॥ 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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E-mail: bos@srtmun.ac.in

शैक्षणिक वर्ष २०२४–२५ पासून लागू व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार पदव्युत्तर स्तरावरील सुधारित अभ्यासक्रमा बाबत....

प रि प त्र क

संदर्भ :– १. जा.क.शै–१/एनईपी/विवत्रविपदवी/२०२४–२५/१०९ दिनांक १२/०६/२०२४

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, संदर्भीय परिपत्रकान्वये दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीतील विषय क्र. १५/५९–२०२४ अन्वये मान्यता दिल्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार अभ्यासक्रम शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्यात आलेले आहेत. तथापी वरील संदर्भीय परिपत्रका अन्वये प्रकाशित केलेल्या M. Sc. Botany II year Affiliated college अभ्यासक्रमामध्ये अभ्यासमंडळानी किरकोळ दुरुस्ती करून अभ्यासक्रम सादर केला असून मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा यांच्या मान्यतेने दुरुस्ती 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/एनईपीपीजीदुरुस्ती/S&T/
२०२४–२५/२१५
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. Second Year

BOTANY

(For Affiliated Colleges)

To be implemented from

Academic year 2024 - 2025

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-III &IV 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 in Botany
Swami Ramanand Teerth Marathwada University, Nanded

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

Sr No	Name of the Member	Designation	Address	Contact No.
1.	Dr. Saheb Laxmanrao Shinde	Chairman	Yeshwant Mahavidylaya, Nanded	7588151967
2	Dr. Babasaheb 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	Anjali Raut	PG Student	C/o Dayanand Science College Latur	7666670721
16	Diobale Sanyukta	UG Student	C/o Sahir Annabhau Sathe College, Mukhed	9021845705

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)**	**SBOTRM401** *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 (3Cr)**	**SBOTE501 (3+1 Cr)** ***(From same Department / School)***	--		Research Project **SBOTRP551** **(4Cr)**	**SBOTP501 (1 Cr)** **SBOTP502 (1 Cr)** **SBOTP503 (1 Cr)** **SBOTEP501 (1 Cr)**	22	44
	4	**SBOTC551 (4 Cr)** **SBOTC552 (4 Cr)**	**SBOTE551 (3+1 Cr)** ***(From same Department / School)***	**SBOTPE 551** Publication Ethics (2 Cr)		Research Project **SBOTRP552** **(6 Cr)**	**SBOTP551 (1Cr)** **SBOTP552 (1Cr)** **SBOTEP551 (1Cr)**	22	
Total Credits		**43**	**12+04**	**05**	**03**	**10**	**11**	**88**	

M. Sc. Second Year Semester III (*Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SBOTC501**	Plant Physiology	04	--	**04**	04	--
	SBOTC502	Molecular Biology and Biostatistics	04	--	**04**	04	--
	SBOTC503	Pharmacognosy and Phytochemistry	03	--	**03**	03	--
Elective (DSE)	**SBOTE501 Or SBOTE502 Or SBOTE503**	Classical Angiosperm Systematics Or Fundamentals of Plant Pathology Or Seed Technology-I	03	--	**03**	03	--
Research Project	**SBOTRP501**	Research Project	--	--	**04**	--	
DSC Practical	**SBOTP501**	Lab 1 / Based on theory Paper **SBOTC501**	--	01	**01**	--	02
	SBOTP502	Lab 2/ Based on theory Paper **SBOTC502**	--	01	**01**	--	02
	SBOTP503	Lab 3/ Based on theory Paper **SBOTC503**	--	01	**01**	--	02
DSE Practical	**SBOTEP 501 Or SBOTEP 502 Or SBOTEP 503**	Based on Elective Paper **SBOTE501** Or Based on Elective Paper **SBOTE502** Or Based on Elective Paper **SBOTE503**	--	01	**01**	--	02
Total Credits			**14**	**04**	**22**	**14**	**08**

M. Sc. Second Year Semester III *(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	**SBOTC501**	Plant Physiology	20	20	20	**80**	--	--	**100**
	SBOTC502	Molecular Biology and Biostatistics	20	20	20	**80**	--	--	**100**
	SBOTC503	Pharmacognosy and Phytochemistry	15	15	15	**60**	--	--	**75**
Elective (DSE)	**SBOTE501 Or SBOTE502 Or SBOTE503**	Classical Angiosperm Systematics Or Fundamentals of Plant Pathology Or Seed Technology-I	15	15	15	**60**	--	--	**75**
Research Project	**SBOTRP501**	Research Project	20	20	20	**80**	--	--	**100**
DSC Practical	**SBOTP501**	Lab 1 / Based on theory Paper SBOTC501	--	--	--	--	05	20	**25**
	SBOTP502	Lab 2/ Based on theory Paper SBOTC502	--	--	--	--	05	20	**25**
	SBOTP503	Lab 3/ Based on theory Paper SBOTC503	--	--	--	--	05	20	**25**
DSE Practical	**SBOTEP 501 Or SBOTEP 502 Or SBOTEP 503**	Based on Elective Paper **SBOTE501** Or Based on Elective Paper **SBOTE502** Or Based on Elective Paper **SBOTE503**	--	--	--	--	05	20	**25**

M. Sc. Second Year Semester IV *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SBOTC551**	Biochemistry and Plant Metabolism	04	--	**04**	04	--
	SBOTC552	Biotechnology and Genetic Engineering	04	--	**04**	04	--
Elective (DSE)	**SBOTE551 Or SBOTE552 Or SBOTE553**	Advance Angiosperm Systematics Or Physiological Plant Pathology and Plant Diseases Or Seed Technology-II	03	--	**03**	03	--
Publication Ethics	**SBOTPE551**	Publication Ethics	02	--	**02**	02	--
Research Project	**SBOTRP1551**	Research Project	--	--	**06**	--	--
DSC Practical	**SBOTP551**	Lab 1 / Based on theory Paper **SBOTC551**	--	01	**01**	--	02
	SBOTP 552	Lab 2/ Based on theory Paper **SBOTC552**	--	01	**01**	--	02
DSE Practical	**SBOTEP 551 Or SBOTEP 552 Or SBOTEP 553**	Based on Elective Paper **SBOTE551** Or Based on Elective Paper **SBOTE552** Or Based on Elective Paper **SBOTE553**	--	01	**01**	--	02
Total Credits			**13**	**03**	**22**	**13**	**06**

