar method or by cobalt-chloride method	4
15	Measurement of vertical plant growth by Auxanometer.	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. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
5. Kochhar, S.L., Gujral, S.K. (2017). Plant Physiology: Theory and Applications. New Delhi, Delhi: Foundation Books, Cambridge University Press India Pvt, Ltd.
6. Raven, P.H., Evert, R.F. and Eichhorn, S. Biology of Plants (5th edition). Worth, New York, 1992. R.G.S. Plant Physiology. MacMillan Publishing Co., New Delhi, 1972.
7. Jain V. K (2022) Fundamentals of Plant Physiology S. Chand Publication New Delhi.
8. Pande S. N and Sinha B. K (2010) Plant Physiology Vikas Publication.

National Education Policy 2020
B.Sc. Botany, III Year (Semester - V)
Major Core Theory Course
Course Code – SBOTCT1302

Title of the Course: PLANT HISTOLOGY, ANATOMY AND EMBRYOLOGY

[No. of Credits: 3 Credit]

[Total:45 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credit.

Course objectives:

- To know about various types of tissues in plants and their organization.
- To obtain awareness on anomalous secondary growth in plants and economic value of woods.
- To acquire knowledge on pollination, fertilization and development of male and female gametophytes in plants.

Course outcomes:

- Students will learn various tissues and evaluate their role in plants.
- Students acquire knowledge of anatomy of primary structure, secondary growth in plants.
- Students will understand pollination, fertilization and development of male and female gametophytes in plants.

Curriculum Details: SBOTCT 1302- Plant Histology, Anatomy and Embryology

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		PLANT HISTOLOGY	
	1.1	Introduction to Histology and plant tissues, Meristematic Tissues: Definition, classification based on origin, function, position and development, organization of root apical meristem (RAM) and shoot apical meristem (SAM), Apical cell theory, Histogen theory and Tunica corpus theory.	12
	1.2	Permanent Tissues: Simple Tissues- Parenchyma, Collenchyma, Sclerenchyma. Complex Tissues- Xylem and Phloem	
	1.3	Secretory Structures in Plants: Laticiferous tissues (Latex cells and vessels), glandular tissues (External glands-digestive glands, nectary glands & internal glands-Oil glands, hydathodes)	
	1.4	Adaptive & Protective systems in plants: Epidermis, cutin, cuticle & other types of coverings, epidermal appendages.	
2.0		PLANT ANATOMY	
	2.1	Introduction: Definition and scope, Primary Structure of Root, Stem and Leaf of Monocot (Maize) and Dicot (Sunflower).	11
	2.2	Secondary growth in Root and Stem of Dicot (Sunflower). Periderm, bark and Lenticels.	
	2.3	Anomalous secondary growth in Dicot (Bignonia) and Monocot (Dracaena).	

	2.4	Wood Anatomy- Annual rings, Wood Elements, heartwood and sapwood, Springwood, Summer wood. Economic importance of wood. Dendrochronology.	
3.0		PLANT EMBRYOLOGY-I	
	3.1	Introduction: Definition and scope of Plant Embryology. Microsporangium: Structure of typical Anther, Microsporogenesis, Structure of Pollen grain. Development of male gametophyte.	10
	3.2	Megasporangium: Structure of typical ovule; Types of ovules: Orthotropous, Anatropous, Hemianatropous, and Camphyotropous; Megasporogenesis; Structure of Embryo sac (Female gametophyte) in flowering plants.	
	3.3	Development of Monosporic (<i>Polygonum</i> type), Biosporic (<i>Allium</i> Type) and Tetrasporic (<i>Adoxa</i> type) female gametophyte.	
	3.4	Pollination: Definition, Types and Agencies (Pollinators)	
4.0		PLANT EMBRYOLOGY-II	
	4.1	Fertilization-Double fertilization and triple fusion. Significance of double fertilization.	12
	4.2	Endosperm- Definition; Types of endosperms- Nuclear, Cellular, Helobial.	
	4.3	Embryo: Development of Monocot embryo (Sagittaria type) and Dicot embryo (Crucifer type).	
	4.4	Post Fertilization Changes-Development of seed and fruit. A brief account of Apomixis and Parthenocarpy.	
		Total	45

Text Books and Reference Books:

1. Agarwal, S. B. 1990 Embryology of Angiosperms - a fundamental approach. Sahitya Bhawan, Agra.
2. Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) A Text Book of Botany, Volume-II, New Central Book Agency Pvt. Ltd., Kolkata
3. Bhojwani S. S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi
4. Dwivedi, J. N. 1998 Embryology of Angiosperms. Rastogi and Co., Meerut.
5. Johri, B.M. (2011) Embryology of Angiosperms. Springer-Verlag, Berlin
6. Maheswari, P. (1971) An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London.
7. Maheshwari, P. 2015. An Introduction to the Embryology of Angiosperms, Scholar Select Publishers.
8. Pandey, B.P. (2013) College Botany, Volumes-II& III, S. Chand Publishing, New Delhi
9. Pandey, A.K., 1997. Introduction to Embryology. CBS Publishers and Distributors, New Delhi
10. Pandey, A. K. (2000) Introduction to Embryology of Angiosperms. CBS Publishers & Distributors Pvt.Ltd., New Delhi
11. Pandey, B. P. 1989 Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
12. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House Pvt. Ltd., , New Delhi
13. Ray F. Evert, 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. John Wiley & Sons.
14. Shivanna, K. R. 2003. Pollen Biology and Biotechnology. Oxford and IBH publishing house, New Delhi.

National Education Policy 2020
B.Sc. Botany, III Year (Semester - V)
Major Core Practical Course
Course Code – SBOTCP 1302

Title of the Course: Practical Based on SBOTCT 1302

[No. of Credits: 2 Credit]

[Total:60 Hours]

Coursepre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To know about various types of tissues in plants and their organization.
- To obtain awareness on anomalous secondary growth in plants and economic value of woods.
- To acquire knowledge on pollination, fertilization and development of male and female gametophytes in plants.

Course outcomes:

- Students will learn various tissues and evaluate their role in plants.
- Students acquire knowledge of anatomy of primary structure, secondary growth in plants.
- Students will understand pollination, fertilization and development of male and female gametophytes in plants.

Curriculum details: SBOTCP 1302: Practical Based on SBOTCT 1302

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of Meristematic tissues: Study of root apex and shoot apex in plants (with the help of slides/ models/ charts /photocopies).	4
2.	Study of Simple Permanent Tissues- Parenchyma, collenchyma, Sclerenchyma (with the help of permanent slides / photocopies)	4
3.	Study of Complex Permanent Tissues- Xylem and Phloem (with the help of permanent slides / photocopies)	4
4.	Study of distribution of stomata on upper and lower epidermis of leaf (Dicot & Monocot) and to calculate stomatal index.	4
5.	Study of Secretary Tissues with the help of slides/models/charts /photocopies.	4
6.	Study of anatomy of Maize stem and preparation of its double stained permanent slide.	4
7.	Study of anatomy of Sunflower stem and preparation of its double stained permanent slide.	4
8.	Study of anomalous secondary growth in Dracaena and Bignonia and preparation of their double stained permanent slides.	4
9.	Study of Leaf anatomy by making temporary slides of dicot leaf (Sunflower) and monocot leaf (Maize).	4
10.	Study of anatomy of dicot root (Sunflower) and monocot root (Maize) and preparation of their double stained permanent slides.	4

11.	Study of T.S. of anther (<i>Datura</i> flower)	4
12.	Study of pollen germination and to calculate percentage of pollen germination (any available flowers).	4
13.	Study of types of ovules (as mentioned in theory syllabus) (Permanent slides/models/ photocopies).	4
14.	Study embryo (monocot & dicot) and structure of embryo sac (L.S. of female gametophyte) (Permanent slides or models/ photocopies)	4
15.	One short and one long Botanical excursion are compulsory (to study the types of pollination in nature)	4
	Total	60

Text Books and Reference Books:

