॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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

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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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Academic-1 (BOS) Section

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शैक्षणिक वर्ष २०२३–२४ पासून लागू व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार पदव्युत्तर स्तरावरील सुधारित अभ्यासक्रमा बाबत....

प रि प त्र क

संदर्भ:– १. जा.क्र.शै–१/एनईपी२०२०/S&T/अक्र/२०२३–२४/१३० दिनांक ३०/०६/२०२३

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, संदर्भीय परिपत्रकान्वये दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीतील ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात आलेले आहेत. तथापी वरील संदर्भीय परिपत्रका अन्वये प्रकाशित केलेल्या M. Sc. Botany I year Affiliated college अभ्यासक्रमामध्ये अभ्यासमंडळानी किरकोळ दुरूस्ती करून अभ्यासक्रम सादर केला असून मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा यांच्या मान्यतेने दुरूस्ती केलेला अभ्यासक्रम लागू करण्यात येत आहे.

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.

डॉ. सरिता लोसरवार
सहाय्यक.कुलसचिव
शैक्षणिक अभ्यासमंडळ विभाग

'ज्ञानतीर्थ' परिसर,

विष्णुपुरी, नांदेड – ४३१ ६०६.

जा.क्र.:शैक्षणिक–१/परिपत्रक/एनईपीपीजीदुरूस्ती/S&T/
२०२४–२५/२९६

दिनांक : ०८.०८.२०२४

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबंधित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ, यानां देवून कळविण्यात येते की, सदरील परिपत्रक विद्यापीठाच्या संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH
MARATHWADA UNIVERSITY, NANDED - 431 606

Two Years Post Graduate Degree Program in Botany

(Faculty of Science and Technology)

Revised Syllabi as per NEP-2020 for

M.Sc. First Year

BOTANY

(For Affiliated Colleges)

To be implemented from
Academic year 2023 - 2024

Framed by
BOARD OF STUDIES IN BOTANY
S.R.T.M. University, Nanded - 431 606

Forward by the Dean, Faculty of Science and Technology

From the Desk of the Dean:

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power",*** is trying hard continuously 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. The recommendations of the ***Sukanu Samiti*** given in the NEP Curriculum Framework-2023 have been followed, keeping the disciplinary approach with rigour 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 first-hand 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

The M.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 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.

OBJECTIVES OF THE M. Sc. BOTANY PROGRAMME:

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

PROGRAM SPECIFIC OUTCOMES (POs) OF M.Sc. BOTANY:

Plant science is now a blend of basic and applied science. In addition to having the unique ability of plants to trap solar energy and provide food for all, plants cannot be replicated by any system. Conventional studies like plant identification are now being supplemented with molecular techniques like DNA Barcoding. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in

mind that these students can teach at various levels, research work in research institutes and or industry, doctoral work, environmental impact assessment, biodiversity studies, entrepreneurship, scientific writing are included in the curriculum.

PO 1: Understanding the taxonomy of plants from Algae to Angiosperm. Identification of plants in field increases the basics of plants. The study of biodiversity in relation to habitat will be related to climate change, land and forest degradation and types of ecosystems. Application of Botany in agriculture is through study of plant pathology, seed technology, tricoderma cultivation and vermicomosting.

PO 2: Understand the ultra structure of Bacteria and Viruses, ultra structure and functions of cell, cell membranes, cell organisation, communications, signaling, genetics, plant breeding, anatomy, taxonomy, ecology and plant Physiology and biochemistry.

PO 3: Understand the multi-functionality of plant cells in the production of fine chemicals and their wide range of industrial applications.

PO 4: Understand research skills, research methodology and research projects during this program.

PO 4: Analyze and apply the methodologies and techniques learnt during the course of studying botany

PO 4: Share social, environmental and ethical concerns with fellow citizens

PO 5: The program enables the students to face NET, SET, MPSC, UPSC and other competitive examinations successfully.

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

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

Sr No	Name of the Member	Designation	Address	Contact No.
1.	Dr. Saheb Laxmanrao Shinde	Chairman	Yeshwant Mahavidylaya, Nanded	7588151967
2	Dr. Babasaheb Shivmurti Surwase	Member	School of Life Sciences, S.R.T.M.U. Nanded	9075829767
3	Dr. B. D. Gachande	Member	Science College, Nanded	8788727840
4	Dr Vijay Tulshiram Gorgile	Member	Shahir Annabhau Sathe Mahavidyalaya, Mkhed	9421762073
5	Dr. Sudhakar V. Chate	Member	Shivaji College, Udgir	8421241300
6	Dr. Suresh Manoharrao Telang	Member	Yeshwant Mahavidyalaya, Nanded	9822174684
7	Dr. R. M. Kadam	Member	M. G. M. Ahmedpur, Tq. Ahmedpur, Dist. Latur.	9422657976
8	Dr. Sopan Dnyanoba Dhavale	Member	Shahir Annabhau Sathe Mahavidyalaya, Mukhed,	9423614703
9.	Dr. Sanjay Marotrao Dalvi	Member	Shri Guru Buddhiswami Mahavidyalaya, Purna (Jn),	9921101210
10	Dr. Prashant A. Gawande	Professor from other University	Sant Gadge Baba Amravati University,Amravati.	9403622568
11	Dr. Ambadas Sheshrao Kadam	Experts	DSM College Parbhani.	8329151172
12	Dr. Kanhaiya Ranganathrao Kadam	Experts	K.K. Herbal Industries, Gut No. 252, Naleshwar Road, Limbgaon, Nanded.	9420261080
13	Bindu Maurya	Experts	07, Mangal Pravesh building Polt. C-16 Sector-3 Airoli, Navi Mumbai.	9987591561
14	Shri Bhanudas Balajirao Pendkar	Experts	K-Ferts Lab, W-4, MIDC Industrial Area, Nanded. Invitee Member	8888896710
15	Dr. D. M. Jadhav	Invitee Member	Science College Nanded	9423413350
16	Dr. S. A. Patil	Invitee Member	Yeshwant Mahavidyalaya Nanded	9356596159
17	Dr. Marathe V. R.	Invitee	Science College Nanded	7588565395

		Member		
18	**Dr. Patil R.B.**	**Invitee Member**	**Shankarrao Chavan Mahavidyalaya, Ardhapur.**	**8208088702**
19	**Narlawar Shivani Sanjay**	**PG Student**	**C/o Science College Nanded**	**9146042070**
20	**Tamkinat Begum Mirza Irshad Saleem**	**UG Student**	**C/o Yeshwant Mahavidyalaya, Nanded**	**9403951262**

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: Botany

Year & Level 1	Sem. 2	Major Subject (DSC) 3	Major Subject (DSE) 4	RM 5	OJT / FP/CS 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
1	1	**SBOTC401 (4 Cr)** **SBOTC402 (4 Cr)** **SBOTC403 (4 Cr)**	**SBOTE401** (3+1 Cr)	**SVECR 401** *Research Methodology* **(3 Cr)**	--		**SBOTP401 (1Cr)** **SBOTP402 (1Cr)** **SBOTP403 (1Cr)** **SBOTEP401 (1Cr)**	22	44
	2	**SBOTC451 (4 Cr)** **SBOTC452 (4 Cr)** **SBOTC453 (4 Cr)**	**SBOTE451** (3+1 Cr)	---	**SBOTOJ 451/** **SBOTFP 451/** **SBOTCS 451** **(3 Cr)**	--	**SBOTP451 (1Cr)** **SBOTP452 (1Cr)** **SBOTP453 (1Cr)** **SBOTEP451 (1Cr)**	22	
Exit option: Exit Option with PG Diploma *(after 2024-25)*									
2	3	**SBOTC501 (4 Cr)** **SBOTC502 (4 Cr)** **SBOTC503 (4 Cr)**	**SBOTE501 (3+1 Cr)** ***(From same Department / School)***	--		Research Project **SDSCR551 (4Cr)**	**SBOTP501 (1 Cr)** **SBOTP502 (1 Cr)** **SBOTEP501 (1 Cr)**	22	44
	4	**SBOTC551 (4 Cr)** **SBOTC552 (4 Cr)**	**SBOTE551 (3+1 Cr)** ***(From same Department / School)***	**SVECP 551** Publication Ethics (2 Cr)		Research Project **SDSCR552** **(6 Cr)**	**SBOTP551 (1Cr)** **SBOTP552 (1Cr)** **SBOTEP551 (1Cr)**	22	
Total Credits		**44**	**16**	**05**	**03**	**10**	**10**	**88**	