M. Sc. Second Year Semester IV *(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	**SBOTC551**	Biochemistry and Plant Metabolism	20	20	20	**80**	--	--	**100**
	SBOTC552	Biotechnology and Genetic Engineering	20	20	20	**80**	--	--	**100**
Elective (DSE)	**SBOTE551 Or SBOTE552 Or SBOTE553**	Advance Angiosperm Systematics Or Physiological Plant Pathology and Plant Diseases Or Seed Technology-II	15	15	15	**60**	--	--	**75**
Publication Ethics	**SBOTPE551**	Publication Ethics	10	10	10	**40**	--	--	**50**
Research Project	**SBOTRP551**	Research Project				**150**			**150**
DSC Practical	**SBOTP551**	Based on theory Paper **SBOTC551**	--	--	--	--	05	20	**25**
	SBOTP 552	Based on theory Paper **SBOTC552**	--	--	--	--	05	20	**25**
DSE Practical	**SBOTEP 551 Or SBOTEP 552 Or SBOTEP 553**	Based on Elective Paper **SBOTE551** Or Based on Elective Paper **SBOTE552** Or Based on Elective Paper **SBOTE553**	--	--	--	--	05	20	**25**

Syllabus for M. Sc. Botany, Second Year

Semester – III

As Per National Education Policy- 2020

To be implemented from

Academic Year 2024-2025

National Education Policy 2020

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

Major Core Theory Course

Course Code – SBOTC 501

Title of the Course: PLANT PHYSIOLOGY

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

Course objectives:

1. To understand basic aspects plant life processes.
2. To understand role of light and hormones in plant.
3. To know process of food synthesis and its breakdown in plants

Course outcomes:

1. Understanding the mechanism of different water based process in plants.
2. Able to understand role of light, hormone in controlling plant activity
3. Understand important plant process i.e. photosynthesis and respiration.

CURRICULUM DETAILS: SBOTC 501: PLANT PHYSIOLOGY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module-I:PLANT WATER INTER-RELATIONS AND MINERAL NUTRITION**	**15**
	1.1	**Introduction:** Scope and Importance of Plant Physiology. Physicochemical properties and importance of water in plant life**:** Solutions, Suspensions, Colloidal System, Diffusion, Osmosis, Imbibitions and Concept of Water Potential.	
	1.2	**Water absorption and Transportation in plants:** Uniport, Symport, Antiport channels, Phloem transports across the plant, Mechanism of Phloem Loading and Unloading source and sink relationship.	
	1.3	**Transpiration:** Types of transpiration, Structure of stomata, Mechanism and theories.	
	1.4	**Macro and Micronutrient**: Source, role and deficiency symptoms of different Macro and Microelements.	
2.0		**Module-II:PHOTOBIOLOGY, HORMONE PHYSIOLOGY AND PLANT MOVEMENT**	**15**
	2.1	**Phytochromes**: Properties of Phytochromes, red and far red pigment system. Role of Phytochromes on plant development.	
	2.2	**Phenomenon of Photoperiodism and Vernalization.** **Seed dormancy**: Causes and methods of breaking	
	2.3	**Hormonal Physiology**: Biochemistry, Mode of actions, Mechanism of biosynthesis and Practical applications of Auxin, Gibberellin, Cytokinin, Abscisic acid and Ethylene.	
	2.4	**Plant Movement**: Introduction and types of spontaneous and induced plants movement.	

3.0		**Module-III:PHOTOSYNTHESIS**	
	3.1	**Photochemistry**: Nature and Properties of light, quantum requirement and quantum yield,	**15**
	3.2	Ultra structure of chloroplast, Location and organization of photosynthetic pigments.	
	3.3	**Photosynthesis**: Hill Reaction, concept of two pigment system, Electron transport system or Z – scheme: cyclic, non cyclic, photophosphorylation and ATP synthesis, Photosynthetic carbon reduction pathways : C3, C4 and CAM plants.	
	3.4	Biochemistry of RUBISCO, Photorespiration and its significance.	
4.0		**Module-IV:RESPIRATION**	
	4.1	**Cell Respiration**: Introduction to plant respiration, respiration types and locations, fermentations and its types, Ultra-structure of Mitochondria, concept of RQ.	**15**
	4.2	**Glycolysis**: Mechanism and its significance.. **Kerb's cycle**: Mechanism and significance, **Electron transport system** and oxidative phosphorylation, mechanism of ATP synthesis.	
	4.3	**Pentose Phosphate Pathway** and its significance, **Glyoxalate** pathway.	
	4.4	Energetics of respiration, Factors affecting on respiration.	
		Total	**60**

SELECTED READINGS:

1. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologistsm Maryland, USA.
2. Saheb L. Shinde and Parshuram V. Pawar. Plant Physiology, Biochemistry and Biotechnology. Vidyawati publication Latur.
3. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.
4. Galstone A.W. 1989. Life processes in Plants. Scientific American Library,Springer Verlag, New York, USA..
5. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer –Verlag, New York, USA.
6. Salibury F.B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.
7. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
8. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates,
9. Inc. Publishes, Massachusetts, USA. 9. Thomas B. and Vince-Prue D. 1997. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA.
10. Verma S.K. and Verma Mohit 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.
11. Leninger A.C 1987. Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint)
12. Devilin and Witham. 2001 Plant physiology. CBS Publisher and distributor New Delhi.
13. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
14. Jain J. L. 2010 Fundamentals of Biochemistry, S.Chand Publications.
15. Jain V. K 2005. Fundamentals of plant physiology S. Chand Publications
16. Sadasivam, S. and Manickam A., 1996. Biochemical methods (2nd Edition). New Age International Publisherublishers New Delhi
17. Plummer, D.T. 1988. An Introduction to practical Biochemistry. Tata McGraw Hill Publishing Co.Ltd.New Delhi

National Education Policy 2020

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

Major Core Theory Course

Course Code – SBOTC 502

Title of the Course: MOLECULAR BIOLOGY AND BIOSTATISTICS

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

Course objectives:

1. To understand DNA characters and its functions.
2. To understand organization and expression of genome.
3. To understand importance of statistics in biology

Course outcomes:

1. Detailed understanding about the nucleic acid.
2. Able to understand expression and regulation of different proteins in body
3. Understanding and interpretation of various statistical tools in biological experiments.