1. Agarwal, S. B. 1990 Embryology of Angiosperms - a fundamental approach. Sahitya Bhawan, Agra.
2. Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) A Text Book of Botany, Volume-II, New Central Book Agency Pvt. Ltd., Kolkata
3. Bhojwani S. S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi
4. Clowers, F. A. L. 1961 Apical Meristems. Blackwell Scientific Publication, Oxford.
5. Cutler, D.F. 1978, Applied plant Anatomy, Orient Longman Publishers, New Delhi
6. Cutler, D.F., T. Botha & D. Wm. Stevenson (2008) Plant Anatomy: An Applied Approach, Wiley, USA
7. Dwivedi, J. N. 1998 Embryology of Angiosperms. Rastogi and Co., Meerut.
8. Easu, K. 1953 Plant Anatomy. John Wiley & Sons Inc., New York.
9. Esau, K. (1971) Anatomy of Seed Plants. John Wiley and Son, USA.
10. Easu, 1987. The Anatomy of seed plants. Wiley Eastern Ltd., New Delhi
11. Fahn, A. (1990) Plant Anatomy, Pergamon Press, Oxford.
12. Johri, B.M. (2011) Embryology of Angiosperms. Springer-Verlag, Berlin
13. Maheswari, P. (1971) An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London.
14. Maheshwari, P. 2015. An Introduction to the Embryology of Angiosperms, Scholar Select Publishers.
15. Pandey, B.P. (2013) College Botany, Volumes-II& III, S. Chand Publishing, New Delhi
16. Pandey, A.K., 1997. Introduction to Embryology. CBS Publishers and Distributors, New Delhi
17. Pandey, A. K. (2000) Introduction to Embryology of Angiosperms. CBS Publishers & Distributors Pvt.Ltd., New Delhi
18. Pandey, B. P. 1989 Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
19. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House Pvt. Ltd., , New Delhi
20. Ray F. Evert, 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. John Wiley & Sons.
21. Shivanna, K. R. 2003. Pollen Biology and Biotechnology. Oxford and IBH publishing house, New Delhi.
22. Singh, V., Pande, P. C. and Jain, D. K. 1987 Anatomy of Seed Plants. Rastogi Publications, Meerut

National Education Policy 2020
B.Sc. Botany, III Year (Semester - V)
Major Core Theory Course
Course Code – SBOTIK 1303

Title of the Course: INDIAN BOTANICAL HERITAGE (IKS)

[No. of Credits: 2 Credit]

[Total:30Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank of Credits.

Course objectives:

- To introduce students to traditional Indian botanical knowledge
- To understand ethnobotany, Ayurveda, and indigenous practices
- To integrate modern plant science with traditional wisdom
- To promote biodiversity conservation and sustainability

Course outcomes:

- Student will understand the scope of the Indian Knowledge System.
- Student will recognize and classify medicinal, sacred, and useful plants.
- Student will evaluate traditional agricultural practices and plant-based uses.
- Student will be able to describe the significance of plants in Indian culture and heritage.

Curriculum Details: SBOTIK1303-Indian Botanical Heritage (IKS)

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		TRADITIONAL BOTANICAL KNOWLEDGE IN INDIA	
	1.1	Concept, Definition and scope of IKS. Overview of holistic health concepts in ancient India	08
	1.2	Historical development of Botanical Knowledge in India. Role of medicinal plants in classical texts such as <i>Charaka Samhita</i> , <i>Sushruta Samhita</i> , and <i>Ashtanga Hridaya</i>	
	1.3	Herbal wealth in Ancient Indian Scriptures, folk lores etc.)	
	1.4	Ancient practices in Agriculture (Vrikshayurveda and Krishi Parashara)	
2.0		ETHNOBOTANY	
	2.1	Ethnobotany: Concept, importance and History	07
	2.2	Indigenous knowledge of plants in rural and tribal communities, Folk taxonomy	
	2.3	Methodology in ethnobotanical research: Field data collection, Quantitative methods	
	2.4	Socio-cultural and religious significance of plants and their Parts.	
3.0		SACRED GROOVES AND PLANT HERITAGE	
	3.1	Sacred Grooves: Concept and role in biodiversity conservation, Nakshtra Vana, Rashi Van	08
	3.2	Sacred Plants: Role in rituals, festivals and culture as food, ornamental and medicine	

	3.3	Regional and sacred plants with holistic approach – Durva, Tulsi, Shami, Banyan Tree, Umbar, Pipal tree, Bel, Coconut	
	3.4	Heritage National and State plant Symbols: Tree, Flower, Fruit, Nakshtravan, Rashivan	
4.0		INDIAN TRADITIONAL HEATH PRACTICES	
	4.1	Ayurveda: Basic principles of Ayurveda (Tridosha concept: Vata, Pitta, Kapha). Role of medicinal plants in Ayurveda	07
	4.2	Overview of Siddha, Unani, Homeopathy and folk medicine	
	4.3	Role of local healers and traditional knowledge holders. Home remedies and indigenous healthcare practices	
	4.4	Therapeutic properties and applications of medicinal plants: Neem, Ashoka, Turmeric and Ginger.	

Text Books and Reference Books:

1. Agarwal, P., & Kumar, V. (2021). *Indian knowledge systems: Ancient wisdom in contemporary times*. Springer.
2. Aher, S. K., (2017). Study of Some Sacred Plants of Ahmednagar District, Maharashtra, India. *International Journal of Current Research*, pp-59706-59709.
3. Ahirwar H. K. and S. Mohabe (2022). Medicinal and Plants, Significance of Sacred Natural Sites, Raisen District of Madhya Pradesh, India. *Journal of Medicinal Plants Studies*, 10(3): 55-61.
4. Badve S. B., (2018). *Nakshatravan*. Ujwal Prakashan, Sanwad Trade Prints, 595, Shaniwar Peth, Pune-411030.
5. Banerjee, S., & Singh, R. (2020). The revival of Ayurveda: An integrative approach in modern medicine. *Journal of Traditional Medicine and Clinical Naturopathy*, 9(4), 78-89.
6. Bhatla N., T. Mukherjee and G. Singh (1984). Plants: Traditional Worshipping. *Indian Journal of History of Science*, 19(1): 37-42.
7. Chakraborty, S., & Gupta, M. (2022). The role of traditional Indian farming practices in sustainable agriculture. *Journal of Sustainable Agriculture*, 32(1), 12-29.
8. Das S. (2018-19). *Sacred Plants of India: A Brief Review*. M.U.C. Women's College, Department of Botany, Burdwan University, Burdwan.
9. Dekhane, M. *Myra Ani Devraiche Gupit Bhag 1& 2*, Dilipraj Prakashan Pvt. Ltd.
10. Gaykar Balasaheb, (2011). *Sacred Groves: Traditional Way of Conserving Plant Diversity*. *Journal of Ecobiotechnology*, 3(9): 23-25.
11. Ghate V., Kore P. and R. Adkar, (2018). *Sacred Groves in Satara District: Traditional Heritage under Threat*. Research wing of Forest Department, Pune, Government of Maharashtra.
12. Gupta S. M. (1968). *Plant Myths and Traditions in India*. Munshiram Manoharlal Publisher, ISBN 978812510073.
13. Jagadeesh, A. Devarai Aakhyan, Prafullata Publication, Pune
14. Juyal P. (2023). *Ethnobotany*, Uttarakhand Open University, Haldwani, Nainital, 263139.
15. Kadam V. and S. Deosthale (2023). Documentation of Sacred Medicinal Plants from Painganga Forest Range, Umardhed, Dist. Yavatmal, Maharashtra. *International Journal for Multidisciplinary research*, ICMRS-23: 1-3.

16. Khare S. M. and S. B. Pawar, (2018). Ethnobotanical Studies of Some Sacred Plants of Jalgaon District, Maharashtra, India. *International Journal of Botany Studies*, pp-79-83.
17. Khare S. M. and S. B. Pawar, (2018). Investigation on Sacred Plants in North Maharashtra: Diversity, Ethno Economics, Significance and Conservation. KBC North Maharashtra University, Shodhganga@INFLIBNET, pp-45-57.
18. Khare S. M., S. Pawar and D. A. Patil, (2020). Role of Exotics Sacred Plants in Bioculture of Khandesh region of Maharashtra. *International Journal of Botany Studies*, pp-293-299,
19. Khare S. M., S. Pawar and D. A. Patil, (2021). Plants of Temples and Religious Places in Khandesh Region (Maharashtra): An Ethnobotanical Perspective. *Plantae Scientia*, 4(5): 257-265.
20. Krishna N. and M. Amrithalingam (2014). *Sacred Plants of India*. Penguin Books India.
21. Krishna N., (2006). *Ecological Traditions of Maharashtra*. C.P.R. Environmental Education Centre. 1 Eldams Road, Alwarpet, Chennai-600 018. Tamil Nadu, India.
22. Kumar, A., & Saxena, S. (2019). Medicinal Plants in Jain Literature: An Analytical Study. *Journal of Indian Traditional Medicine*, 7(2), 123-130.
23. Kumar, N., & Rao, K. (2021). Sacred groves and biodiversity conservation in India. *Ecology Environment*, 27(2): 115-130.
24. Kumar, R., & Singh, A. (2021). Traditional Indian environmental practices and their impact on contemporary environmental policies. *Environmental Policy and Practice*, 33(2), 123-136.
25. Mohanty, A., & Singh, V. (2021). Integration of Ayurveda in modern healthcare: A review. *Journal of Integrative Medicine*, 19(2), 142-153.
26. Nadkarni, A. *Devraichya Savalit*, Prafullata Publication, Pune
27. Pande D. and V. C. Pandey (2016). Sacred Plants from Ancient to Modern Era: Traditional Worshipping towards Plants Conservation. *Tropical Plant Research: An International Journal*, 3(1): 136-141.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -V)
Major Elective Theory Course
Course Code – SBOTET1301

Title of the Course: PLANT SYSTEMATICS-I

[No. of Credits: 2 Credit]

[Total: 30 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To know about the fundamentals of plant classification.
- To study in detail the principles of plant taxonomy.
- To acquire knowledge of different families of polypetalae, gamopetalae and apetalae

Course outcomes:

- The students will be able to understand fundamentals of classification of angiosperms.
- The students will be able to understand in detail the principles of plant taxonomy.
- Students will acquire knowledge of different families of polypetalae, gamopetalae and apetalae.