M. Sc. First Year Semester I *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SBOTC401**	Diversity of Microbes	04	--	**04**	04	--
	SBOTC402	Diversity of Cryptogams	04	--	**04**	04	--
	SBOTC403	Taxonomy of Angiosperms and Gymnosperms	04	--	**04**	04	--
Elective (DSE)	**SBOTE401**	Bioinstrumentation and Methods in Biology	03	--	**03**	03	--
Research Methodology	**SVECR401**	Research Methodology	03	--	**03**	03	
DSC Practical	**SBOTP401**	Lab 1 / Based on theory Paper SBOTC401	--	01	**01**	--	02
	SBOTP402	Lab 2/ Based on theory Paper SBOTC402	--	01	**01**	--	02
	SBOTP403	Lab 3/ Based on theory Paper SBOTC403	--	01	**01**	--	02
DSE Practical	**SBOTEP401**	Elective Lab/ Based on Elective Paper SBOTE401	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

M. Sc. First Year Semester I *(Level 6.0)*

Examination Scheme

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

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

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SBOTC401**	Diversity of Microbes	20	20	20	**80**	--	--	**100**
	SBOTC402	Diversity of Cryptogams	20	20	20	**80**	--	--	**100**
	SBOTC403	Taxonomy of Angiosperms and Gymnosperms	20	20	20	**80**	--	--	**100**
Elective (DSE)	**SBOTE401**	Bioinstrumentation and Methods in Biology	15	15	15	**60**	--	--	**75**
Research Methodology	**SVECR401**	Research Methodology	15	15	15	**60**	--	--	**75**
DSC Practical	**SBOTP401**	Lab 1 / Based on theory Paper SBOTC401	--	--	--	--	05	20	**25**
	SBOTP402	Lab 2/ Based on theory Paper SBOTC402	--	--	--	--	05	20	**25**
	SBOTP403	Lab 3/ Based on theory Paper SBOTC403	--	--	--	--	05	20	**25**
DSE Practical	**SBOTEP401**	Elective Lab/ Based on Elective Paper SBOTE401	--	--	--	--	05	20	**25**

M. Sc. First Year Semester II *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SBOTC451**	Cell Biology, Genetics and Plant Breeding	04	--	**04**	04	--
	SBOTC452	Plant Resource Utilization and Biodiversity Conservation	04	--	**04**	04	--
	SBOTC453	Plant Anatomy and Embryology of Angiosperms	04	--	**04**	04	--
Elective (DSE)	**SBOTE451**	Plant Ecology , Environmental Biology and Phytogeography	03	--	**03**	03	--
On Job Training / Field Project / Case Study	**SBOTOJ 451/ SBOTFP 451/ SBOTCS 451**	On Job Training (OJ) / Field Project (FC) / Case Study (CS)	--	03	**03**		03
DSC Practical	**SBOTP451**	Lab 1 / Based on theory Paper SBOTC451	--	01	**01**	--	02
	SBOTP452	Lab 2/ Based on theory Paper SBOTC452	--	01	**01**	--	02
	SBOTP453	Lab 3/ Based on theory Paper SBOTC453	--	01	**01**	--	02
DSE Practical	**SBOTEP451**	Elective Lab/ Based on Elective Paper SBOTE451	--	01	**01**	--	02
Total Credits			**15**	**07**	**22**	**15**	**11**

M. Sc. First Year Semester II *(Level 6.0)*

Examination Scheme

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

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

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SBOTC451**	Cell Biology, Genetics and Plant Breeding	20	20	20	**80**	--	--	**100**
	SBOTC452	Plant Resource Utilization and Biodiversity Conservation	20	20	20	**80**	--	--	**100**
	SBOTC453	Plant Anatomy and Embryology of Angiosperms	20	20	20	**80**	--	--	**100**
Elective (DSE)	**SBOTE451**	Plant Ecology , Environmental Biology and Phytogeography	15	15	15	**60**	--	--	**75**
On Job Training / Field Project / Case Study	**SBOTOJ 451/ SBOTFP 451/ SBOTCS 451**	On Job Training (OJ) / Field Project (FC) / Case Study (CS)	--	--	--	--	15	60	**75**
DSC Practical	**SBOTP451**	Lab 1 / Based on theory Paper SBOTC451	--	--	--	--	05	20	**25**
	SBOTP452	Lab 2/ Based on theory Paper SBOTC452	--	--	--	--	05	20	**25**
	SBOTP453	Lab 3/ Based on theory Paper SBOTC453	--	--	--	--	05	20	**25**
DSE Practical	**SBOTEP451**	Elective Lab/ Based on Elective Paper SBOTE451	--	--	--	--	05	20	**25**

Syllabus for M. Sc. Botany, First Year

Semester – I

As Per National Education Policy- 2020

To be implemented from

Academic Year 2023-2024

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Major Core Theory Course

Course Code – SBOTC 401

Title of the Course: DIVERSITY OF MICROBES

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of Bacteria, Viruses and lower plants such as fungi, lichens
2. To inspire students to study diversity of plant forms

Course outcomes:

1. Understand the morphology, structure and importance of the various organisms
2. Differentiate between various groups of Fungi, Bacteria, Viruses, and Lichens & Mycorrhiza.
3. Learn the life cycles of individuals belonging to Fungi, Bacteria, Viruses, Lichens & Mycorrhiza.

CURRICULUM DETAILS: SBOTC401: DIVERSITY OF MICROBES

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**BACTERIA**	
	1.1	General characters, Classification based on Bergey's manual, Ultra Structure, types, Structure of Endospore, Nutrition (Autotrophic, Heterotrophic and Symbiotic),	**15**
	1.2	Reproduction: Binary fission, Transformation, Transduction and Conjugation	
	1.3	Differential staining of bacteria- Gram Staining.	
	1.4	Symptoms of Bacterial diseases of plants, Bacterial Diseases: Citrus canker, Black arm of cotton and Soft rot of Potato. Economic importance of bacteria.	
2.0		**VIRUSES AND MYCOPLASMA**	
	2.1	Viruses: General characters, classification, chemical composition, Ultra structure of plant viruses (TMV), Multiplication, transmission of plant viruses and Symptoms of viral diseases of plants.	**15**
	2.2	Viral Disease: Bean Mosaic Virus, Leaf curl of Papaya and Yellow Vein Mosaic of Bhendi. Economic importance of viruses.	
	2.3	Mycoplasma: General characters, Ultra structure, Symptoms of Mycoplasma diseases of plants,	

	2.4	Mycoplasmal Diseases: Grassy shoot disease, Sessamum phyllody and Little leaf of brinjal. Economic importance of Mycoplasma.	
3.0		**INTRODUCTORY MYCOLOGY**	**15**
	3.1	Fungi: General characters, Classification (As per Ainsworth, 1973; Alexopoulos and Mims,1979),	
	3.2	Ultra structure of fungal cell, Thallus organization, Nutrition and reproduction (Asexual and Sexual).	
	3.3	Life cycle patterns and Phylogeny of different fungal groups- Gymnomycota, Mastigomycota and Amastigomycota: Zygomycotina, Ascomycotina, Basidiomycotina and Deteuromycotina.	
	3.4	Fungal Diseases: Early Blight of tomato, Downy mildew of grape and yellow rust of wheat.	
4.0		**APPLIED MYCOLOGY**	**15**
	4.1	Fungi as food and feeds: Mushrooms – Types, cultivation, nutritional and medicinal value.	
	4.2	Role of fungi in food processing, industry, medicine, agriculture, biological control of pests and fungi as bio fertilizers.	
	4.3	Mycorrhizae Types (Ecto and endo). formation of mycorrhizal association with plants.	
	4.4	Lichens: General characters, types and economic importance.	
		Total	**60**

SELECTED READINGS:

1. Vashishta B.R. (1990) Botany for Degree Students Part-I Algae, S. Chand & Co. New Delhi.
2. Vashishta B.R. (1990) Botany for Degree Students Part-II Fungi, S. Chand & Co. New Delhi.
3. Alexopolous C.J. & C.W. Mims (1979) Introductory Mycology Wiley Eastern Ltd., New Delhi
4. Smith G.M. (1971) Cryptogamic Botany Vol-I. Algae and Fungi, Tata McGraw Hill Publishing Co. New Delhi.
5. Dubey H.C. (1990) An Introduction to Fungi, Vikas Publishing House, New Delhi.
6. Sharma P.D. (1995) The Fungi, Rastogi & Co., Meerut.
7. Sharma O.P. (1992) A Text Book of Thallophytes, Tata McGraw Hill Publishing Co. New Delhi.
8. Fritsch F.E.(1945) The Structure and Reproduction of Algae Vol-I & II. Cambridge University Press.
9. Chapman V.J. and D.J. Chapman (1962) The Algae, English Language Book SocietyMcMillan, London.
10. Mehrotra R.S. and K.R.Aneja (1990) Introduction to Mycology, Wiley Eastern Ltd. New Delhi.
11. Pandey S.N.,P.S. Trivedi and S.P. Mishra. A Text Book of Botany Vol-I & II Vikas Publishing House, New Delhi.
12. Pandey B.P. (2000) College Botany Vol-I (Algae, Fungi, Bryophytes) S. Chand & Co. New Delhi.
13. Pandey B.P. (2000) College Botany Vol-II (Pteridophyta, Gymnosperms, Paleobotany) S. Chand & Co. New Delhi.
14. Clintion A (1958) Introduction to Bacteria McMillan, New York.
15. Bower F.O. (1988) Primitive Land Plants Vol-I & II, Arihant Publishers, Jaipur.
16. Gangule H.C. & Kar A.K. (1995) College Botany Vol-II, New Central Book Agency, Calcutta.
17. Rajan S. Sundra (1995) College Botany Vol-I & II Himalaya Publication House.
18. Saxena A.K.& Sarabhai R.P. (1968) Text Book of Botany Vol-I Ratan Prakashan Mandir, Agra.
19. Saxena A.K. & Sarabhai R.P. (1968) Text Book of Botany Vol-II Ratan Prakashan Mandir, Agra.

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Major Core Theory Course

Course Code – SBOTC 402

Title of the Course: DIVERSITY OF CRYPTOGAMS

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of Algae, Bryophyta and Pteridophyta .
2. To inspire students to study diversity of plant forms

Course outcomes:

1. Understand the morphology, structure and importance of the various organisms
2. Differentiate between various groups of Algae, Bryophyta and Pteridophyta .
3. Learn the life cycles of individuals belonging to Algae, Bryophyta and Pteridophyta .

CURRICULUM DETAILS: SBOTC402: DIVERSITY OF CRYPTOGAMS

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**ALGAE-I**	**15**
	1.1	Introduction, General characters and classification of algae as per F.E. Fritsch (1944) and G.M. Smith (1955),	
	1.2	Thallus organization, Habitat (terrestrial, fresh water, marine) and Ultra structure of algal cell. Pigments, reserve food, Types of flagella in algae and algal blooms	
	1.3	Reproduction (vegetative, asexual and sexual)	
	1.4	Algal Culture, Cultivation of Spirulin and SCP.	
2.0		**ALGAE-II**	**15**
	2.1	General Morphology, reproduction and Phylogenenetic considerations of Cyanophyta, Chlorophyta and Charophyta.	
	2.2	General Morphology, reproduction and Phylogenenetic considerations of Xanthophyta and Chrysophyta.	
	2.3	General Morphology, reproduction and Phylogenenetic considerations of Phaeophyta and Rhodophyta	
	2.4	Economic importance of Algae	
3.0		**BRYOPHYTA**	**15**

	3.1	Introduction: Habitat, Habit, distribution and outline of classification of Bryophytes as per Smith (1955) and Proskauer (1957).	
	3.2	Thallus organization: internal structure and reproduction in Marchantiales, Anthocerotales, Sphagnales and Funariales	
	3.3	Structure and evolution of gametophytes and sporophytes in Bryophytes	
	3.4	Economic importance of Bryophytes.	
4.0		**PTERIDOPHYTA**	
	4.1	General characters and classification (based on the classification proposed by Smith, 1955; Bold, 1957 and Zimmermann, 1959).	**15**
	4.2	Morphology, anatomy and reproduction in Psilotales, Lycopodiales, Equisetales, Filicales and Marsileales.	
	4.3	Steler organization and evolution in Pteridophytes	
	4.4	Heterospory and seed habit, Geological Time Scale and Fossilization process. Economic importance of Pteridophytes.	
		Total	**60**

SELECTED READINGS:

1. Smith G.M. (1971) Cryptogamic Botany Vol-II Bryophytes and Ptridophytes. Tata McGraw Hill Publishing Co. New Delhi.
2. Sharma O.P. (1992) A Text Book of Pteridophytes Tata McGraw Hill Publishing Co. New Delhi.
3. Vashishta B.R. (1990) Botany for Degree Students Part-III Bryophyta, S. Chand & Co. New Delhi.
4. Vashishta B.R. (1990) Botany for Degree Students Part-II Algae, S. Chand & Co. New Delhi.
5. Puri P. (1980) Bryophyta Atmaram & Sons. New Delhi.
6. Parihar N.S. (1965) An Introduction to Embryophyta Vol-I Bryophyta Central Book Depot, Allahabad.
7. Vashishta P.C. (1991) Botany for Degree Students Part-V Vascular Cryptogams (Pteridophyta), S. Chand & Co. New Delhi.
8. Parihar N.S. (1965) An Introduction to Embryophyta Vol-II Pteridophyta Central Book Depot, Allahabad.
9. Sharma O.P. (1992) A Text Book of Pteridophytes McMillan (India) Ltd
10. Rashid A (1976) An Introduction to Pteridophyta Vikas Publishing House, New Delhi
11. Sporne K.R. (1976) The Morphology of Pteridophytes B.I. Publication, Bombay
12. Pandey B.P. Text book of Botany Gymnosperms S. Chand & Co. Ltd. New Delhi.
13. Biswas C. B. M. Johri The Gymnosperms Narosa Publishing House, New Delhi.

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Major Core Theory Course

Course Code – SBOTC 403

Title of the Course: TAXONOMY OF ANGIOSPERMS AND GYMNOSPERMS

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course pre-requisite:

1. Students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To study and impart knowledge about the occurrence, distribution, structure and life history of Gymnosperms, Angiosperms and fossil plants.
2. To inspire students to study diversity of plant forms

Course outcomes:

1. Understand the morphology, structure and importance of the various organisms.
2. Differentiate between various groups of Gymnosperms, Angiosperms and fossil plants.
3. Learn the characters of taxa belonging to Gymnosperms, Angiosperms and fossil plants.

CURRICULUM DETAILS: SBOTC403: TAXONOMY OF ANGIOSPERMS AND GYMNOSPERMS

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**GYMNOSPERMS & PALAEOBOTANY**	**15**
	1.1	General characters and classification Gymnosperms as proposed by Professor Birbal Sahni (1920), Sporne (1965), S.P. Bhatnagar and Alok Moitra (1996).	
	1.2	Comparative account of sporophyte and gametophyte of Cycadales, Ginkgoales, Coniferales and Gnetales.	
	1.3	General account of Pteridospermales, Pentoxylales and Cordiatales. Economic importance of Gymnosperms.	
	1.4	Palaeobotany: Principles of palaeobotany, Fossilization: Process, types, methods of preservation. Geological time scale and importance of fossil plants.	
2.0		**GENERAL PRINCIPLES OF TAXONOMY**	**15**
	2.1	Aims and Principles of taxonomy, taxonomic structure	
	2.2	Origin of Angiosperms: Theories, cradle of angiosperms, abominable mystery, Continental drift theory.	
	2.3	Plant Speciation: Allopathic, Abrupt, Sympatric, Hybrid, Apomictic speciation, Isolating mechanisms.	
	2.4	Concept of species: Typological, Evolutionary and Biological. International Code of Nomenclature for algae, fungi and plants (ICNafp): Salient features, Principles, Important Rules and Recommendations, Provisions, Appendices.	