Curriculum Details: SBOTC502: Molecular biology and biostatistics

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module-I: MOLECULAR BIOLOGY**	**15**
	1.1	Basics of Nucleic acids; Structure and chemical, physical, spectroscopic and thermal properties of nucleic acids (Buoyant density, melting temperature, effect of acid and alkali, UV absorption, hypo and hyperchromicity);	
	1.2	Nuclear DNA content, Dissociation and reassociation kinetics of DNA, Cot curves, Cot ½ values and its significance.	
	1.3	Unique, moderately repetitive and highly repetitive DNA, forms of DNA;	
	1.4	Prokaryotic Transcription; Transcription unit; Promoters, Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Transcriptional regulation-Positive and negative, Eukaryotic transcription and regulation; RNA polymerase.	
2.0		**Module-II:GENOME ORGANIZATION AND REGULATION**	**15**
	2.1	Organization and structure of prokaryotic and eukaryotic genes; structure and role of promoters, exons, introns, terminators and enhancers.	
	2.2	Mechanism of prokaryotic and eukaryotic DNA replication, Enzymes of DNA replications and their role, Models of replication, replication apparatus, Origins of replication, priming and DNA polymerases.	
	2.3	Regulation of gene expression in pro-and eukaryotes, Attenuation and antitermination,	
	2.4	Operon concept and types, DNA methylation, Heterochromatization,	

		Regulatory sequencesand transcription factors, Environmental regulation of gene expression.	
3.0		**Module-III:PROTEIN SYNTHESIS AND BACTERIAL GENETICS**	**15**
	3.1	Processing of tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; Translation machinery;	
	3.2	Ribosomes- Composition and assembly; Genetic Code; Mechanism of initiation, elongation and termination; post-translational modifications;	
	3.3	Mobile DNA - conjugative and non-conjugative plasmids, insertional sequences, and transposons,	
	3.4	Bacterial growth and Genetics, genetic transformation, conjugation and transduction in bacteria, genetic recombination, Plaque formation, Lytic and lysogenic cycles. Specialized transduction, site specific recombination, genetic map of Lambda (λ) phage.	
4.0		**Module-IV:BIOSTATISTICS**	**15**
	4.1	Central value- Mean, mode, median, mean deviation, standard deviation and coefficient of variation	
	4.2	Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics;	
	4.3	Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X2 test;	
	4.4	Basic introduction to Multivariate statistics, Hypothesis tests, Types of errors, P-values, ANOVA.	
		Total	**60**

SELECTED READINGS:

1. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists. Maryland, USA
2. Jain J. L. 2010 Fundamentals of Biochemistry, S.Chand Publications.
3. 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 York, USA
4. Plummer, D.T. 1988. An Introduction to practical Biochemistry. Tata McGraw Hill Publishing Co.Ltd.New Delhi.
5. Sadasivam, S. and Manickam A., 1996. Biochemical methods (2nd Edition). New Age International Publishers New Delhi
6. Sambrook J and Russell DW (2001). Molecular Cloning – A Laboratory Manual, Vols I – III, Cold Spring Harbor Laboratory, USA.
7. Hammes GD (2005) Spectroscopy for the Biological Sciences; Wiley Interscience USA.
8. Harlow and Lane D (Eds.) (1988) Antibodies – A Laboratory Manual; Cold Spring
9. Harbor Laboratory, USA. 9. David Edwards (Ed.) (2007) Plant Bioinformatics: Methods and Protocols, Humana Press, New Jersey, USA. David Edwards (Ed.) (2007) Plant Bioinformatics: Methods and Protocols, Humana Press, New Jersey, USA.
10. Kulas JT (2008) SPSS Essential: Managing and Analyzing Social Science Data. John Wiley & Sons, New York.
11. Pagano M, Gauvreau K (2007) Principles of Biostatistics. Thomson India Edition, New Delhi.
12. Randal Schwartz, Tom Phoenix and Brian d Foy (2005) Learning Perl (4th edition), O'Reilly & Associates, ISBN: 0-596-10105-8.
13. Singer M and Berg P (1991). Genes and Genomes: A Changing Perspective; University Science

Books, CA, USA.
14. Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of Genetics Saunders College Publishing, Frot Worth, USA.
15. Busch, H. and Rothblum. L 1982. Volume X. The Cell Nucleus rDNA part A. Academic Press.
16. Karp, G. 1999. Cell and Molecular Biology : Concept and Experiments. John Wiley and Sons, Inc., USA.
17. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
18. Lewis, R. 1997. Human Genetics : Concepts and Application (Second Edition). WCB McGraw Hill, USA.
19. Malacinski, G.M and Freifelder, D. 1998 : Essentials of Molecular Biology (Third Edition). Jones and B. Artlet Publisher, Inc., London.
20. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
21. Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai. Verma and Agarwal, Genetics, S. Chand Co, New Delhi..
22. Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana.
23. Gupta P.K Genetics and Cytogenetics, Rastogi Publications.
24. Biostatistics, Anil Mungikar, Aurangabad
25. Bhojwani, S.S. (1990) Plant Tissue Culture. Elsevier Science Publisher, The Netherlands.
26. Galun, E. and Breiman, A. (1997) Transgenic Plants. Imperial College Press, UK.
27. George, E.F. (1996) Plant Propagation by Tissue Culture Part 1 & Part II. Exegetics Ltd., UK.
28. Glick, B.R. and Pasternak, J.J. (2003) Molecular Biotechnology. ASM Press American Society for Microbiology, USA.
29. 30 Halford, N. (2006) Plant Biotechnology. John Wiley & Sons Ltd., Wiley-VCH Verlag GmbH & Co., Germany.