Curriculum Details: SBOTET 1301- Plant Systematics-I

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		CLASSIFICATION	
	1.1	Introduction: Definition, scope and applications of angiosperms taxonomy,	07
	1.2	Types of classification- Artificial, Natural and Phylogenetic	
	1.3	Linnaeus's classification of flowering plants; Bentham & Hooker's classification of angiosperms (Outline of classification is expected) with merits and demerits.	
	1.4	Robert Thorne's classification of angiosperms (Outline of classification is expected) with merits and demerits.	
2.0		TAXONOMIC TOOLS	
	2.1	Herbarium- Techniques of plant preservation, Importance of herbarium.	07
	2.2	Botanical gardens -Role in plant taxonomy, Important Botanical gardens in India	
	2.3	Plant identification keys -Types (Dichotomous and Punched Card keys); and uses of keys.	
	2.4	Flora, Monographs, Numerical Taxonomy, Molecular Systematics.	
3.0		FAMILIES OF DICOTS (As per Bentham & Hooker's Classification)	
	3.1	Study of systematic position, general characters, floral formula	08

		floral diagram and economic importance of Cucurbitaceae	
	3.2	Study of systematic position, general characters, floral formula floral diagram and economic importance of Apiaceae, Rutaceae	
	3.3	Study of systematic position, general characters, floral formula floral diagram and economic importance of Rubiaceae	
	3.4	Study of systematic position, general characters, floral formula floral diagram and economic importance of Apocynaceae	
4.0		FAMILIES OF MONOCLAMYDEAE AND MONOCOTS (As per Bentham & Hooker's Classification)	
	4.1	Study of systematic position, general characters, floral formula floral diagram and economic importance of Nyctaginaceae	
	4.2	Study of systematic position, general characters, floral formula floral diagram and economic importance of Santalaceae	
	4.3	Study of systematic position, general characters, floral formula floral diagram and economic importance of Orchidaceae, Commelinaceae	08
	4.4	Study of systematic position, general characters, floral formula floral diagram and economic importance of Cyperaceae	
		Total	30

Text Books and Reference Books:

1. Vashista, P.C. (1990) – Taxonomy of Angiosperms – S. Chand & Co., New Delhi.
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 crops Vol.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. Subramaniam, 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.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -V)
Major Elective Practical Course
Course Code – SBOTEP 1301

Title of the Course: Practical Based on SBOTET 1301

[No. of Credits: 2 Credits]

[Total: 60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank of Credits.

Course objectives:

- To study how to describe a flowering plant for their taxonomic details.
- To study different floras, to prepare plant identification keys and to identify locally available plants.
- To acquire knowledge for the preparation of Herbarium specimens

Course outcomes:

- The students will be able to describe a flowering plant for its taxonomic details
- The students will be able to understand in detail the floras, and able to prepare plant identification for the identification of locally available plants.
- Students will acquire knowledge of Herbarium

Curriculum details: SBOTEP 1301: Practical Based on SBOTET 1301

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Cucurbitaceae	4
2.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Apiaceae	4
3.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Rutaceae	4
4.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Rubiaceae	4
5.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Apocynaceae	4
6.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Nyctaginaceae	4
7.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Santalaceae	4
8.	Description, identification and classification with sketches, floral	4

	formulae and floral diagrams of locally available plants of the family Orchidaceae	
9.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Commelinaceae	4
10.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Cyperaceae	4
11.	Preparation of dichotomous key of any family by studying locally available plants of the same family.	4
12.	Identification of at least four locally available plants up to species level with the help of flora (sketches, floral formulae and floral diagrams are not expected)	4
13.	Preparation of herbarium specimens (Students will submit at least five herbarium specimens in practical exam).	4
14.	Visit to nearby Herbarium and Botanical gardens.	4
15.	One long and two short (local) excursions are expected (Students should submit 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, II S. Chand and Company.
3. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
4. O.P. Sharma (2017) Plant Taxonomy; Mc Graw Hill Learning
5. Gopinath Hait (2023) Field Manual for Plant Taxonomy; Global Net Publication
6. Swapnil Yadav (2022) Plant Systematics with Practical; Mahaveer publications.com
7. O.P. Sharma (2017) Plant Taxonomy; Mc Graw Hill Learning
8. Pandey BP (2000) Taxonomy of Angiosperm; S. Chand & Co., New Delhi.
9. S. Sundara Rajan (2000) College Botany Vol. III; Himalaya Publishing House, Mumbai
10. Singh, V. and Jain, V.K. (1989) Taxonomy of Angiosperms. Rastogi Publication, Meerut.
11. Sivarajan, V.V. (1989) Introduction to principles of plant Taxonomy. Oxford and IBH, New Delhi.
12. Sutaria RN (1970) A text book of Systematic Botany; Khadayata Book Depot, Ahmedabad
13. Varma BK (2023) Introduction to Taxonomy of Angiosperms PHI Learning Ltd.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -V)
Major Elective Theory Course
Course Code – SBOTET 1302

Title of the Course: PLANT PATHOLOGY-I

[No. of Credits: 2 Credit]

[Total: 30 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as a major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To know about the fundamentals of plant pathology.
- To study in detail the process of plant disease development.
- To know about the fundamentals of Aerobiology.
- To acquire knowledge of different plant diseases in different plants and their control measures.

Course outcomes:

- The students will understand fundamentals of Plant Pathology.
- The students will understand in detail the process of plant disease development.
- The students will understand fundamentals of Aerobiology.
- Students will acquire knowledge of different plant diseases in different plants and their control measures.

Curriculum Details: SBOTET 1302-Plant Pathology-I

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		FUNDAMENTALS OF PLANT PATHOLOGY	
	1.1	Plant Pathology- Scope, importance, history of plant pathology. Contribution of E.J. Butler, J.F. Dastur, G.S. Kulkarni, K.C. Mehta.	8
	1.2	Classification of plant diseases on the basis of causal organism and symptoms. Mode of transmission (soil, water, air, seed and insects)	
	1.3	Field and laboratory diagnosis of plant disease, Isolation of plant pathogens from infected plant parts, soil and air, pure culture techniques, Koch's postulates for pathogenicity.	
	1.4	Key terms in plant pathology (disease, disorder, pathogen, vector, parasite, host, pathogenesis, pathogenicity, virulence, symptom, sign, infection, inoculum, susceptibility, resistant, hypersensitivity, immune, tolerance, epidemiology, eradication, control measures/management).	
2.0		PLANT DISEASE DEVELOPMENT	
	2.1	Concept of Plant disease: Disease triangle, Causes of plant diseases (Biotic and Abiotic), Types of Disease cycle (monocyclic & polycyclic).	8
	2.2	Nutrient deficiencies diseases: 1) stunted growth; 2) chlorosis; 3) interveinal chlorosis; 4) necrosis.	
	2.3	Disease development- Mode of entry of pathogens (Direct penetration,	

		through natural openings - stomata, root hairs, hydathodes & lenticels and wounds), Factors affecting disease development (Temperature, Humidity, Wind and Soil pH)	
	2.4	Chemical weapons of pathogen: Cell wall degrading enzymes, Mycotoxins and Growth regulators in pathogenesis.	
3.0		PLANT DISEASES-I	
	3.1	Symptoms, Causal organisms, Disease cycle and Control Measure of Red rot of sugarcane.	7
	3.2	Symptoms, Causal organisms, Disease cycle and Control Measure of Downy Mildew of Grapes.	
	3.3	Symptoms, Causal organisms, Disease cycle and Control Measure of Rust of Ground nut.	
	3.4	Symptoms, Causal organisms, Disease cycle and Control Measure of Root Knot of Tomato, Grain smut of Jowar	
4.0		PLANT DISEASES-I	
	4.1	Symptoms, Causal organisms, Disease cycle and Control Measure of Ergot of Bajra	7
	4.2	Symptoms, Causal organisms, Disease cycle and Control Measure of Rust of Jawar	
	4.3	Symptoms, Causal organisms, Disease cycle and Control Measure of Anthracnose of mango	
	4.4	Symptoms, Causal organisms, Disease cycle and Control Measure of Alternaria leaf spot of Soyabean, Bean Mosaic	
		Total	30