3.0		**PLANT SYSTEMATICS**	
	3.1	Comparative account of various systems of classification of angiosperms proposed by Linnaeus, Bentham and Hooker, Engler and Prantl, Cronquist and APG-IV system.	**15**
	3.2	Study of comparative account of following Angiospermic families- Magnoliaceae, Annonaceae, Rosaceae, Malvaceae, Apiaceae and Apocynaceae,	
	3.3	Study of comparative account of following Angiospermic families- Verbenaceae, Acanthaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Nyctaginaceae, and Euphorbiaceae	
	3.4	Study of comparative account of following Angiospermic families- Poaceae, Cannaceae and Orchidaceae.	
4.0		**MODERN TRENDS IN ANGIOSPERM TAXONMY**	
	4.1	Taxonomic evidences and techniques used in- Chemotaxonomy: Origin of chemotaxonomy, classes of compounds and their taxonomical significance, techniques	**15**
	4.2	Numerical taxonomy: Principles, Operational taxonomic Units (OTU), construction of taxonomic groups, cluster analysis and applications.	
	4.3	Molecular Systematics: Molecular techniques, restriction fragment length polymorphism (RFLP's), Random amplified polymorphic DNA (RAPD)	
	4.4	Applications of molecular systematics. Biosystematics: steps, categories and importance of bio systematic studies.	
		Total	**60**

SELECTED READINGS:

1. Davis P. H. and Heywood V.H. (1993) – Principles of Angiosperms Taxonomy Tobert E. Kreigher Pub. Co. New York
2. Grant. V. (1971) – Plant Speciation – Columbia University Press New York.
3. Harrison, H.J. (1971) – New concepts in flowering plant Taxonomy – Hieman Educational Books Ltd. London
4. Heslop – Harrison J. (1967) – Plant Taxonomy- English Language Book Soc. and Edward Arnold Pub. Ltd. UK.
5. Hey wood. V.H. and Moore D.M. (1984) – Current concepts in plant Taxonomy, Academic press, London.
6. Jones A.D. and Wilbins, A.D. (1971) – Variation and adaptations in plant species. Hieman & Co-Educational Books Ltd. London.
7. Jones S.B. Jr. and Luchsinger, A.E. (1986) – Plant systmatics (2nd edition) Mc Graw Hill Book Co., New York.
8. Nordenstam, B.EL Gazaly, G. and Kassas, M. Zoo – Plant systematic for 21st Century. Portland press Ltd. London.
9. Radford, A.E. (1986) – Fundamentals of plant systematics – Harper & Row Publications, USA.
10. Stebbins G.L. (1974) – Flowering plant Evolution Above species level – Edward Arnold Ltd., London.
11. Plant Taxonomy and Bio Systematics (2nd, edition) – Edward Arnold Ltd. London
12. Takhtajan A.L. (1997) Diversity and classification of flowering plant– Colubia University, press New York.
13. Woodland, D.W. (1991) – Contemporary plant systematics : Pentice Hall, New Jersey.
14. Flora of Osmanabad – V. N. Naik.
15. Flora of Marathwada – Chief Ed. By Dr. V.N. Naik.

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Elective Theory Course

Course Code – SBOTE 401

Title of the Course: BIOINSTRUMENTATION AND METHODS IN BIOLOGY

[No. of Credits: 3 Credit] **[Total 45 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

2. To know working hazards and safety measures in laboratory
3. To know principles and applications of various laboratory equipments

Course outcomes:

1. Understand the actual working and applications of different laboratory equipments
2. Learn the various techniques used in life sciences and their utility.

CURRICULUM DETAILS: SBOTE401: BIOINSTRUMENTATION AND METHODS IN BIOLOGY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**MICROSCOPIC AND STAINING TECHNIQUES**	**15**
	1.1	Introduction: Safe use of laboratory equipments, Personal protection, Hazards and waste disposal.	
	1.2	Microscopy-Working and application of simple microscope, compound microscope, phase contrast microscope and fluorescence microscope	
	1.3	Scanning and transmission electron microscope	
	1.4	Micrometry, flow cytometry, Microtomy- material selection, block designing, fixation, cutting and staining.	
2.0		**CHROMATOGRAPHIC AND STERILIZATION TECHNIQUES**	**15**
	2.1	Principle and applications of Paper chromatography, Thin layer chromatography and Column chromatography.	
	2.2	Principle and applications of Gel filtration, Ion exchange, affinity chromatography, Gas chromatography, HPLC, HPTLC.	
	2.3	Principles, working and applications of Laminar air flow, Autoclave, Hot air.	
	2.4	Principles, working and applications of oven, Incubator and pH Meter. Sterilization by filtration methods.	
3.0		**SPECTROSCOPIC AND RADIOACTIVE TECHNIQUES**	**15**

	3.1	Beer-Lamberts Law, Principles and techniques of colorimeter and UV-Visible Spectrophotometer	
	3.2	NMR, Atomic absorption Spectrometry and plasma emission spectroscopy.	
	3.3	X-ray diffraction, Radioactive isotopes and half life of isotopes, autoradiography, effect of radiations on biological systems, units of radioactivity, uses of radioisotopes in life sciences & biotechnology, detection and measurement techniques,	
	3.4	Liquid scintillation counting, solid state counting- Geiger counter - Radiation hazard & laboratory handling methods.	
4.0		**ELECTROPHORETIC AND CENTRIFUGATION TECHNIQUES**	**15**
	4.1	Electrophoresis: Principle and applications, Types- paper, gel-agarose, PAGE, pulsed field, capillary, isoelectric focusing, 2 D Electrophoresis, RFLP, RAPD and AFLP techniques.	
	4.2	Blotting techniques: western, southern & northern, methods and applications in life sciences.	
	4.3	Centrifugation: Principle and Applications of centrifugation techniques,	
	4.4	Designs of rotors, Bench top, Low speed, High speed, Cooling, Ultracentrifuge.	
		Total	**60**

SELECTED READINGS:

1. Biophysical Chemistry. M. Sataske, Y. Hayashi, M.S. Sethi, S A Iqbal, Discovery Publishing House (1997) New Delhi – 110002.
2. Practical Microbiology. R. C. Dubey, D K Maheshwari S Chand and company Ltd. New Delhi
3. Instrumental Methods of Chemical Analysis 5th Ed. Galen W Ewing. Mc Graw Hill International
4. Biotechniques Theory and Practice S Y S Rana Rastogi Publications, Meerat 250002
5. A manual of laboratory experiments in cell biology C Edward Gasque Universal book Stall, New Delhi.
6. Modern experimental biochemistry 3rd ed. Rodney Boyer Pearson education Inc.
7. Research Experiences in plant physiology.-A Laboratary Mannual Thomas C. Moore Spinger-Verlag,Berlin.
8. Biochemical methods 2nd ed. S. Sadasivam, A. Manickam. New Age International Publisher (P) Ltd, New Delhi.
9. Experiments in Microbiology, Plant Pathology and Tissue Culture K.R. Aneja, Wishwa Prakashan, New Delhi.
10. Frontiers in Applied Microbiology K.G. Mukerji, N C Pathak, Vedpal Sing Print Hall, Lucknow
11. Practical Microscopy Martin and Johnsen Blackie and Sen Limited, London
12. Freifelder D. M. Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd ed., W.H. Freeman, 1982.
13. Principles and Techniques of Biochemistry and Molecular Biology, ed, Keith Wilson & John Walker, March 2010, Cambridge Univ Press.
14. West & Todd. Biochemistry. 4th ed. Oxford and IBH.
15. Horst Friebolin. Basic One and Two-dimensional spectroscopy. VCH Publ, 1991 3.Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st ed. Wiley-Liss, 2001.

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Research Methodology Theory Course

Course Code – SVECR401

Title of the Course: RESEARCH METHODOLOGY

[No. of Credits: 3 Credit] **[Total 45 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To learn and practice the literature survey aspects of projects and prepare the scope and goals for the proposed project.
2. To learn, practice and improve the research presentation skills and with latest tools

Course outcomes:

1. Develop the ability to apply the methods while working on a research project wor
2. Develop a appropriate framework for research studies

CURRICULUM DETAILS: SVECR401: RESEARCH METHODOLOGY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**INTRODUCTION OF RESEARCH -I**	**12**
	1.1	Introduction of Research: Meaning of Research, its importance, aims and objectives, Identification and criteria of selecting a Research Problem (Hypothesis), literature collection, Research Plan and its components.	
	1.2	Methodology (Experimental design / Field data collection). Data presentation and interpretation. Drawing conclusions.	
	1.3	Hypothesis – Different Types – Significance – Development of Working Hypothesis, Null hypothesis	
	1.4	Research Methods: Scientific method vs Arbitrary Method, Logical Scientific Methods: Deductive, Inductive, Deductive-Inductive, pattern of Deductive – Inductive logical process – Different types of inductive logical methods.	
2.0		**INTRODUCTION OF RESEARCH -II**	**10**
	2.1	Scientific paper writing – Manuscript preparation and presentation. Research Journals, Impact Factor and paper citation index.	
	2.2	Major Research Institutes related to Plant Sciences in India.	
	2.3	A brief idea about Government Research and funding agencies, as DST, DBT, ICAR, ICMR, CSIR, UGC, CST, etc..	
	2.4	IPR and Patenting.	