National Education Policy 2020

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

Major Core Theory Course

Course Code – SBOTC503

Title of the Course: PHARMACOGNOSY AND PHYTOCHEMISTRY

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

Course objectives:

1. The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Course outcomes: Upon completion of the course, the student shall be able

1. To know the techniques in the cultivation and production of crude drugs
2. To know the crude drugs, their uses and chemical nature
3. To know the evaluation techniques for the herbal drugs
4. To carry out the microscopic and morphological evaluation of crude drugs

Curriculum Details: SBOTC503: PHARMACOGNOSY AND PHYTOCHEMISTRY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module-I: INTRODUCTION TO PHARMACOGNOSY**	**12**
	1.1	Definition, history, scope and development of Pharmacognosy.	
	1.2	Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).	
	1.3	Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs	
	1.4	Quality control of Drugs of Natural Origin: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.	
2.0		**Module-II: CULTIVATION AND PROCESSING OF MEDICINAL PLANTS**	**10**
	2.1	Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants.	
	2.2	Plant hormones and their applications.	
	2.3	Polyploidy, mutation and hybridization with reference to medicinal plants	
	2.4	Conservation of medicinal plants	
3.0		**Module-III: PHARMACOGNOSY IN VARIOUS SYSTEMS OF MEDICINE**	**10**

	3.1	Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.	
	3.2	Introduction to secondary metabolites: Definition, classification, properties and test for identification of Alkaloids and Glycosides.	
	3.3	Introduction to secondary metabolites: Definition, classification, properties and test for identification of Flavonoids and Tannins.	
	3.4	Introduction to secondary metabolites: Definition, classification, properties and test for identification of Volatile oil and Resins.	
4.0		**Module-IV: INTRODUCTION TO PRIMARY AND SECONDARY METABOLITES**	**13**
	4.1	**Primary metabolites:** General introduction, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites. 1. **Carbohydrates:** Acacia, Agar, Tragacanth, Honey	
	4.2	**2. Proteins and Enzymes :** Gelatin, casein, proteolytic enzymes (Papain, streptokinase, pepsin). **3. Lipids:** Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax.	
	4.3	**Secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides and Flavonoids.	
	4.4	**Secondary metabolites:** Definition, classification, properties and test for identification of Tannins, Volatile oil and Resins.	
		Total	**45**

Suggested Books:

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar
10. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
11. Anatomy of Crude Drugs by M.A. Iyengar

National Education Policy 2020

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

Elective Theory Course

Course Code – SBOTE 501

Title of the Course: CLASSICAL ANGIOSPERM SYSTEMATICS

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

Course objectives:

1. To Study the general principles of Plant taxonomy
2. To understand the history and development of plant classification
3. To know the role of ICN in Botanical nomenclature
4. To study the interrelationships of families included in the order

Course outcomes:

1. Students will able to understand pre and post Darwinian concept of classification.
2. Understand role of ICN in Botanical nomenclature.
3. Acquaint interrelationships of families with in the orders.
4. Identify and classify the plants.

Curriculum Details: SBOTE 501: Classical Angiosperm Systematics

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module-I: GENERAL PRINCIPLES OF TAXONOMY**	**12**
	1.1	Principles, objectives and scope of plant taxonomy. Time and place of origin of Angiosperms. Probable ancestors of angiosperms (Isoetes – monocotyledon theory, Pteridosperm theory, Coniferales- amentiferae theory, Gnetales- angiosperm theory, Bennettitalean theory, Caytonialean theory, Pentoxylales theory.	
	1.2	General Evolutionary Trends in Angiosperms: Evolution of inflorescence, Concept of primitive flower, Primitive stamen, Primitive carpel: Foliar Appendicular and receptacular (Axial) theories; Evolution of fruit	
	1.3	Concept of taxonomic Characters: synthetic v/s analytic characters, Qualitative v/s Quantitative characters. Homology and Analogy, Parallelism and Convergence, Monophyly and Polyphyly.	
	1.4	Taxonomic Structure: Taxonomic hierarchy, Categories and ranks. The species concept- Taxonomical, Biological and Evolutionary.	
2.0		**Module-II: NOMENCLATURE AND CLASSIFICATION**	**10**
	2.1	International Code of Nomenclature for algae, fungi and plants (ICNafp): History, Salient features, Principles, Important Rules and Recommendations, Provisions, Appendices.	
	2.2	History of Plant Classification, Phenetic versus phylogenetic systems.	
	2.3	General account of Pre- Darwinian Classification (Introduction, Outline and Merits & Demerits): Andrea Caesalpino, John Ray, de Jussieu and A. P. de Candolle;	
	2.4	General account of Post Darwinian Classification (Introduction,	

		Outline and Merits & Demerits): Charles E. Bessey, Armen L. Takhtajan, R. M. T. Dahlgren, Robert Thorne and APG classification.	
3.0		**Module-III:SYSTEMATICS OF ANGIOSPERMS - I**	**10**
	3.1	Comparative account of floral morphology, interrelationship of plant families belonging to following orders as per Engler and Prantl's system of classification. **Rhoeadales:** Papaveraceae, Capparidaceae, Cruciferae and Moringaceae	
	3.2	**Malvales:** Elaeocarpaceae, Tiliaceae, Malvaceae, Bombacaceae, Sturculiaceae	
	3.3	**Contortae:** Oleaceae, Loganiaceae, Gentianaceae, Apocynaceae	
	3.4	**Geraniales:** Geraniaceae, Oxalidaceae, Zygophyllaceae, Rutaceae, Meliaceae	
4.0		**Module-IV:SYSTEMATICS OF ANGIOSPERMS - II**	**13**
	4.1	Comparative account of floral morphology, interrelationship of plant families belonging to following orders as per Engler and Prantl's system of classification **Pandanales:** Typhaceae, Sparganiaceae and Pandanaceae	
	4.2	**Glumiflorae:** Gramineae and Cyperaceae	
	4.3	**Liliflorae:** Juncaceae, Liliaceae, Amaryllidaceae, Dioscoriaceae, Iridaceae	
	4.4	**Microspermae:** Burmanniaceae, Orchidaceae	
		Total	**45**

SELECTED READINGS:

1) Davis, P. H. and V. H. Heywood (1991). Principles of Angiosperm Taxonomy.
2) Judd WS, Campbell CS, Kellog EA & Stevens PF (1999). Plant Systematics. Kolkatta.
3) Lawrence GHM (1964). Taxonomy of Vascular Plants, Mac Millon Co., New
4) Laymen David Benson. (1962). Plant Taxonomy: Methods and Principals. Ronald
5) Mondal A. K. 2014. Advances in Plant taxonomy. New Central Book Agency (P) Ltd., London
6) Naik, V. N (1984). Taxonomy of Angiosperms, TMH, New Delhi.
7) Pandey A. K. and Shruti Kasana. 2021. Plant Systematics. Jaya publishing House, Delhi.
8) Rendle, A. B (1967). Classification of flowering plants, Cambridge University
9) Sharma O. P (1990). Plant Taxonomy, Oxford Publishers, New Delhi.
10) Shivrajan V. V. 1984. Introduction to Principles of Plant Taxonomy, Oxford and IBH publications, New Delhi.
11) Singh, G (1999). Plant systematics: Theory and Practice, Oxford IBH.
12) Sneath, P.H.A. &R.R.Sokal, Numerical Taxonomy. W.H.Freeman. & Co. San Fransisco. Today and Tomorrow Publications, New Delhi.
13) Variations and Evolution in Plants: G L Stebbins
14) Vashista, PC. (2011). Taxonomy of Angiosperms. R. Chand and Co. New York.