List of Reference/Text books

1. Diseases of crop plants in India- G. Rangaswami
2. Diseases of crop plants in India- G. Rangaswami & Mahadevan
3. Aerobiology- S.T. Tilak
4. Essentials of Plant Pathology-V.N. Pathak
5. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom Cultivation- K.R. Aneja
6. Fungi & Plant Diseases- B.B. Mundkar
7. Principles of Plant Pathology- R.S. Singh
8. Fungicides in Plant Disease Control- Y.L. Nene
9. Illustrated Kingdom of Fungi- D.S. Mukadam
10. Illustrated Genera of Fungi Imperfecti- Barnett
11. Plant Diseases- R.S. Singh
12. Plant Pathology- B. P. Pande
13. Plant Pathology- G. N. Agrios
14. Plant Pathology- R.S. Mehrotra
15. Plant Protection- Chattopadhyay.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -V)
Major Elective Practical Course
Course Code – SBOTEP 1302

Title of the Course: Practical Based on SBOTET 1302

[No. of Credits: 2 Credit]

[Total: 60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- The primary objectives are to ensure proficiency in handling, maintaining, and utilizing scientific apparatus for studying fungi, bacteria and viruses.
- To enable students to diagnose, understand, and manage diseases in their immediate environment, thereby contributing to food security and agricultural sustainability.
- To master techniques for preparing culture media, isolating pathogens from diseased plant tissues, and identifying airborne inoculum.

Course outcomes:

- The students will understand working operating of laboratory equipments.
- Students will develop skills to prepare general (e.g., PDA, NA) and selective/differential media for culturing pathogenic fungi and bacteria.
- Students will be able to detect, enumerate, and identify airborne microorganisms (bacteria, fungi, and actinomycetes) in specific indoor or outdoor environments using standard air sampling techniques.
- The students will understand in detail the pathogenicity, symptoms, causal organisms and control measures of plant diseases.

Curriculum details: SBOTEP 1302: Practical Based on SBOTET 1302

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of laboratory equipments-Autoclave, Hot air oven, inoculating chamber, laminar air flow, Air sampler, Incubator, Centrifuge	04
2.	Preparation of culture media-PDA/NA	04
3.	Isolation of fungal pathogens from diseased plant parts.	04
4.	Micrometry-Calibration of microscope and measurement of fungal spores.	04
5.	Study of Symptoms, causal organisms, disease cycle and control measures of Grain smut of Jowar.	04
6.	Study of Symptoms, causal organisms, disease cycle and control measures of Downy mildew of Grapes.	04
7.	Study of Symptoms, causal organisms, disease cycle and control measures of <i>Alternaria</i> leaf spot of Soybean	04
8.	Study of Symptoms, causal organisms, disease cycle and control measures of Anthracnose of Mango.	
9.	Study of Symptoms, causal organisms, disease cycle and control measures	04

	of Ergot of Bajra	
10.	Study of Symptoms, causal organisms, disease cycle and control measures of Bean Mosaic	04
11.	Study of Symptoms, causal organisms, disease cycle and control measures of Rust of Groundnut.	04
12.	Study of Symptoms, causal organisms, disease cycle and control measures of Red rot of Sugarcane.	04
13.	Field visits (<i>Kharif</i>) for the collection of diseased plant specimens are expected.	06
14.	Biological Excursion	06
	Total	60

Text Books and Reference Books:

1. Diseases of crop plants in India- G. Rangaswami
2. Diseases of crop plants in India- G. Rangaswami & Mahadevan
3. Aerobiology- S.T. Tilak
4. Essentials of Plant Pathology-V.N. Pathak
5. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom Cultivation- K.R. Aneja
6. Fungi & Plant Diseases- B.B. Mundkar
7. Principles of Plant Pathology- R.S. Singh
8. Fungicides in Plant Disease Control- Y.L. Nene
9. Illustrated Kingdom of Fungi- D.S. Mukadam
10. Illustrated Genera of Fungi Imperfecti- Barnett
11. Plant Diseases- R.S. Singh
12. Plant Pathology- B. P. Pande
13. Plant Pathology- G. N. Agrios
14. Plant Pathology- R.S. Mehrotra
15. Plant Protection- Chattopadhyay

National Education Policy 2020
B.Sc. Botany, III Year (Semester -V)
VSC Course

Course Code – SBOTVC 1301

Title of the Course: BICOMPOST TECHNOLOGY

[No. of Credits: 2 Credit]

[Total: 60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank of Credits.

Course objectives:

- To provide hands-on training in composting techniques
- To understand organic waste management
- To develop skills for sustainable agriculture practices
- To promote eco-friendly and income-generating activities

Course outcomes:

- The students will be able to prepare different types of compost.
- The students will be able identify suitable raw materials for composting.
- The students will analyse compost quality.
- The students will be able to apply compost in agriculture and gardening.

Curriculum details: SBOTVC 1301: Biocompost Technology

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Introduction to Composting: Overview of eco-friendly waste management, classification of waste materials, and their environmental impact.	04
2.	Composting Biota: Study of the microorganisms involved, including bacteria, fungi, and actinomycetes, and their specific roles in decomposition. (Microbiology of the composting process)	04
3.	Mechanisms of Biodegradation: The chemical and biological processes that break down organic matter into stable humus.	04
4.	Study of phases of composting (key thermal stages) and preparation of EM for composting	04
5.	Segregation and assessment of raw material for composting process (locally available raw materials, crop residues, animal manure, poultry waste, municipal solid waste, press mud, kitchen waste).	04
6.	To study composting techniques preparation of compost by Various methods (Indore, Bangalore, Coimbatore, Windrow methods etc)	04
7.	Monitoring and management the composting process	04
8.	Quality evaluation and testing of matured compost	04
9.	Nutrient Estimation: determination of Total Nitrogen, Phosphorus, Potassium (NPK), and Organic Carbon.	04

10.	Post-Harvest processing of compost Sieving, air-drying and machineries in compost making	04
11.	Packaging the finished compost.	04
12.	Establishing and managing small-scale (home/kitchen) and large-scale compost bins.	04
13.	Calculation of cost of production and profitability of different compost systems.	04
14.	Testing the effect of compost application on seed germination and plant growth	04
15.	Visit to composting facilities, vermicomposting units, and commercial solid waste management plants.	04
	Total	60

Text Books and Reference Books:

1. Somasundaram, E., Nandhini, D. U., & Meyyappan, M. (2021). Principles of organic farming. CRC Press.
2. Das, S., Chatterjee, A., & Pal, T.K. (2020). Organic farming in India: A vision towards a healthy nation. Food Quality and Safety, 4(2), 69-76.
3. Dabbert, S., Haring, A.M., & Zanoli, R. (2004). Organic farming: policies and prospects. Zed books.
4. Maheshwari, D. K. (Ed.). (2014). *Composting for sustainable agriculture*. Springer International Publishing.
5. Meghvansi, M. K., & Varma, A. (Eds.). (2020). *Biology of composts*. Springer.
6. Singh, R. K., et al. (Eds.). (2026). *Composting of farm residues by nature-based solutions*. Springer Cham.
7. Gershuny, G., & Martin, D. L. (1992). *The Rodale book of composting*. Rodale Press.
8. Campbell, S. (1998). *Let it rot!: The gardener's guide to composting*. Storey Publishing.
9. Diaz, L. F., de Bertoldi, M., & Bidlingmaier, W. (Eds.). (2007). *Compost science and technology*. Elsevier.
10. Haug, R. T. (1993). *The practical handbook of compost engineering*. CRC Press.
11. Appelhof, M. (1982). *Worms eat my garbage*. Flower Press.
12. Howard, A. (1940). *An agricultural testament*. Oxford University Press.
13. Rynk, R., et al. (1992). *On-farm composting handbook*. NRAES.

Semester – VI

B.Sc. III Year

Botany

As Per National Education Policy- 2020

National Education Policy 2020
B.Sc. Botany, III Year (Semester - VI)
Major Core Theory Course
Course Code – SBOTCT1351

Title of the Course: PLANT METABOLISM AND BIOCHEMISTRY

[No. of Credits: 3 Credit]

[Total:45 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To study of different pathways in Photosynthesis, respiration, nitrogen metabolism.
- To gain the knowledge of basic aspects of enzymes and their role.
- To study the different biomolecules and secondary metabolites.