3.0		**DATA COLLECTION AND ANALYSIS**	
	3.1	Sources of Data – Primary, Secondary and Teritary – Types of Data – Categorical, nominal & ordinal.	**10**
	3.2	Methods of Collecting Data : Observation, field investigations, Direct studies – Reports, Records or Experimental observations.	
	3.3	Methods of Collecting Data: Sampling methods, Data Processing and Analysis strategies, Graphical representation, Descriptive Analysis.	
	3.4	Methods of Collecting Data: Inferential Analysis- Correlation analysis, Least square method, Data Analysis using statistical package, Hypothesis, testing, Generalization and Interpretation and Modeling.	
4.0		**SCIENTIFIC WRITING**	
	4.1	Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports - Illustrations and tables – Bibliography, Referencing and foot notes – Importance of Effective Communication.	**13**
	4.2	Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, ISBN & ISSN.	
	4.3	Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – Budget and Justification – References	
	4.4	Documentation and scientific writing Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography	
		Total	**45**

SELECTED READINGS:

1. Arora, J.R.. Madhan Mohan, T., Rajendran, G.J., Kannan, S. And Nambiseshan, S. 1993. Research Profile of Biotechnology Activities in India-A Directory. PID, New Delhi.
2. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
3. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
4. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
5. Gupta S.P. (2008). Statistical Methods. 37 th ed. (Rev)Sultan Chand and Sons. New Delhi. 1470 p.
6. Leon & Leon (2202). Internet for everyone, Vikas Publishing House.
7. Wadehra, B.L.2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

8. Research Methodology Dr P M Bulakh,Dr P. S. Patki and Dr A S Chodhary 2010 Published by Expert Trading Corporation Dahisar West, Mumbai 400068
9. Banerjee, P.B. 2014. Introduction to Biostatistics. S.Chand & Company Pvt. Ltd., New Delhi, India.
10. Bhattacharya, D.K. 2013. Research Methodology, Excel Books, New Delhi. 5
11. Chandel, S.R.S. 1999. A Handbook of Agricultural Statistics. Acha Prakashan Mandir, Kanpur, India
12. Dhopte, A.M. and Livera-M, M. 1989. Useful Techniques for Plant Scientists. Publication of Forum for Plant Physiologist, R.D.G. College, Hostel-1, Akola-444001(M.S.), India.
13. Freeze, J.T. 2000. Sams' Teach yourself: Computer Basics. Macmillan Computer Pub, USA with Techmedia Pub, New Delhi.
14. Gupta, V. 2014. Rapidex Computer Course. Pustak Mahal, Delhi.
15. Harborne J.B. 1998. Phytochemical Methods - A Guide To Modern Technique of Plant Analysis, 3rd edn, Champan & Hall, UK.
16. Heldt, Hans-Walter. 2005. Plant Biochemistry. Academic Press- an Imprint of Elsevier, New Delhi, India.
17. Jain S. K. and R. R. Rao. 1977. Handbook of Field and Herbarium Techniques. Today and Tommorrows Printers and Publishers, New Delhi.
18. Kothari, C.R. and Garg, G. 2014. Research Methodology: Methods and Techniques. New Age International Publishers, New Delhi, India.
19. Kumar, R. 2012. Research Methodology: A Step-By-Step Guide for Beginners. SAGE Pub. India Pvt. Ltd., New Delhi.
20. Panse, V.G. and Sukhatme, P.V.1985. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India.
21. Singh, V.P. and Purohit, S. 2003. Research Methodology in Plant Sciences. Scientific Publishers (India), Jodhpur.
22. Snell, N. 1998. Sams' Teach yourself: The Internet Starter Kit. Macmillan Computer Pub, USA with Techmedia Pub, New Delhi.
23. Sundararaj, P. And Siddu, A. 1995. Qualitative Tests and Quantitative Procedures in Biochemistry. Wheeler & Co. Ltd., New delhi, India.
24. Swain T. 1963. Chemical Plant Taxonomy, Academic Press London
25. Wilson K and John Walker, 1999. Principles and Techniques of Practical Biochemistry, Cambridge University Press.

LABORATORY COURSE WORK
Semester-I
(Semester Pattern)

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Core Practical Course

Course Code – SBOTP401

Title of the Course: Based on theory Paper SBOTC401

[No. of Credits: 1 Credit] **Lab 1** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTP401: Lab 1 / Based on theory Paper SBOTC401

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Preparation of Stains (Cotton blue, Lactophenol, Gram's iodine, Crystal violet, Safranine, light green).	2
2.	Preparation of Culture media (PDA /Czapek Dox Agar/ Nutrient Agar.)	2
3.	Staining of bacteria by Gram's staining method.	2
4.	Isolation and identification of fungi from Air.	2
5.	Isolation and identification of fungi from Soil by dilution plate technique.	2
6.	Study of fungi: Stemonitis, Agaricus, Polyporus, Ganoderma.	2
7.	Determination of alcohol produced by Yeast (Saccharomyces cerevisiae)	2
8.	Estimation of Citric acid produced by Aspergillus niger.	2
9.	Antibiotics assay by Penicillium sp.	2
10.	Study of symptoms and causal organism of bacterial plant diseases: Citrus canker, Black arm of cotton and Soft rot of Potato	2
11.	Study of symptoms and causal organism of plant diseases caused by Viruses: Bean Mosaic Virus, Leaf curl of Papaya and Yellow Vein Mosaic of Bhendi	2
12.	Study of symptoms and causal organism of plant diseases caused by Mycoplasma:Grassy shoot disease, Sessamum phyllody and Little leaf of brinjal	2
13.	Study of symptoms and causal organism of plant diseases caused by Fungi: Early Blight of tomato, Downy mildew of grape and Yellow rust of wheat.	2
14.	Study of crustose, foliose and fruticose lichens.	2
15.	At least one long botanical excursion, two local study tours and visits to Industries, Research institutes, Agriculture universities etc.	2
	Total	**30**

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Core Practical Course

Course Code – SBOTP402

Title of the Course: Based on theory Paper SBOTC402

[No. of Credits: 1 Credit] **Lab 2** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTP402: Lab 2/ Based on theory Paper SBOTC402

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Identification, classification and description, of the algae Volvox, Hydrodictyon, Pithophora.	2
2.	Identification, classification and description, of the algae Nostoc, Oscillatoria.	2
3.	Identification, classification and description, of the algae Chara, Nitella, Xanthophyta-Botrydium, Vaucheria.	4
4.	Identification, classification and description, of the algae Laminaria, Sargassum, Ectocarpus, Diatoms	4
5.	Identification, classification and description, of the algae Fucus, Batrachospermum, Polysiphonia.	2
6.	Study of External and Internal Structure of Marchantia & Pellia.	2
7.	Study of External and Internal Structure of Anthoceros, Notothallus.	2
8.	Study of External and Internal Structure of Sphagnum and Funaria	2
9.	Study of Morphology, Internal Structure (Double stained slide preparation) and reproductive Structures of Psilotum, Lycopodium	2
10.	Study of Morphology, Internal Structure (Double stained slide preparation) and reproductive Structures of Equisetum and Marsilea	2
11.	Study of Morphology, Internal Structure (Double stained slide preparation) and reproductive Structures of Ophioglossum and Pteris	4
12.	At least one long Botanical excursion and two local study tours	2
	Total	**30**

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Core Practical Course

Course Code – SBOTP 403

Title of the Course: Based on theory Paper SBOTC403

[No. of Credits: 1 Credit] **Lab-3** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTP 403: Lab 3/ Based on theory Paper SBOTC 403

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of Morphology, Internal Structure (Double stained Slide Preparation) and Reproductive Structure of Thuja and Ephedra.	2
2.	Study of Morphology, Internal Structure (Double stained Slide Preparation) and Reproductive Structure of Araucaria and Ginkgo.	2
3.	Study of Morphology, Internal Structure (Double stained Slide Preparation) and Reproductive Structure of Taxus and Gnetum.	2
4.	Study of Fossil Gymnosperms with the help of Slides / Specimens.	2
5.	Description and identification of at least two plant species belonging to Family – Magnoliaceae, Annonaceae with their floral formulae and floral diagrams	2
6.	Description and identification of at least two plant species belonging to Family – Rosaceae with their floral formulae and floral diagrams	2
7.	Description and identification of at least two plant species belonging to Family – Malvaceae, Apiaceae with their floral formulae and floral diagrams	2
8.	Description and identification of at least two plant species belonging to Family – Apocynaceae, Verbenaceae with their floral formulae and floral diagrams	2
9.	Description and identification of at least two plant species belonging to Family – Acanthaceae, Rubiaceae with their floral formulae and floral diagrams	2
10.	Description and identification of at least two plant species belonging to Family – Cucurbitaceae, Asteraceae with their floral formulae and floral diagrams	2
11.	Description and identification of at least two plant species belonging to Family – Nyctaginaceae, Euphorbiaceae with their floral formulae and floral diagrams	2
12.	Description and identification of at least two plant species belonging to Family – Poaceae, Cannaceae with their floral formulae and floral diagrams	2
13.	Description and identification of at least two plant species belonging to Family – Orchidaceae with their floral formulae and floral diagrams	2
14.	Field trips within and around the campus for study of local flora.	2
15.	At least one Botanical excursion, compilation of field notes and preparation of wild and cultivated plants as are abundant	2
	Total	**30**