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

Elective Theory Course

Course Code – SBOTE502

Title of the Course: FUNDAMENTALS OF PLANT PATHOLOGY

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

Course objectives:

1. To develop interest among the about Plant pathology
2. To understand the importance of epidemics and forecasting of plant diseases.
3. To understand the process of infection for disease development.
4. To study symptoms of major diseases of cereal crops, pulses, oil seeds, vegetables and their management
5. To impart knowledge about different strategies for management of plant diseases.

Course outcomes:

1. The students will be able to understand the importance of plant pathology and will helps to develop interest in Plant Pathology.
2. They will bring the awareness among the farmers for losses caused due to epidemics.
3. They will adapt plant pathology as a profession to learn research and diagnostic skills.
4. Student will know importance of sign and symptoms for detection of pathogens and disease, integrated methods of disease management, use of biological and chemicals in disease management.
5. Students will know symptoms, etiology, disease cycle and management of major diseases of cereals, pulses, oil seeds and vegetables in this region.

Curriculum Details: SBOTE502: Fundamentals of Plant Pathology

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module I: Scope and Importance of Plant Pathology**	**12**
	1.1	Scope and Importance of Plant Pathology, Worldwide development of Plant Pathology as Profession and Careers in Plant pathology.	
	1.2	History of Plant Pathology with special reference to Indian works., stages in disease development, causes of plant diseases, effect of pathogen on the plants, effect of plant diseases on human affairs	
	1.3	**Classification of plant diseases:** Classification of plant diseases: Criteria used in classification, Classification based on origin (soil, air, and seed), symptoms, causal Organism and spread and severity of infection. Detection and diagnosis of plant diseases.	
	1.4	**Methods of Studying Plant Diseases**: Methods of Studying Plant Diseases in field and in laboratory, Koch'spostulates,	
2.0		**Module II: The Pathogenesis**	

	2.1	Pre penetration activity of pathogen on the host surface:Direct penetration, Entry through intact surface (Epidermis), Entry through non cutinized surface (flower, bud and root hair).	**10**
	2.2	Indirect entry of pathogens into the host: through natural openings (Stomata, Lenticels and Hydathodes) and wounds.	
	2.3	Effect of Environment on Pathogenesis: Effect of temperature, humidity, wind, light, soil reaction (pH). The biotic environment: The rhizosphere, Phylloplane, Antagonistic association, phenomenon of fungistatis, symbiotic association.	
	2.4	**Dispersal of plant pathogens:** Autonomous dispersal soil as a means of autonomous dispersal, seed as a source of autonomous dispersal, plant and plant organs as a means of autonomous dispersal. **Passive dispersal:** Dispersal by air, water, insects, nematodes, animals, man and phanerogamic plant parasites.	
3.0		**Module III: Defence Mechanism In Plants**	
	3.1	**Structural Defence**: Pre existing Structural Defense: Waxes and cuticle, structure of epidermal cell wall, stomata, mechanical tissues.	
	3.2	**Post inflectional Structural defence in host plants:** Formation of Cork layer, Tyloses, Abscission layers, Gum deposition, Sheathing of hyphae.	
	3.3	**Biochemical Defence: Pre existing biochemical defence**: Antifungal and antimicrobial compounds released by the plant in its environment, Inhibitors already present in plant cells, Deficiency of essential nutrients for growth of pathogen.	**10**
	3.4	**Post infectional Biochemical Defence**: Defence through detoxification of pathogen toxins, Defence through induced synthesis of proteins and enzymes, Defence through hypersensitivity, Toxic chemicals produced in plant in response to infection. **Phytoalexins:** Synthesis, Characteristics and role.	
4.0		**Module IV: Disease Management Principles**	
	4.1	Bases of disease management principles, Avoidance of the pathogen, exclusion of pathogen, plant quarantines, Eradication of the pathogen, Protective measures.	
	4.2	**Disease Management Practices:** Cultural practices for disease management, production and use of disease free propagating materials.	**13**
	4.3	**Disease management through toxic chemicals:** Chemical nature, classification and action of Sulphur fungicides, copper fungicides, mercury fungicides, systemic fungicides.	
	4.4	Antibiotics, Nematicides, Antiviral chemicals and biopesticides. Biological control.	
		Total	**45**

Suggested Readings:

1. Agrios GN. (2005). Plant Pathology. 5th Ed. Academic Press, New York.

2. Alexopoulos, C.J., C.M.Mims. Introductory Mycology:,Wiley Eastern Ltd. New Delhi, Bangalore,

Bombay, Culcutta, Madras, Hydrabad.

3. Aneja K.R. 4th Ed.(2007). Experiments In Microbiology, Plant Pathology and Biotechnology.New Age International.
4. Bilgrami K S & H C Dube .A Text book of Modern Plant pathology.Vikaspubli.housepvt.Ltd. New Delhi.11004
5. Cruickshank, I. A. M. (1963).Phytoalexins.Annu. Rev. Phytopathol. 1, 351–374.
6. Deverall BJ. (1977). Defence Mechanisms in Plants. Cambridge Univ. Press, Cambridge, NewYork.
7. Dhingra OD & Sinclair JB. (1986) .Basic Plant Pathology Methods. CRC Press, London,Tokyo.
8. Duncan, J. M., and Torrance, L. (1992). "Techniques for the Rapid Detection of Plant Pathogens." Blackwell, Oxford.
9. Fokkemma MJ. (1986). Microbiology of the Phyllosphere. Cambridge Univ. Press, Cambridge.
10. Goto, M. (1992)."Fundamentals of Bacterial Plant Pathology." Academic Press, San Diego.
11. John William Hershberger. A Text-book of Mycology and Plant Pathology. Paul Y.S. (2014). Textbook of Mycology and Plant Pathology.Kalyani Publishers,
12. Keitt, G. W. (1959). History of plant pathology. In "Plant Pathology" (J. G. Horsfall and