Course outcomes:

- The students will be able to understand the various metabolic processes such as photosynthesis, respiration and nitrogen metabolism.
- Students will become familiar with the enzymes.
- Students shall learn different biomolecules and secondary metabolites.

Curriculum Details: SBOTCT 1351-Plant Metabolism and Biochemistry

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		PHOTOSYNTHESIS	
	1.1	Photosynthesis: Introduction, ultra structure of chloroplast, photosynthetically active radiation, concepts of two Photosystems	12
	1.2	Mechanism of photosynthesis, Light reaction, Hill's reaction, Cyclic and Non-cyclic photophosphorylation	
	1.3	Calvin cycle (C3), Hatch and Slack (C4) pathway, photorespiration (C2 Pathway)	
	1.4	CAM pathway; Significance of photosynthesis	
2.0		RESPIRATION	
	2.1	Respiration: Introduction, ultra structure of mitochondria, structure and functions of ATP, significance of respiration. Respiratory quotient (RQ)	12
	2.2	Types of respiration: Aerobic respiration- Glycolysis (EMP Pathway)	
	2.3	Kreb's cycle and Electron Transport System (ETS)	
	2.4	Anaerobic respiration Fermentation (Alcoholic and Lactic acid fermentation)	
3.0		ENZYMES AND NITROGEN METABOLISM	
	3.1	Enzymes: Introduction, nomenclature and classification (IUB), mechanism of enzyme action (Lock and key model, induced fit model), Concept of holoenzyme,	11
	3.2	Mechanism of regulation of Enzyme activity - Feedback and allosteric	

		regulation	
	3.3	Nitrogen metabolism: Introduction, types of nitrogen fixation-Physical and biological (Symbiotic and Asymbiotic)	
	3.4	Ammonification, Nitrification and Denitrification, Nitrate reductase, Nitrogen cycle.	
4.0		BIOMOLECULES AND SECONDARY METABOLITES	
	4.1	Carbohydrates: Introduction, classification of carbohydrates Structure and functions of monosaccharides, disaccharides (sucrose), and polysaccharides home and hetero (starch and cellulose)	10
	4.2	Proteins: Introduction, Amino Acids, Structure (primary, secondary, tertiary, and quaternary), properties and biological roles of proteins	
	4.3	Lipids: Structure and properties of fatty acids and fats; functions of lipids	
	4.4	Secondary metabolites: Introduction, functions of tannins, terpenoids, flavonoids, alkaloids, essential oils, and organic acids in plants.	
		Total	45

Text Books and Reference Books:

1. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
2. Devi P. 2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
3. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
4. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
5. Kochhar, S.L., Gujral, S.K. (2017). Plant Physiology: Theory and Applications. New Delhi, Delhi: Foundation Books, Cambridge University Press India Pvt, Ltd.
6. Lincoln Taiz and Eduardo Zeiger. Plant Physiology 5th Edition. Sunderland, Massachusetts, USA, 2010.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nded). SpringerVerlag, New York, USA.
8. Noggle G.R. and Fritz G. J., 1986 Introductory Plant Physiology Prentice Hall.
9. India.PrivateLtd.Delhi, 1992.Performance, in Cultivation, MacMillan Education. Sydney, Australia, 1999.
10. Raven, P.H., Evert, R.F. and Eichhorn, S. Biology of Plants (5th edition). Worth, New York, 1992.
11. RGS.Plant Physiology. MacMillan Publishing Co., New Delhi, 1972.
12. Salisbury, C. B and Ross C.W. Plant Physiology, CBS Publication and Distributions, Delhi, 1986.
13. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development, 6th edition. New York, NY: Oxford University Press, Sinauer Associates.
14. Jain V. K (2022) Fundamentals of Plant Physiology S. Chand Publication New Delhi.
15. Pande S. N and Sinha B. K (2010) Plant Physiology Vikas Publication.

National Education Policy 2020
B.Sc. Botany, III Year (Semester - VI)
Major Core Practical Course
Course Code – SBOTCP 1351

Title of the Course: Practical Based on SBOTCT 1351

[No. of Credits: 2 Credit]

[Total:60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

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

Course outcomes:

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

Curriculum details: SBOTCP 1351: Practical Based on SBOTCT 1351

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Separation of photosynthetic pigments by paper chromatography	04
2.	To study the effect of light intensity on rate of photosynthesis.	04
3.	Measurement of pH of C3, C4 and CAM plant extracts.	04
4.	Demonstration of Alcoholic Fermentation using a Kuhne's fermentation tube	04
5.	To study and demonstrate the rate of respiration takes place in germinating seeds with the help of a Ganong's respirometer	04
6.	Study of catalase and peroxidase activity under different pH and temperature.	04
7.	To study the symbiotic association between <i>Rhizobium</i> bacteria and leguminous plant roots.	04
8.	Qualitative analysis of carbohydrate: Molisch's Test, Benedict's Test, Fehling's Test, Iodine Test	04
9.	Qualitative analysis of proteins: Biuret Test, Xanthoproteic Test, Millon's Test	04
10.	Qualitative analysis of lipid: Sudan III/IV Stain Test, Emulsion Test, Saponification Test	04
11.	Microchemical Test for Malic Acid (Lead Acetate Test), oxalic acid (Silver Nitrate Test), citric acid (calcium hydroxide), Tartaric acid (Copper Sulfate test,	04

	Calcium Chloride test)	
12.	Qualitative tests for tannins (Ferric Chloride Test), Flavonoids (Alkaline Reagent Test NaOH Test),	04
13.	Qualitative tests for terpenoids (Liebermann-Burchard Test), Saponins (Confirmatory Saponin Test Foam with HCl),	04
14.	Qualitative tests for essential oil (Ferric Chloride Test), Alkaloids (Mayer's Test)	04
15.	Visit to research Laboratory / Industry (Drug research, metabolomics, Biochemistry etc .)	04
	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. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nded).
5. Jain V. K (2022) Fundamentals of Plant Physiology S. Chand Publication New Delhi.
6. Pande S. N and Sinha B. K (2010) Plant Physiology Vikas Publication.
7. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
8. Devi P.2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
9. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
10. Kochhar, S.L., Gujral, S.K. (2017). Plant Physiology: Theory and Applications. New Delhi, Delhi: Foundation Books, Cambridge University Press India Pvt, Ltd.
16. Jain V. K (2022) Fundamentals of Plant Physiology S. Chand Publication New Delhi.
17. Pande S. N and Sinha B. K (2010) Plant Physiology Vikas Publication.

National Education Policy 2020
B.Sc. Botany, III Year (Semester - VI)
Major Core Theory Course
Course Code – SBOTCT1352

Title of the Course: GYMNOSPERM AND PALEOBOTANY

[No. of Credits: 3 Credit]

[Total:45 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank Credits.
- The students should have basic knowledge of plant science.
- Introductory knowledge of plant morphology is crucial for understanding Gymnosperms.

Course objectives:

- To know about morphology, anatomy and reproduction in Gymnosperms
- To study diversity of Gymnosperms.
- To acquire knowledge about paleobotany.

Course outcomes:

- The students will be able to understand fundamentals of classification of gymnosperm.
- Students understand morphology, anatomy and reproduction in Gymnosperms
- The Student understand the detail structure of fossils, process of fossilization and basics of paleobotany.

Curriculum Details: SBOTCT 1352-Gymnosperm and Paleobotany

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		GYMNOSPERMS: CYCAS	
	1.1	Introduction and general characters of Gymnosperms. Economic importance of Gymnosperms.	12
	1.2	Classification of Gymnosperms (as per Sporne 1965).	
	1.3	<i>Cycas</i> : Systematic position, morphology, anatomy of leaf, anatomy of stem (primary and secondary growth).	
	1.4	Reproductive structures: Megasporophylls and male cone. (developmental stages not expected). Alternation of generations. Economic importance of <i>Cycas</i> .	
2.0		PINUS	
	2.1	<i>Pinus</i> : Systematic position, morphology, anatomy of leaf, anatomy of stem (primary and secondary growth).	11
	2.2	Reproductive structures: Male cone, structure of pollen grain. female cone, structure of ovule. (Developmental stages are not expected).	
	2.3	Alternation of generations in <i>Pinus</i>	
	2.4	Economic importance of <i>Pinus</i> .	
3.0		GNETUM	11