National Education Policy 2020

M.Sc. Botany, I Year (Semester - I)

Elective Practical Course

Course Code – SBOTEP 401

Title of the Course: Based on theory Paper SBOTE 401

[No. of Credits: 1 Credit] **Lab-4** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTEP401: Elective Lab/ Based on Elective Paper SBOTE401

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of Principle and working of laminar air flow & Autoclave	2
2.	Study of Principle and working of Incubator & Hot air Oven	2
3.	Sterilization of Media/Glassware with the help of autoclave and hot air oven.	2
4.	Study the principle and working of Simple and Compound microscope	2
5.	Demonstration of microscopes (phase contrast, fluorescence, SEM, TEM)	2
6.	Calibration of Microscope and measurement of microorganisms	2
7.	Micrometry of pollen grains	2
8.	Microtome section cutting and staining technique	2
9.	Separation of amino acids by paper chromatography or paper electrophoresis	2
10.	Separation of chlorophyll pigments by Paper or thin layer chromatography.	2
11.	Detection of plant proteins by Polyacrylamide Gel Electrophoresis	2
12.	Study the principle and working of pH meter and measurement of pH of soil / solutions.	2
13.	Analysis of DNA and RNA by one and two dimensional gel electrophoresis	2
14.	Visit to research centre (CCMB, NCL, CFTRI, ICRISAT, and BARC),	2
15.	Visit to Biotechnology/ Tissue culture laboratories, Agriculture Universities, Pharmaceutical industries etc.	2
	Total	**30**

Syllabus for M. Sc. Botany, First Year

Semester – II

As Per National Education Policy- 2020

To be implemented from

Academic Year 2023-2024

National Education Policy 2020

M.Sc. Botany, I Year (Semester -II)

Major Core Theory Course

Course Code – SBOTC 451

Title of the Course: CELL BIOLOGY, GENETICS AND PLANT BREEDING

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To understand basic aspects of cell, cell organelles.
2. To know various basic aspects and techniques used in genetics and plant breeding.

Course outcomes:

1. Understand the structural organization and functions of cell and cell organelles.
2. Able to understand Gene structure, linkage groups, Genetic inheritance and extra chromosomal inheritance in plants.
3. Understand basic techniques of hybridization.

CURRICULUM DETAILS: SBOTC451: CELL BIOLOGY, GENETICS AND PLANT BREEDING

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**CELL BIOLOGY**	**15**
	1.1	Structure and function of prokaryotic and eukaryotic cells, Structural organization and functions of Cell wall, Mitochondria, Vacuoles, Chloroplast, ER, Golgi Complex, Lysosome and Nucleus. Structure and function of cytoskeleton.	
	1.2	Chromosome- structure and function; Heterochromatin and Euchromatin. Karyotype.	
	1.3	Cell division and cell cycle- Mitosis, Meiosis, regulation and control of cell cycle.	
	1.4	Membrane structure and function- lipid bilayer and membrane protein. Cell signaling and cell receptors, G-Protein Coupled Receptor, signal transduction.	
2.0		**GENETICS-I**	**15**
	2.1	Introduction to pre Mendelian, Mendelian and Post Mendelian genetics	
	2.2	Gene Interaction and Epistasis	
	2.3	Linkage and Crossing over. Sex linked inheritance (Charecters, cause, and linkage in human and other organisms).	

	2.4	Sex determination (Chromosomal), Dosage Compensation Characters of multiple alleles; examples: A,B, AB and O blood groups in humans, Rh factor.	
3.0		**GENETICS-II**	**15**
	3.1	Gene structure and regulation of gene expression in Prokaryotic and Eukaryote. C-value paradox	
	3.2	Cytoplasmic inheritance (Mitochondria and Plastid).	
	3.3	Chromosomal aberrations-(Structural and Numerical)	
	3.4	Population genetics (Gene and genotype Frequency, Hardy-Weinberg law), gene pool. Factors affecting Gene frequency (selection, mutation, migration and genetic drift).	
4.0		**PLANT BREEDING**	**15**
	4.1	Breeding methods in crop plants (Self and cross pollinated crops)	
	4.2	Sexual reproduction (Cross and self pollination), asexual reproduction. Imcompatibility and Male sterility, their types, mechanisms and applications in plant breeding	
	4.3	Hybridization (types, procedure and its importance)	
	4.4	Heterosis (Definition, Genetic Basis and Methods of Estimation). Mutation breeding (Types and Role in plant breeding).	
		Total	**60**

SELECTED READINGS:

1. Lewin B. 2000. Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe S.L 1993 Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
4. Rost, T. Etal 1998. Plant Biology. Wadsworth Publishing Company, California, USA.
5. Krishnamurthy, K.V 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
6. Buchanan B.B, Gruissm W. and Jones R.L 2000. Biochemistry and Molecular.
7. Biology of Plant. American Society of Plant Physiologist, Maryland, USA.
8. De D.N 2000. Plant Cell Vacuoles : An Introduction. CISRO Publication, Collingwood, Australia.
9. Kleinsmith L.J and Kish V.M 1995. Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York, USA.
10. Lodish H., Berk A., Zipursky, S.L Matsudaira P., Baltimore D. and Darnell J. 2000. Molecular Cell Biology (Fourth Edition). W.H. Freeman and Company, New USA.
11. David Freifelder 1996. Essentials of Molecular Biology, Panima Publishing Company, New Delhi.
12. Brow T.A 2007 Genomes – 3 – Garland Science House, New York.
13. Malacinski G.M 2006 (Fourth Edition). Freifelders Essentials of Molecular Biology, Narosa Publishing House, New Delhi.
14. Rastogi V.B Concepts in Molecular Biology.
15. Twxman R.M 2003 (Third Reprint). Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
16. Watson J.D Etal. Molecular Biology of Gene. Forth Edition, Benjamin and Cummings Publishing Co., California.

National Education Policy 2020

M.Sc. Botany, I Year (Semester -II)

Major Core Theory Course

Course Code – SBOTC 452

Title of the Course: PLANT RESOURCE UTILIZATION AND BIODIVERSITY CONSERVATION

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To know economic importance of plant wealth
2. To know principles and strategies of Biodiversity and its conservation.
3. To study role of various organization in sustainable development.

Course outcomes:

1. Study of origin, cultivation and economic importances of various plant wealth
2. Learn the importance of biodiversity and motivation of students for its conservation

CURRICULUM DETAILS: SBOTC452: PLANT RESOURCE UTILIZATION AND BIODIVERSITY CONSERVATION

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**PLANT RESOURCE UTILIZATION**	**15**
	1.1	Domestication and introduction of plants, origin of cultivated plants, Vavilov's centers of origin.	
	1.2	Plants as source of food, fodder, fibre, spices, beverages, edible oils, drugs, narcotics, timber, gums, resins, dyes and latex	
	1.3	Medicinal and Aromatic plants. Plants as source of renewable energy	
	1.4	Role of biotechnology in agriculture, medicine, industry and green house technology.	
2.0		**BIODIVERSITY**	**15**
	2.1	Concept of Biodiversity: Species diversity, Genetic diversity, Ecosystem diversity.	
	2.2	Origin,values and Threats to Biodiversity. Biodiversity and agriculture; Biodiversity and food diversity.	
	2.3	Bioprospecting. Biodiversity in India, Endemism: Concept and types, endemic and endangered species of India,	
	2.4	Hot spots- Global and Indian. IUCN categories, Red data book, Convention on Biological Diversity (CBD).	
3.0		**CONSERVATION-I**	**15**