A. E. Dimond, eds.), Vol. 1, pp. 61–97. Academic Press, New York.

13. Mehrotra R.S. & Agarwal A. (2003).Plant Pathology.2nd Ed. Oxford & IBH, New Delhi.
14. Pandey B.P. (2016) Plant pathology .S.Chand&co.Pvt.LtdNew delhi-110055
15. Pathak V.N. (1984). Laboratory Manual of Plant Pathology.Oxford & IBH, New Delhi.Gurr SJ, Mc
16. Pathak V N and C N Khatri.Fundamentals of Plant Pathology
17. Rangaswami, G., D.J. Bagyaraj. Agricultural Microbiology: - prentice Hall of India .Pvt .Ltd. New Delhi.110001
18. Rangaswami ,G and A. Mahadevan (2006). Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd. New Delhi- 110001.
19. Ravichandra N.G. (2013).Fundamentals of Plant Pathology.PHI Learning Pvt.Ltd.Delhi- 110092.
20. Singh RS. (2002) .Introduction to Principles of Plant Pathology. Oxford & IBH, NewDelhi.
21. Sharma P.D. Plant Pathology: Rastogi Publication, Shivaji Road Meerut. 25002 (India)
22. Pandey,B.P. Plant Pathology, Pathogens And Plant Diseases,.S.Chand and Company Pvt.Ltd.Ramngar, New Delhi 110055
23. Shrivastav, A.K. Principles of plant pathology & Diseases.PragatiPrakashan, Meerut.250001
24. Singh US, Mukhopadhyay AN, Kumar J &Chaube HS.(1992). Plant Diseases of International Importance.Vol. I. Diseases of Cereals and Pulses. Prentice Hall, Englewood Cliffs, New Jersey.
25. StakmanE.C.andJ.G.Harrar (1957).Principles of Plant Pathology, Ronald press New York.
26. Subbarao N. S .Soil microorganisms and plant growth.

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

Elective Theory Course

Course Code – SBOTE503

Title of the Course: SEED TECHNOLOGY-I

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

Course objectives:

1. To study and impart knowledge about the aspects of Seed technology, types of seeds, and different physiological process of seed.
2. To understand how to test viability, purity and vigour of seed.
3. To know the skills of identification of seed borne pathogens.
4. To understand the diagnosis and control of seed borne diseases.

Course outcomes:

1. Students will get the knowledge of seed technology, seed development, different types of seeds and various physiological processes of seeds.
2. Student will adopt the skill of purity , viability and vigour testing.
3. Students will get the knowledge of identification of seed borne pathogens.
4. Students will recommend the control measures for seed borne diseases.

Curriculum Details: SBOTE503: Seed Technology-I

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0		**Module I: BASICS OF SEED TECHNOLOGY**	**12**
	1.1	Introduction, Definition and history of seed technology, exomorphic and endomorphic characters of seeds, seed development, mode of reproduction, sporogenesis, pollination, fertilization, embryogenesis, apomixes, parthenocarpy, synthetic seeds	
	1.2	Seed dormancy, definition, types and importance. Methods of breaking of seed dormancy	
	1.3	Seed germination, Definition, types, mechanism, Instruments and substrata required, methods of seed germination testing.	
	1.4	Types of seeds-Orthodox seeds, recalcitrant seeds and intermediate seeds.	
2.0		**Module II: SEED HEALTHING TESTING**	**10**
	2.1	Viability and vigour testing: Introduction, definition of viability and vigour, importance of viability testing. Types of seed viability testing. Vigour testing: Principle and different methods used for testing vigour	
	2.2	Physical and genetic purity testing: Physical purity test by number and by weight, objective and criteria for genetic purity testing, types	

		of genetic purity tests.	
	2.3	Seed storage: Life span of seed, factors influencing life span of seed, maintaining seed in storage, four principle approaches: conditioned, cryogenic, hermetic and containerized storage.	
	2.4	Seed deterioration : definition and causes, Seed moisture content: Importance of seed moisture content, determination of seed moisture content	
3.0		**Module III: SEED PATHOLOGY**	
	3.1	Seed pathology : definition, history, economic importance of seed pathology in seed industry, contribution of seed pathologists : Paul Neergard, S. B. Mathur and K. C. Mehta. Seed pathology work in India	
	3.2	Seed borne microorganisms: Externally and internally seed borne pathogens, mode of infection. Methods of detection of seed borne diseases.	**10**
	3.3	Significance of seed infection and environmental factors affecting seed infection. Losses caused by seed borne diseases. Epidemiology and forecasting of seed borne diseases of plants.	
	3.4	General characters of important seed borne fungi : Aspergillus, Alternaria, Dreschlera, Cercospora, Curvularia, Fusarium, Colletotrichum, Botrytis, Ascochyta, Penicillium, Rhizopus.	
4.0		**Module IV: SEED BORNE DISEASES**	
	4.1	Seed borne diseases of Jowar : Grain smut, grain mould, charcoal rot, leaf blight and seedling blight	
	4.2	Seed borne diseases of Wheat : Loose smut, black point, alternaria leaf blight, helminthosporium leaf blight, ear cockle	**13**
	4.3	Seed borne diseases of Bajra : Green ear, ergot	
	4.4	Seed borne diseases of pulses Pea : Powdery mildew, Pigeon pea : wilt , Gram : Ascochyta blight, Botrytis grey mould Green gram : Mosaic, Powdery mildew	
		Total	**45**

SELECTED READINGS:

1. Introduction to Principles of Plant Pathology (3rd edition)-R.S.singh.
2. Plant Pathology - R.S.Mehrotra
3. Principles of Plant Pathology -C.E.Owens
4. Plant Pathology (2nd edition) George N.Agrios.
5. Plant Diseases - R.S.Singh
6. Plant Deseases -G.Rangaswamy
7. D. Lalithakumari (2000): Fungal Protoplast: A Biotechnological Tool: Oxford and IBH Publishing Co.Pvt.Ltd.
8. R.E.F. Mathews (1970) : Plant Virology.
9. S.T.Tilak (1998):Aerobiology. 4. Kenneth M. Smith (1968): Plant Viruses.
10. F.C.Bawden (1964): Plant Viruses and Virus Diseases.
11. Mehrotra R.S.(1980): Plant Pathology
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13. NyVall, R.F.(1979): Field Crop Diseases Handbook.
14. Singh, R.S.(1963): Plant Diseases.
15. Padoley, S.K. and P.B.Mistry: A manual of Plant pathology.
16. Gangopadhyay, S.(1984): Clinical Plant Pathology.
17. Principles of plant pathology &Diseases :-A.K. Shrivastav, PragatiPrakashan, Meerut 250001 (India).
18. Plant Pathology G.P, Gupta, Discovery publishing House,New Delhi, 11002.
19. Plant Pathology: - P.D.SharmaRastogi Publication, Shivaji Road Meerut. 25002 (India)
20. Plant pathology, pathogens and plant diseases B.P. Pandey,.S.Chand and CompanyPvt.Ltd.Ramngar,New Delhi 110055

National Education Policy 2020

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

Core Practical Course

Course Code – SBOTP501

Title of the Course: Based on theory Paper SBOTC501

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

Curriculum Details: SBOTP501: Based on theory Paper SBOTC501

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Determination of water potential of potato tuber.	2
2.	Determination of osmotic potential by plasmolytic method	2
3.	Effect of IAA on seed germination and seedling growth	2
4.	Effect of GA on seed germination and seedling growth	2
5.	Effect of Cytokinin on seed germination and seedling growth	2
6.	Effect of an Inhibitor and an Un-Coupler on the Rate of Photosynthesis	2
7.	Determination of RQ of given plant material (seeds). Demonstration of respiratory enzymes (oxidase, peroxidase, dehydrogenase and catalase) in the plant tissues	2
8.	Isolation of chloroplasts and its ultramicroscopic observation.	2
9.	Isolation of mitochondria and its ultramicroscopic observation	2
10.	Separation of pigments by paper chromatography and TLC	2
11.	To determine the chlorophyll a / chlorophyll b ratio in C3 and C4 plants.	2
12.	Extraction of chlorophyll pigments from the leaves and preparation of absorption spectra	2
13.	Survey of C4 plants and CAM plants from local Botanical garden/Campus vegetation	2
14.	Visit to research centre	2
15.	Short tour. and long tour	2
	Total	**30**

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

Core Practical Course

Course Code – SBOTP502

Title of the Course: Based on theory Paper SBOTC502

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

Curriculum Details: SBOTP502: Based on theory Paper SBOTC502

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of aseptic techniques, safe handling of microorganisms,	2
2.	Establishing pure culture (streak plate method) storage of culture and subculturing,	2
3.	Study of growth characteristic of *E.coli*by plating method	2
4.	Study of growth characteristic of *E.coli*using turbidimetric method.	2
5.	Isolation of DNA from plants and Estimation by DPA method	2
6.	Isolation of RNA and Estimation of RNA by orcinol method	2
7.	Isolation of plasmid from E. coli by alkaline lysis method	2
8.	Quantitative estimation of plamidspectrophotometrically.	2
9.	Study of bacterial transformation	2
10.	Study of bacterial conjugation.	2
11.	Problem based on mean, mode, median, mean deviation, standard deviation, C.V. from the data.	2
12.	Study of frequency distribution, frequency curve and frequency histogram based on data	2
13	Plotting of Contingency table, frequency table	2
14	Plotting of Simple bar chart, stem and leaf plot, Histogram, Box and whisker plot	2
15	Visit to biotechnology laboratory/ field visit/long/short tour	2
	Total	**30**

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

Core Practical Course

Course Code – SBOTP503

Title of the Course: Based on theory Paper SBOTC503

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

Curriculum Details: SBOTP503: Based on theory Paper SBOTC503

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Qualitative detection of secondary metabolites in plant material by phytochemical tests.	4
2.	Quantitative estimation of secondary metabolites from plants mentioned in syllabus	4
3.	Study of macro and microscopic characters of plant parts powder of drug of plants mentioned in syllabus	2
4.	Determination of Extractive values of crude drugs	2
5.	Determination of moisture content of crude drugs	2
6.	Determination of swelling index and foaming	2
7.	Determination of ash values	2
8.	Qualitative detection of Gums and Resins by using standard phytochemical test	4
9.	Separation and Identification of phytoconstituents using standard compounds by Thin layer chromatography or Paper chromatography	2
10.	Two local study tours	2
11.	One long study tours	2
12.	One visit to Pharmaceutical industry	2
	Total	**30**

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

Elective Practical Course

Course Code – SBOTEP 501

Title of the Course: Based on theory Paper SBOTE501

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

Curriculum Details: SBOTEP 501: Based on theory Paper SBOTE 501

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Description and identification of flowering plants belonging to different families of the order **Rhoeadales** up to genus and species level with their sketches and floral formula and floral diagrams.	3
2.	Description and identification of flowering plants belonging to different families of the order **Malvales** up to genus and species level with their sketches and floral formula and floral diagrams.	3
3.	Description and identification of flowering plants belonging to different families of the order **Contortae** up to genus and species level with their sketches and floral formula and floral diagrams.	3
4.	Description and identification of flowering plants belonging to different families of the order **Geraniales** up to genus and species level with their sketches and floral formula and floral diagrams.	3
5.	Description and identification of flowering plants belonging to different families of the order **Pandanales** up to genus and species level with their sketches and floral formula and floral diagrams.	3
6.	Description and identification of flowering plants belonging to different families of the order **Glumiflorae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
7.	Description and identification of flowering plants belonging to different families of the order **Liliflorae** up to genus and species level with their sketches and floral formula and floral diagrams.	3
8.	Description and identification of flowering plants belonging to different families of the order **Microspermae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
9.	Identification of local plants up to species level with the help of Standard floras	2
10	Preparation of checklist of a particular area (Institute/ College campus)	2
11.	At least two local study tours for the study and identification of local flora of the region	2
12.	At least one long botanical excursion, and visits to Botanical Garden, Research institutes, Botanical Survey of India etc.	2
	Total	**30**