	3.1	<i>Gnetum</i> : Systematic position, morphology, anatomy of leaf, anatomy of stem (primary and secondary growth).	
	3.2	Reproductive structures: Male and female strobili. (Developmental stages are not expected),	
	3.3	Alternation of generations in <i>Gnetum</i>	
	3.4	Economic importance of <i>Gnetum</i>	
4.0		PALEOBOTANY	
	4.1	Paleobotany: Introduction. Importance of Paleobotany. Birbal Sahani institute of Paleosciences. Geological time scale.	11
	4.2	Process of plant fossilization. Types of fossils: Impressions, Compressions, Petrifications and Coal balls.	
	4.3	Study of fossil Gymnosperms- <i>Lyginopteris oldhamia</i> (stem), <i>Bennettites</i> (flower) and <i>Rhynia major</i>	
	4.4	<i>Ginkgo biloba</i> : A living fossil.	
		Total	45

Text Books and Reference Books:

1. Text book of Botany Gymnosperms, Pandey, B. P S. Chand & Co Ltd New Delhi
2. Gymnosperms, S.P. Bhatnagar, Alok Moitra new Age International publishers, New Delhi.
3. Botany for Degree students- Gymnosperm, Anil Kumar, s chand publishing, New, Delhi.
4. The Gymnosperms, C. Biswas, B.M Jokri, New Delhi.
5. A Text book of Bryophytes, Pteridophytes Gymnosperms and paleobotany Chittaranjan Mohanty
6. Gymnosperms (Fossil & Living central publishing Hour Allahabad, Sharma O.P.(1995)
7. Gymnosperms, Narosa Biswas, C & Jokri, BN. (2004) Publishing House Delhi is was, Gymnosperms, Pragati Prakashan Meerut
8. Gymnosperms. S. Chand Vashishta P.C. A.R. Sinha, Anil Kumar -2006
9. Introduction to Paleobotany, Mc Graw Hill, Arnold C.A.(1947)
10. An Introduction to Paleobotany - Arnold, C.A. (1972)
11. Studies in Paleobotany - Andrews H.N. (1961), Wiley, New York.
12. Principles of Paleobotany - Darroh, W.C. (1960).
13. Essentials of Paleobotany. Shukla, A.C. Mishra, S.D. (1975).
14. Indian fossil Pteridophytes - Surange, K.R(1968).

National Education Policy 2020
B.Sc. Botany, III Year (Semester - VI)
Major Core Practical Course
Course Code – SBOTCP 1352

Title of the Course: Practical Based on SBOTCT 1352

[No. of Credits: 2 Credit]

[Total:60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To know about morphology, anatomy and reproduction in Gymnosperms
- To study preparation of double stained permanent slides.
- To acquire knowledge about paleobotany

Course outcomes:

- Students understand morphology, anatomy and reproduction in Gymnosperms.
- Students learn technique to prepare double stained permanent slides.
- The students understand the detailed structure of some fossil plants.

Curriculum details: SBOTCP 1352: Practical Based on SBOTCT 1352

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Identification, systematic position and external morphology of <i>Cycas</i>	4
2.	Study of internal structure of <i>Cycas</i> : T.S. of leaflet and T.S. of stem	4
3.	Study of male cone and female cone (megasporophyll) of <i>Cycas</i>	4
4.	Identification, systematic position and external morphology of <i>Pinus</i>	4
5.	Study of internal structure of <i>Pinus</i> : T.S. of needle and T.S. of stem	4
6.	Study of male cone and female cone of <i>Pinus</i>	4
7.	Identification, systematic position and external morphology of <i>Gnetum</i>	4
8.	Study of internal structure of <i>Gnetum</i> : T.S. of stem	4
9.	Study of male and female strobili of <i>Gnetum</i>	4
10.	Preparation of double stained permanent slides of materials taught in above practicals. (Students will submit such slides at the time of practical examination).	4
11.	Study of fossil genus <i>Lyginopteris oldhamia</i> (stem) with the help of photocopies/ slides.	4
12.	Study of fossil genus <i>Bennettites</i> (flower) with the help of photocopies/ slides.	4

13.	Study of fossil genus <i>Rhynia major</i> with the help of photocopies/ slides.	4
14.	One or two short study tour in the forest to collect the plant specimens of Gymnosperm plants.	4
15.	At least one long tour to study the Gymnosperm plants	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. Text book of Botany Gymnosperms, Pandey, B. P S. Chand & Co Ltd New Delhi
5. Gymnosperms, S.P. Bhatnagar, Alok Moitra new Age International publishers, New Delhi.
6. Botany for Degree students- Gymnosperm, Anil Kumar, S. Chand publishing, New, Delhi.
7. A Text book of Bryophytes, Pteridophytes Gymnosperms and paleobotany Chittaranjan Mohanty
8. Gymnosperms (Fossil & Living central publishing Hour Allahabad, Sharma O.P.(1995)
9. Gymnosperms, Narosa Biswas, c & Jokri, BN. (2004) Publishing House Delhi is was, Gymnosperms, Pragati Prakashan Meerut
10. Gymnosperms. S. Chand Vashishta P.C. A.R. Sinha, Anil Kumar -2006
11. Introduction to Paleobotany, Mc Graw Hill, Arnold C. A. (1947)
12. An Introduction to Paleobotany - Arnold, C.A. (1972)
13. Indian fossil Pteridophytes - Surange, K.R(1968).

National Education Policy 2020
B.Sc. Botany, III Year (Semester - VI)
Major Core Theory Course
Course Code – SBOTCT1353

Title of the Course: PLANT RESOURCE UTILISATION

[No. of Credits: 2 Credit]

[Total:30 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To inculcate concepts of economically important plants.
- To understand economically important of plants.
- To increase employability of the students.
- To make the students aware of various herbal plants that can be grown in their area, be able to identify different plants and understand medicinal uses of these plants.

Course outcomes:

- Students will understand the economically important plants and their uses.
- Students will understand the role of plants in human health.
- Students will understand the scope and importance of the common medicinal plants in the neighbourhood for therapeutical use.

Curriculum Details: SBOTCT1353-Plant Resource Utilisation

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		FRUITS, CEREALS, MILLETS, PULSES AND OIL YIELDING PLANTS	8
	1.1	Botanical name, nutritional value and uses of Mango, Banana, Papaya, Guava, Lemon, Custard apple, Orange, Sweet lime.	
	1.2	Botanical name, nutritional value and uses of Wheat, Jowar, Rice, Maize and Bajra	
	1.3	Botanical name, nutritional value and uses of Tur, Chana, Green gram and Black gram	
	1.4	Botanical name, nutritional value and uses of Groundnut, Soyabean, Safflower and Sunflower	
2.0		VEGETABLE, SPICES, FIBER PLANTS, BEVERAGE AND TIMBER PLANTS	8
	2.1	Botanical name, nutritional value and uses of Radish, Carrot, Spinach, Methi and Cauliflower, Bheni, Karela, Brinjal and Tomato.	
	2.2	Botanical name, nutritional value and uses of Coriander, Cumin, Black Pepper, Cardamom, Cinnamon, Turmeric and Ginger.	
	2.3	Botanical name and uses of Cotton, Coconut, Tea, Coffee and Sugarcane.	
	2.4	Botanical name and uses of Teak, Neem and Babool.	
3.0		MEDICINAL PLANTS-I	7
	3.1	Botanical name and medicinal uses of Tulsi (<i>Ocimum</i> sp), Pudina (<i>Mentha</i> sp), Gulvel (<i>Tinospora</i> sp), Adulsa (<i>Adhatoda</i> sp).	

	3.2	Botanical name and medicinal uses of Korphad (<i>Aloe</i> sp.), Panfuti (<i>Bryophyllum</i> sp), Jakhamjodi (<i>Tridax</i> sp), Nirgudi (<i>Vitex negundo</i>)	
	3.3	Botanical name and medicinal uses of Ashwagandha (<i>Withania</i> sp), Shatavari (<i>Asparagus</i> sp), Gudmar (<i>Gymnema</i> sp) and Kandwel (<i>Cissus quadrangularis</i>)	
	3.4	Botanical name and medicinal uses of Aawla (<i>Phyllanthus</i> sp.) Hirda (<i>Terminalia chebula</i>), Behda (<i>Terminalia belerica</i>) and Arjuna (<i>Terminalia arjuna</i>)	
4.0		MEDICINAL PLANTS-II	
	4.1	Botanical name and medicinal uses of Gunj (<i>Abrus precatorius</i>), Kal-lavi (<i>Gloriosa superba</i>), Nai (<i>Enicostema axillare</i>) and Gawti chaha (<i>Cymbopogon</i> sp).	7
	4.2	Botanical name and medicinal uses of Bel (<i>Aegle</i> sp), Karwand (<i>Carissa</i> sp), Mehandi (<i>Lawsomia</i> sp), Kadhypatta (<i>Muraya</i> sp) and Noni (<i>Morinda citrifolia</i>)	
	4.3	Botanical name and medicinal uses of Muradsheng (<i>Helicteres</i> sp), Guggul (<i>Commiphora</i> sp), Punarnava (<i>Boerhavia</i> sp) and Kattha (<i>Acacia</i> sp).	
	4.4	Botanical name and medicinal uses of Mahabhrungraj (<i>Eclipta</i> sp), Brahmi (<i>Bacopa</i> sp), Jambhul (<i>Sizijium</i> sp) and Chandan (<i>Santalum</i> sp)	
		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. Sambamurty and Subramanyam (2018) A Textbook of Modern Economic Botany, CBS Publishers
8. Verma V (2009) Text Book of Economic Botany, Ane Books Prit Ltd.
9. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dha.
10. Medicinal Plants by P.C. Trivedi (2009).
11. Handbook of Medicinal and Aromatic Plants by S.K. Bhattacharjee (2004).
12. Recent Progress in Medicinal Plants Vol.12, Globalization of Herbal Health by A.K. Sharma (2006).
13. Handbook of Ayurvedic Medicinal Plants by L.D. Kapoor (2005).
14. Indian Medicinal Plants (Vol 1- 4) by K.R. Kirtikar and B.D. Basu (2006).
15. Glossary of Medicinal Plants Used in Ayurveda by Amrutpal Singh Saroya (2006).
16. Indigenous Medicinal Plants Social Forestry & Tribals by M.P. Singh et al. (2003).