	3.1	Green revolution- Benefits and adverse consequences, Principles of conservation.	
	3.2	major approaches to conservation and current practices in conservation of genetic diversity, species diversity, ecosystem diversity.	
	3.3	Conservation strategies– In-situ conservation, Project tiger, biosphere reserves and sanctuaries.	
	3.4	Conservation strategies: National parks, Mangroves, on-farm and home garden conservation.	
4.0		**CONSERVATION-II**	
	4.1	Conservation strategies – Ex-situ conservation, principles and practices, germ plasm collections, Botanic gardens, seed banks, test tube gene banks, pollen banks, cryobanks, ex-situ conservation of microbes.	**15**
	4.2	Social approaches to conservation- sacred groves, sthala vrikshas.	
	4.3	Peoples movement for biodiversity conservation- Chipko movement, river dam and tribal campaign. Role of universities and other educational institutions in biodiversity conservation.	
	4.4	Role of BSI, NBPGR, ICAR, CSIR and Department of Biotechnology in sustainable development.	
		Total	**60**

SELECTED READINGS:

1. Biodiversity Consevation- Kotwal, Bonerjee Argobios, (India) 2000.
2. Biodiversity- Ramamurthi Rallapalli, Geetha Bai. APH Housing Corporation, New Delhi. (2002)
3. An advanced text Book on Biodivesity- K.V. Krishnamurthy Oxford & IBH Publishing, Co. Pvt. Ltd. (2006)
4. Kocchar, S.L. 1998. Economic Botany of the Tropics, 2nd edition. Macmillan India Ltd., Delhi.
5. Kothari, A. 1997. Understanding Biodiversity : Life Sustainability and Equity. Orient Longman.
6. Kohli, R., Arya, K.S., Singh, P.H. and Dhillon, H.S. 1994. Tree Directory of Chandigarh. Lovedale Educational, New Delhi.
7. Nair, M.N.B. etal (Eds) 1998. Sustainable Management of Nonwood Forest Products. Faculty of Forestry, University Putra Malaysia, 434004 PM Serdong, Selangor, Malaysia.
8. Paroda, R.S. and Arora, R.K. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Publication) South Asia Office, C/o NBPGR, Pusa Campus, New Delhi.
9. 29. Pimentel, D. and Hall, C.W. (Eds) 1989. Food and Natural Resources. Academic Press, London-New York.
10. Pinstrup-Anderson, P. 1999. World Food Prospects : Critical issues for the Early 21st Century. International Food Policy Research Institute, Washington, D.C., USA.

National Education Policy 2020

M.Sc. Botany, I Year (Semester -II)

Major Core Theory Course

Course Code – SBOTC 453

Title of the Course: PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

[No. of Credits: 4 Credit] **[Total 60 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. To study and impart knowledge about the plant anatomy, embryology and palynology of angiosperms.
2. To inspire students to study internal structure and development of plant.

Course outcomes:

1. Understand the anatomy, embryology and palynology of angiosperms.
2. Learn the applied aspects of palynology, embryology and anatomy.

CURRICULUM DETAILS: SBOTC453: PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**PLANT ANATOMY- I**	
	1.1	Introduction, importance and scope of histology and anatomy of plants.	**15**
	1.2	Types of meristem, Organization of root apical meristem (RAM), Lateral root and root hairs. Organization of Shoot Apical Meristem (SAM). Types of vegetative shoot apex. Cytological and molecular aspects of SAM.	
	1.3	Vascular tissue differentiation- Xylem and phloem.	
	1.4	Primary and secondary growth: stem and root. Wood development in relation to environmental factors.	
2.0		**PLANT ANATOMY- II**	
	2.1	Development, types and phyllotaxy of leaf, Leaf structure with reference to C3 and C4 plants and Kranz anatomy	**15**
	2.2	Structure and types of stomata and trichomes.	
	2.3	Floral meristem and floral development in Arabidopsis and Antirrhinum, Vascular anatomy of flower, Inferior ovary, transition to flowering and Role of floral anatomy in taxonomy	
	2.4	Secretary tissues: types and functions.	

3.0		**PLANT DEVELOPMENT**	
	3.1	Gametophyte in Angiosperms: outline and types of development of male and female gametophyte.	
	3.2	Ultrastructure of male gametophyte: Vegetative cell, generative cell, pollen wall, pollen tube, abnormal male gametophyte and their function	**15**
	3.3	Ultrastructure of female gametophyte: Synergids, Eggs, antipodal, central wall. Double Fertilization and triple fusion.	
	3.4	Development, types and functions of endosperm, Development and types of embryo. Polyembryony and apomixes, experimental embryology.	
4.0		**PALYNOLOGY**	
	4.1	Importance and scope of palynology, Application of palynology in oil exploration and forensic science. Pollen morphology and NPC classification.	
	4.2	Palynotaxonomy- Role of palynology in taxonomy, Palaeopalynology- Principles,	**15**
	4.3	Aeropalynology- Principles, techniques of pollen analysis, pollen calendar its importance, allergic properties of pollen,	
	4.4	Agropalynology- pollen viability, pollen germination, pollen storage and their significance.	
		Total	**60**

SELECTED READINGS:

1. Tayal M.S. (1983 Plant anatomy Rastogi Publication, Meerut.
2. Pandey B.P. (1993) Plant anatomy S. Chand & Co. Pvt. Ltd.
3. Saxena A.K., & Atext book of Botany Kitab Ghar, Gwaliar
4. R.P.Sarabhai (1975) Vol – II Embryophyta Pergamon Press Oxford.
5. Singh v, Pande P.C. D.K. Jain (1994) Anatomy of seed plants. Rastogi Publication, Meerut.
6. Esau K (1977) Anatomy of seed plants John Wiley & Sons, New York
7. Eames A.J. & L.H. MacDaniel (1974) Introduction to plant anatomy, Mc Graw Hill Book Co. New York.
8. Maheswari P. (1972) An introduction to embryology of Angiosperms, Tata Mc Graw Hill Pub. Co. Ltd. New York.
9. Bhojwani S.S. & Bhatnagar S.P.(1974) Embryology of Angiosperms Vikas Publication House, Pvt. Ltd. New Delhi.

National Education Policy 2020

M.Sc. Botany, I Year (Semester -II)

Elective Theory Course

Course Code – SBOTE 451

Title of the Course: PLANT ECOLOGY, ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY

[No. of Credits: 3 Credit] **[Total 45 Lectures]**

Course pre-requisite:

1. The students who passed B. Sc. with Botany as one of the optional subjects with 24 credits are eligible to take admission for PG course in Botany.

Course objectives:

1. Acquainted with basic concepts of Ecology, Ecosystem, and phytogeography
2. To learn basic aspects of recent problems related to enviormental biology

Course outcomes:

1. Able to understand the ecological principles, structure and functions of ecosystem.
2. Learn about the causes of environmental pollution and its control measures.
3. Learn about different phytogeographic regions and their vegetation pattern.

CURRICULUM DETAILS: SBOTE451: PLANT ECOLOGY, ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**ECOLOGY**	
	1.1	Introduction- Scope and importance of ecology in India, Ecological tools and techniques, Sampling techniques of population, methods of estimating primary production and consumer production.	**15**
	1.2	Ecosystems - Concepts of ecosystem, Function of Ecosystem – Energy flow and Mineral cycling (C, N, P),	
	1.3	Structure and function of some Indian ecosystems – Terrestrial ecosystem (Grassland and Forest ecosystem), Aquatic ecosystem (Fresh water, marine and estuarine ecosystem)	
	1.4	Food chains, Food webs and ecological pyramids.	
2.0		**POPULATION ECOLOGY**	
	2.1	Characterization of a population, population growth curves, population regulation, life history strategies (Y and K selection),	**15**
	2.2	Concepts of metapopulation- demes and dispersal, interdemic extinctions, age structured populations.	
	2.3	Community ecology- Nature of communities, community structure, levels of species diversity and its measurement, edges and ecotones.	
	2.4	Ecological succession – Types, mechanism, changes involved in	

		succession, concept of climax.	
3.0		**ENVIRONMENTAL BIOLOGY**	**15**
	3.1	The Environment – Physical and biotic environment, biotic and abiotic interactions.	
	3.2	Environmental pollution – Causes, effects and control measures of air, water, soil and thermal pollution, Nuclear hazards, phytoremediation,	
	3.3	Global warming and climate change, acid rains, ozone layer, ozone hole.	
	3.4	Social issues and the environment – EPA 1986, Urban problems related to energy, water conservation, rain water harvesting, environmental ethics, issues and possible solutions.	
4.0		**PHYTOGEOGRAPHY**	**15**
	4.1	Phytogeography: introduction, Botanical provinces of India and their characteristic vegetation.	
	4.2	Forest types of India. Ecological importance of forests, aforestation, deforestation, social forestry	
	4.3	Geographical history, Continental Drift, Land Bridges, shifting of poles.	
	4.4	Theories of differentiation and natural selection, types and areas of natural distribution and theory of tolerance.	
		Total	**60**