National Education Policy 2020
B.Sc. Botany, III Year (Semester -VI)
Major Elective Theory Course
Course Code – SBOTET 1351

Title of the Course: PLANT SYSTEMATICS-II

[No. of Credits: 2 Credit]

[Total: 30 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank of Credits.

Course objectives:

- To acquire knowledge of different families of flowering plants.
- To know about the principles of taxonomy.
- To study in detail the origin of angiosperms.

Course outcomes:

- Students will acquire knowledge of different families of flowering plants
- The students will understand principles of taxonomy.
- The students will understand in detail the origin of angiosperms.

Curriculum Details: SBOTET 1351-Plant Systematics-II

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		FAMILIES OF DICOTS (As per Bentham & Hooker's Classification)	
	1.1	Study of systematic position, general characters, floral formula floral diagram and economic importance of Papaveraceae	8
	1.2	Study of systematic position, general characters, floral formula floral diagram and economic importance of Meliaceae	
	1.3	Study of systematic position, general characters, floral formula floral diagram and economic importance of Asteraceae	
	1.4	Study of systematic position, general characters, floral formula floral diagram and economic importance of Convolvulaceae, Verbenaceae	
2.0		FAMILIES OF MONOCLAMYDAE AND MONOCOTS (As per Bentham & Hooker's Classification)	
	2.1	Study of systematic position, general characters, floral formula floral diagram and economic importance of Amaranthaceae	8
	2.2	Study of systematic position, general characters, floral formula floral diagram and economic importance of Moraceae	
	2.3	Study of systematic position, general characters, floral formula floral diagram and economic importance of Musaceae, Cannaceae	
	2.4	Study of systematic position, general characters, floral formula floral diagram and economic importance of Liliaceae	
3.0		PRINCIPLES OF TAXONOMY	
	3.1	ICN (International Code of Nomenclature): Brief history, principle of priority, effective and valid publication, typification and author citation	7

	3.2	Species concept: Morphological, biological and Evolutionary Species	
	3.3	Role of phytochemistry, cytology and palynology in relation to taxonomy	
	3.4	Pollen morphology with reference to pollen grains of <i>Hibiscus</i> , <i>Ipomoea</i> , <i>Datura</i> and grasses	
4.0		ORIGIN OF ANGIOSPERMS	
	4.1	Probable place of origin of angiosperms.	7
	4.2	Time of origin of angiosperms,	
	4.3	Probable ancestors of Angiosperms: Bennettitalean Theory, Gnetalean Theory	
	4.4	Pteridosperm theory regarding ancestors of angiosperms	
		Total	30

Text Books and Reference Books:

1. Vashista, P.C. (1990) – Taxonomy of Angiosperms – S. Chand & Co., New Delhi.
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 crops Vol.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. Subramaniam, N.S. (1995) Modern Plant Taxonomy. Vikas Publishing House, New Delhi.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -VI)
Major Elective Practical Course
Course Code – SBOTEP 1351

Title of the Course: Practical Based on SBOTET 1351

[No. of Credits: 2 Credit]

[Total:60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank of Credits.

Course objectives:

- To acquire knowledge of different families of flowering plants.
- To know about the principles of taxonomy.
- To study in detail the origin of angiosperms.

Course outcomes:

- Students will acquire knowledge of different families of flowering plants
- The students will understand principles of taxonomy.
- The students will understand in detail the origin of angiosperms.

Curriculum details: SBOTEP 1351: Practical Based on SBOTET 1351

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Papaveraceae	4
2.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Meliaceae	4
3.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Asteraceae	4
4.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Convolvulaceae	4
5.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Verbenaceae	4
6.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Amaranthaceae	4
7.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Moraceae	4
8.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Musaceae	4

9.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Cannaceae	4
10.	Description, identification and classification with sketches, floral formulae and floral diagrams of locally available plants of the family Liliaceae	4
11.	Study of pollen morphology of pollen grains of <i>Hibiscus</i> and <i>Ipomoea</i>	4
12.	Study of pollen morphology of pollen grains of <i>Datura</i> and grasses	4
13.	Identification of at least four locally available plants up to species level with the help of flora (sketches, floral formulae and floral diagrams are not expected)	4
14.	Preparation of Herbarium specimen (Students will submit at least five herbarium specimens in practical exam)	4
15.	Botanical excursion. At least one long and two short excursions are expected. (Student will submit excursion report/field visit in practical exam)	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. Subramaniam, 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.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -VI)
Major Elective Theory Course
Course Code – SBOTET 1352

Title of the Course: PLANT PATHOLOGY-II

[No. of Credits: 2 Credit]

[Total:30 Hours]

Coursepre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank ofCredits.

Courseobjectives:

- To know about the fundamentals of Plant Pathology.
- To know about the fundamentals of Seed Pathology.
- To study in detail the process of Plant Defence mechanism and disease management.
- To acquire knowledge of different plant diseases in different plants and their control measures.

Course objectives:

- The students will be able to understand fundamentals of seed pathology.
- The students will be able to understand in detail the process of Plant Defence mechanism and disease management.
- Students will acquire knowledge of different plant diseases in different plants.

Curriculum Details: SBOTET 1352-Plant Pathology-II

Module No.	Unit No.	Topics	Hrs. Required to cover the contents
1.0		AEROBIOLOGY AND SEED PATHOLOGY	
	1.1	Aerobiology- Definition, scope and importance. Disease forecasting, Role of Artificial Intelligence (AI) in Disease Forecasting,	8
	1.2	Definition, importance in agriculture, seed borne pathogens (external and internal),	
	1.3	Detection of seed borne pathogens (fungi) by blotter paper and agar plate methods. Biodeterioration of storage seeds: Causes of Deterioration (Biotic & Abiotic factors).	
	1.4	Management of Seed-borne Diseases: Physical (hot water, solar heat) and chemical (seed dressing, fungicidal sprays) methods.	
2.0		PLANT DEFENCE MECHANISM AND DISEASE MANAGEMENT	
	2.1	Structural (pre-existing and post inflectional) and Biochemical Defence (pre-existing and post inflectional (phytoalexins),	7
	2.2	Exclusion and Eradication.	
	2.3	General account of Sulphur, Copper, systemic fungicides	
	2.4	Antibiotics, biological control, IPM	

3.0		PLANT DISEASES-I	
	3.1	Symptoms, Causal organisms, Disease cycle and Control Measure of Late Blight of Potato.	8
	3.2	Symptoms, Causal organisms, Disease cycle and Control Measure of Powdery Mildew of Gram.	
	3.3	Symptoms, Causal organisms, Disease cycle and Control Measure of Loose smut of Wheat.	
	3.4	Symptoms, Causal organisms, Disease cycle and Control Measure of Papaya Mosaic, Wilt of Tur	
4.0		PLANT DISEASES - II	
	4.1	Symptoms, Causal organisms, Disease cycle and Control Measure of Green Ear of Bajra.	7
	4.2	Symptoms, Causal organisms, Disease cycle and Control Measure of Black/Stem rust of Wheat.	
	4.3	Symptoms, Causal organisms, Disease cycle and Control Measure of Whip smut of sugarcane.	
	4.4	Symptoms, Causal organisms, Disease cycle and Control Measure of Angular Leaf spot of Cotton and Tikka disease of ground nut	
		Total	30

List of Reference/Text books

1. Diseases of crop plants in India- G. Rangaswami
2. Diseases of crop plants in India- G. Rangaswami & Mahadevan
3. Seed Pathology- D. Suryanarayana
4. Essentials of Plant Pathology-V.N. Pathak
5. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom Cultivation- K.R. Aneja
6. Fungi & Plant Diseases- B.B. Mundkar
7. Principles of Plant Pathology- R.S. Singh
8. Fungicides in Plant Disease Control- Y.L. Nene
9. Illustrated Kingdom of Fungi- D.S. Mukadam
10. Illustrated Genera of Fungi Imperfecti- Barnett
11. Plant Diseases- R.S. Singh
12. Plant Pathology- B. P. Pande
13. Plant Pathology- G. N. Agrios
14. Plant Pathology- R.S. Mehrotra
15. Plant Protection- Chattopadhyay
16. A Text Book of Modern Plant Pathology-K.S. Bilgrami & H.C. Dube
17. An Introduction to Microbiology- C. Edward Gasque
18. Applied Microbiology- Vinita Kale, Kishore Bhusari
19. Practical Microscopy- Martin & Johnsen
20. Seed Pathology- D.K. Jha
21. Seed Pathology- Paul Neergaard.

National Education Policy 2020
B.Sc. Botany, III Year (Semester -VI)
Major Elective Practical Course
Course Code – SBOTEP 1352

Title of the Course: Practical Based on SBOTET 1352

[No. of Credits: 2 Credit]

[Total: 60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant science and required credit in their Academic Bank of Credits.

Course objectives:

- To detect and identify seed-borne diseases, understand their transmission mechanisms, and develop effective control measures to prevent yield losses and ensure food security.
- To accurately measure the dimensions (length, breadth, diameter) of microscopic organisms through Micrometry.
- To study in detail the pathogenicity, symptoms, causal organisms and control measures of plant diseases.

Course outcomes:

- The students will acquire specialized, hands-on knowledge in diagnosing, managing, and preventing seed-borne diseases.
- Students will be able to estimate the size of particles seen in the microscope through Micrometry.
- The students will be able to understand in detail the pathogenicity, symptoms, causal organisms and control measures of plant diseases.

Curriculum details: SBOTEP 1352: Practical Based on SBOTET 1352

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of Seed health Testing Methods – Dry seed examination for visual symptoms, fungal fruiting bodies, or diseased contaminants. Study of Common seed treatment methods- Seed dressing, Slurry treatment, Soaking treatment.	04
2.	Isolation and identification of seed-borne pathogen by blotter & agar plate Method.	04
3.	Study of air-borne pathogen by exposed Petri plates / Air sampler method	04
4.	Study of Symptoms, causal organisms, disease cycle and control measures of Powdery Mildew of Gram.	04
5.	Study of symptoms and causal organisms of Loose smut of Wheat.	04
6.	Study of Symptoms, causal organisms, disease cycle and control measures of Tikka disease of Groundnut.	04
7.	Study of Symptoms, causal organisms, disease cycle and control measures of Angular leaf spot of Cotton.	04
8.	Study of Symptoms, causal organisms, disease cycle and control measures of Whip smut of Sugarcane	04

9.	Study of Symptoms, causal organisms, disease cycle and control measures of Late Blight of Potato.	04
10.	Study of Symptoms, causal organisms, disease cycle and control measures of Green Ear of Bajra	04
11.	Study of Symptoms, causal organisms, disease cycle and control measures of Stem rust of Wheat (Uredinal & Telial Stages expected)	04
12.	Study of Symptoms, causal organisms, disease cycle and control measures of Wilt of Tur.	04
13.	Field visits (<i>Rabbi</i>) for the collection of diseased plant specimens are expected.	06
14.	Visit to Seed Pathology Laboratory and Preparation of Excursion Report.	06
	Total	30

Text Books and Reference Books:

1. Diseases of crop plants in India- G. Rangaswami
2. Diseases of crop plants in India- G. Rangaswami & Mahadevan
3. Seed Pathology- D. Suryanarayana
4. Essentials of Plant Pathology-V.N. Pathak
5. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom Cultivation- K.R. Aneja
6. Fungi & Plant Diseases- B.B. Mundkar
7. Principles of Plant Pathology- R.S. Singh
8. Fungicides in Plant Disease Control- Y.L. Nene
9. Illustrated Kingdom of Fungi- D.S. Mukadam
10. Illustrated Genera of Fungi Imperfecti- Barnett
11. Plant Diseases- R.S. Singh
12. Plant Pathology- B. P. Pande
13. Plant Pathology- G. N. Agrios
14. Plant Pathology- R.S. Mehrotra
15. Plant Protection- Chattopadhyay
16. A Text Book of Modern Plant Pathology-K.S. Bilgrami & H.C. Dube
17. An Introduction to Microbiology- C. Edward Gasque
18. Applied Microbiology- Vinita Kale, Kishore Bhusari
19. Practical Microscopy- Martin & Johnsen
20. Seed Pathology- D.K. Jha
21. Seed Pathology- Paul Neergaard

National Education Policy 2020
B.Sc. Botany, III Year (Semester -VI)
VSC Course

Course Code – SBOTVC 1351

Title of the Course: NURSERY MANAGEMENT

[No. of Credits: 2 Credits]

[Total:60 Hours]

Course pre-requisite:

- The course is offered for a student who completes second year undergraduate programme with Botany as major subject.
- The students should have basic knowledge of plant sciences and required credit in their Academic Bank of Credits.

Course objectives:

- To Provide practical training in plant propagation, nursery layout and gardening
- Equip learners with nursery practices
- Build entrepreneurial capacity for self-employment and nursery development
- Integrate use of modern technologies (mist chambers, polyhouses, media management)
- Promote industry-ready skills to meet workforce and market demands

Course outcomes:

- The students will be able to describe and differentiate between the types of gardens.
- The students will practice different methods for propagation of plants.
- The students will execute several nursery and gardening operations.
- The students will assess growing conditions of different horticultural plants, their general requirements and understand their role in landscaping.

Curriculum details: SBOTVC 1351: Nursery Management

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings, hardening of plants, green house, mist chamber, shed roof, shade house and glass house. Gardening: definition, objectives and scope, different types of gardening, landscape and home gardening, parks and its components, plant materials and design, computer applications in landscaping, landscaping highways and educational institutions. Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	04
2.	Study Garden tools and implements, Study of containers - earthen containers, pots, Polybags, cement pots and ceramic pots.	04
3.	Preparation of nursery beds, Soil sterilization process, sowing of seeds, transplantation methods, Hardening plants in the nursery.	04
4.	To study landscaping basics: laying lawns, hedges, garden beds, and topiary designs	04

5.	Practicing different types of cuttings, layering, grafting and buddings	04
6.	Pest, disease, and weed management in nursery environments	04
7.	Value-added nursery products: potted plants, bonsai, ornamental sets etc.	04
8.	Waste management and organic practices in nurseries and gardens	04
9.	Study of different types of gardens (indoor and outdoor) and key features of gardens (Paths & Avenues, Hedges & Edges, Lawn, Flowerbeds, Arches)	04
10.	Study of different types of gardens: Pergolas, Fencing, Water bodies, Rock Garden).	04
11.	Study of important gardens of India (any five).	04
12.	Study of important gardens of world (any Two).	04
13.	Methods of Landscape designing of Residential areas and Public Gardens, Aquatic Garden, Rock Garden, Industrial gardens.	04
14.	Care and maintenance of various garden plants.	04
15.	Visit to Nurseries and Gardens	04
	Total	60

Text Books and Reference Books:

1. Bose T.K. & Mukherjee, D., Gardening in India, Oxford & IBH Publishing Co., New Delhi.1972.
2. Sandhu, M.K., Plant Propagation, Wile Eastern Ltd., Bangalore, Madras. 1989.
3. Kumar, N., Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.1997.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 1993.
6. Janick Jules. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.1979.
7. Krishnan, P. R., Kalia, R. K., Tewari, J. C., & Roy, M. M. (2014). Plant nursery management: principles and practices. Central Arid Zone Research Institute, Jodhpur, 40.
8. Ray, P.K. (2012). Plant Nursery Management: How to Start and Operate a Plant Nursery. Scientific Publishers.
9. Hartmann, H.T., Kester D.E., Davis, F.T and R.L Geneve (2010) Plant Propagation: Principles and practices (8th Edition)
10. Mason, J. (2004). Nursery management. Landlinks Press.
11. Sharma, R.R and Srivastav M (2004): Plant propagation and nursery management (First Edition) International Book Distributing Co.
13. K. K. Nanda and V.K. Kochhar (1985). Vegetative propagation of plants. Kalyani Publisher- New Delhi-Ludhiana.

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