SELECTED READINGS:

1. India's Environment Crises and Responces J. Bandyopathyay, N. D. Jayal, U. Schoetlli, Chhatrapatising. Natraj Publication, Rajpur Road, Dehradun. (1985)
2. Air Pollution- Physiological Effects, James J., Charles D. Barnes, McGrath Academic Press, New Yark, Landon. (1987)
3. Photochemistry Of Air Pollution Philip A. Leighton Academic Press, New Yark, Landon. (1961)
4. Air Pollution (Vol. II)- Arthur C. Stern Academic Press, (Third Edition) New Yark, Landon. (1977)
5. Concepts of Ecology Edward J. Kormondy Perntice Hall of India Pvt Ltd. (1974)
6. Current Pollution- Researches in India, R.K. Trivedy, P.K. Goel. Environmental Publications, Karad. (1985)
7. Molecular Approaches to Ecology Marcel, Ernest schoffeniels. Florkin and Academic press, New Yark. (1969)
8. Fundamentals of Ecology- Eugene P. Odum, Natraj Publishers, Dehra Dun. (1996) 9. Environmental Studies H. Kaur Pragatiprakashan. (2005)
9. Elements of Ecology P. D. Sharma Rastogi Publications.
10. Elements of Ecology George L. Clarke Johnwiley & sons, Inc. New Year, London. (1954)
11. Ecology & Environment- P.D. Sharma, Rastogi Publications. (1996)
12. Environmental Science S.C. Santra New Central Book Agency, Pvt. Ltd. (2005)
13. Respectives in Environment- Dr. S.K. Agarwal, J.P. Kaushik, K.K. Koul, A.K. Jain.
14. A.P.H. Housing Carporation, New Delhi. (1998)
15. Environmental Awareness- Dr. D.N. Khairnar Vision Publications.
16. Environmental Pollution- Timmy Katyal, M. Satake (1998), Anmol Publications, Pvt. Ltd.

Air Pollution & Plant Life Michael Treshow John Wiley & Sons .(1984)

LABORATORY COURSE WORK
Semester-II
(Semester Pattern)

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M.Sc. Botany, I Year (Semester -II)

Core Practical Course

Course Code – SBOTP 451

Title of the Course: Based on theory Paper SBOTC 451

[No. of Credits: 1 Credit] **Lab-1** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTP451: Lab 1 / Based on theory Paper SBOTC451

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of different stages of mitosis and determination of mitotic index in *Allium/ Aloe/ Chlorophytum/* Pea	2
2.	Study of mitotic abnormalities in *Allium* cells by chemical treatments	2
3.	Study of different stages of meiosis and meiotic irregularities in *Allium* and *Rhoeo/ Tradeschantia*	2
4.	Isolation of Mitochondria from eukaryotic cell	2
5.	Isolation of Chloroplasts from plant cell	2
6.	Study of ultramicroscopic structures of cell organelles with the help of Photographs (Golgi apparatus, Ribosomes,Chloroplast,Mitochondria E.R. and Nucleus,)	2
7.	Study of mutation in Yeast/Bacteria by replica plate technique.	2
8.	Study of Karyotype and ideogram in plants/ human	2
9.	Determination of blood grouping	2
10.	Problems based on Gene interaction	2
11.	Problems based on Multiple alleles.	2
12.	Problems based on Gene mapping	2
13.	Problems based on linkage & Hardy Weinberg equation	2
14.	Emasculation and bagging of flowers of Brasicaceae, Malvaceae, and liliaceae, pollinating them manually and estimating fruit and seed set.	2
15.	Visit to research institutes / Biotechnology/ Tissue culture laboratories / Agriculture Universities.	2
	Total	**30**

National Education Policy 2020

M.Sc. Botany, I Year (Semester -II)

Core Practical Course

Course Code – SBOTP 452

Title of the Course: Based on theory Paper SBOTC 452

[No. of Credits: 1 Credit] **Lab-2** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTP452: Lab 2/ Based on theory Paper SBOTC452

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Methods of Cultivation, harvesting and economic importance of food, fodder plants.	2
2.	Methods of Cultivation, harvesting and economic importance of vegetable, fruits, spices and oil yielding plants.	2
3.	Qualitative tests for carbohydrates, proteins and starch from given materials-cereals, pulses, oils/fats, spices.	2
4.	Study of morphology, anatomy, microscopic study of whole fiber using appropriate stain of textile fibers (cotton, jute) cordage fiber (coir).	2
5.	To estimate the reducing and non-reducing sugars from different fruit juices and food materials.	2
6.	Study of medicinal uses and properties of (Neem, Adhatoda, Ocimum, Garlic Aloe,)	2
7.	Study of medicinal uses and properties of (Mentha, Withania, Asparagus, Brahmi)	2
8.	Determination of chemical nature of gums, resins, dyes, by Performing simple chemical test.	2
9.	Determination of chemical nature of Narcotics, insecticides, & beverages by Performing simple chemical test.	2
10.	To estimate protein from food materials by suitable method.	2
11.	To estimate carbohydrates from food materials by suitable method.	2
12.	Case studies on conservation strategies for plants in India.	2
13.	Scientific visits to Biosphere reserves, National parks, Sanctuary, A mangrove forests,NBPGR New Delhi or its regional circles, Head quarters of BSI or one of its regional circles.	2
14.	Scientific visits to CSIR laboratories, doing research on plant utilization, ICAR research station	2
15.	Scientific visits to field station, Recognized botanical garden/museum (FRI Dehradun, NBRI Lucknow	2
	Total	**30**

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M.Sc. Botany, I Year (Semester -II)

Core Practical Course

Course Code – SBOTP 453

Title of the Course: Based on theory Paper SBOTC 453

[No. of Credits: 1 Credit] **Lab-3** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTP 453: Lab 3/ Based on theory Paper SBOTC 453

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of root and shoot apical meristems with the help of permanent slides.	2
2.	Study of epidermal peels for stomatal types / stomatal index	2
3.	Study of trichomes	2
4.	Study of Leaf phyllotaxy in plants	2
5.	Study of leaf anatomy in C3 and C4 plants.	2
6.	Study of secretary tissues with the help of permanent slides	2
7.	Study of Xylem elements by maceration technique	2
8.	Preparation and staining of slides for the study of floral anatomy by microtome technique.	2
9.	Microscopic examination of Pollengrains by Chitale technique.	2
10.	Pollen viability test by using tetrazolium salts	2
11.	Pollen germination test hanging drop / sitting drop cultures,/ suspension culture or surface culture.	2
12.	Study of monosporic, bisporic and teltrasporic types of embryo sac development through examination of permanent stained serial sections.	2
13.	Study of nuclear cellular endosperm through dissections and staining	2
14.	Field study of several types of flower with different pollination mechanisms (wind pollination, Bat pollination, bee/butterfly pollination, bird pollination).	2
15.	One long and two short botanical excursion arranged by the department.	2
	Total	**30**

National Education Policy 2020

M.Sc. Botany, I Year (Semester -II)

Elective Practical Course

Course Code – SBOTEP 451

Title of the Course: Based on theory Paper SBOTE 451

[No. of Credits: 1 Credit] **Lab-4** **[Total 30 Lectures]**

CURRICULUM DETAILS: SBOTEP 451: Elective Lab/ Based on Elective Paper SBOTE 451

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use test for comparing two means related ecological data.	2
2.	To find out the relationship between two ecological variables using correlation and regression analysis.	2
3.	To study the vegetation by Line Transect method	2
4.	To determine minimum size and number of quadrates required for reliable estimate of biomass in grassland.	2
5.	To determine IVI of the species in grass land using suitable method & state whether vegetation is homogeneous or heterogeneous	2
6.	To determine gross and net phytoplankton productivity by light & dark bottle method.	2
7.	To determine the soil carbonates by rapid titration method.	2
8.	To find out association between important grassland species using Chi-square test.	2
9.	To determine the water holding capacity of soils collected from different locations.	2
10.	To determine percent organic carbon and organic matter in the soils of cropland and grassland ecosystem	2
11.	To determine percent organic carbon and organic matter in the soils of forest ecosystem	2
12.	To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by Winkler's method.	
13.	To determine the biochemical oxygen demand (BOD) of polluted water.	2
14.	Field visit to study different terrestrial ecosystem of India.	2
15.	Field visit to study different aquatic ecosystem of India.	2
	Total	**30**

Guidelines for Course Assessment:

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score (col 6).

B. End Semester Assessment (80% of the Maximum Marks):

(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)

1. **ESA Question paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

Note: Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45lectures.

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