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

Elective Practical Course

Course Code – SBOTEP 502

Title of the Course: Based on theory Paper SBOTE502

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

Curriculum Details: SBOTEP 502: Lab 1 / Based on theory Paper SBOTE 502

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of survival of fungal pathogens in soil and infected host plant	1
2.	Study of dormant organs of fungal pathogens as a source of survival	1
3.	Isolation and identification of plant pathogens from air over infected field/soil/infected host plants.	2
4.	Isolation and identification of Rhizosphere mycoflora from different soil samples of infected and healthy plants by Serial Dilution Technique.	2
5.	Isolation and identification of Phylloplane mycoflora from diseased and healthy plant by Leaf Print Method.	2
6.	Screening of suitable Carbon/nitrogen sources for good growth of fungal plant pathogens by radial colony growth	2
7.	Effect of temperature/light/P^H on growth of plant pathogenic fungi by radial colony growth.	2
8.	Synthesis of Phytoalexins and its effect on spore germination of fungal pathogen by hanging drop technique.	2
9.	Measurement of fungal spore /bacteria using ocular and stage micrometer.	1
10.	Collection and preservation of diseased specimens, plant pathogens and use of Camera Lucida.	1
11.	Study of spraying and dusting equipments.	1
12.	Preparation of Bordeaux mixture, Burgundy mixture and Bordeaux paste	1
13.	*In -vitro* and *in- vivo* evaluation of fungicides against plant pathogens; ED and MIC values.	2
14.	Evaluation of antibiotics against a pathogenic fungus/bacterium (zone of inhibition).	1
15.	Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in-vivo* conditions.	2
16	Study on antagonism between isolate antagonists and plant pathogens.	1
17	Evaluation of biopesticides (neem, turmeric and garlic) against some fungal plant pathogens (food poison technique).	2
18	Visit to at least two plant protection research stations, Plant Pathology Labs. Research institutes, Agricultural Universities and three short excursions for collection of diseased specimens and at least one long excursion.	4
	Total	**30**

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

Elective Practical Course

Course Code – SBOTEP 503

Title of the Course: Based on theory Paper SBOTE503

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

CurriculumDetails: SBOTEP 503: Based on theory Paper SBOTE503

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Structure of monocot and dicot seeds of important plant species	2
2.	Identification and handling of instruments used in seed testing laboratory	2
3.	Physical purity analysis of samples of different crops	2
4.	Estimation of seed moisture content (Oven method)	2
5.	Seed dormancy breaking methods	2
6.	Seed viability testing by tetrazolium test	2
7.	Seed and seedling vigour tests	2
8.	Genetic purity testing by chemical, biochemical and molecular methods	2
9.	Effect of temperature and moisture on seed viability	2
10.	Seedling evaluation	2
11.	Study of symptoms and causal organism of seed borne diseases: Jowar- grain smut, grain mould, charcoal rot, leaf blight, seedling blight	2
12.	Study of symptoms and causal organism of seed borne diseases: Wheat- Loose smut, Alternaria leaf blight, ear cockle	2
13.	Study of symptoms and causal organism of seed borne diseases: Bajara- Green ear, Ergot	2
14.	Study of symptoms and causal organism of seed borne diseases: Pea – Powdery mildew, Pigeon pea- Wilt, Gram- Ascochyta blight, Botrytis grey mould Green gram – Mosaic, Powdery mildew	2
15.	At least one long botanical excursion, two local study tours and visits to seed Industries, Research institutes, Agriculture universities etc.	2
	Total	**30**

Syllabus for M. Sc. Botany, Second Year

Semester – IV

As Per National Education Policy- 2020

National Education Policy 2020

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

Major Core Theory Course

Course Code – SBOTC 551

Title of the Course: BIOCHEMISTRY AND PLANT METABOLISM

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

Course objectives:

1. To understand biochemistry of amino acids, proteins and enzymes.
2. To know importance of nitrogen, sulphur and phosphorous in plant life.
3. To understand carbohydrate and lipid metabolism in plants.

Course outcomes:

1. Understanding the biochemistry and metabolism of amino acids, proteins including enzyme kinetics.
2. Able to understand nitrogen, sulphur and phosphorous metabolism in plant.
3. Understand role and importance of carbohydrate and lipids in plants.

Curriculum Details: SBOTC 551:Biochemistry and Plant Metabolism

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module I: AMINO ACIDS AND PROTEIN METABOLISM**	**15**
	1.1	**Amino Acids**-Structure Classification and various physicochemical properties of amino acids. Protein and Non Protein amino acids, Essential and non essential amino acids	
	1.2	Bio- Synthesis of amino acids with reference to GS and GOGAT in plants. Breakdown of amino acid -deamination, transamination, reductive amination.	
	1.3	Primary structure of proteins, Conformation of proteins and polypeptides (secondary, tertiary, quaternary and domain structure), Ramachandran plot. Van der Waal's forces, electrostatic interactions, hydrogen bonding and hydrophobic interactions in proteins.	
	1.4	Protein metabolism- Mechanism of synthesis.	
2.0		**Module II: ENZYMOLOGY**	**15**
	2.1	**Enzyme:** Introduction, Classification, properties and structure of enzyme, Enzyme Specificity, mechanism of enzyme catalyzed reaction.	
	2.2	**Enzyme kinetics,** Effect of temp, pH, on enzyme activity. Michaelis-Menten equation, Significance of Km and V-max, Enzyme.	
	2.3	Regulation of enzyme activity and Allosteric enzymes	
	2.4	Activators and inhibitors, Coenzymes, co-factors, Isozymes, Ribozymes and Abzymes	

3.0		**Module III: NITROGEN METABOLISM**	**15**
	3.1	Role and sources of nitrogen in plants..	
	3.2	Nitrogen fixation: Physical and Biological nitrogen fixation, characteristics and functions of Leghaemoglobin.	
	3.3	Structure and physiology of Nitrogenase enzyme, 'NIF' genes and its regulation.	
	3.4	Ammonification , Nitrification and Denitrification.	
4.0		**Module IV: CARBOHYDRATE AND LIPID METABOLISM**	**15**
	4.1	Classification, structure, chemical properties of monosaccharides, formation of glycosidic bond.	
	4.2	Chemistry and Biological role of homo and heteropolysaccharides; Structural polysaccharides (Cellulose and Chitin), Storage polysaccharides (Starch and Glycogen);	
	4.3	**Lipid:** Structure and properties of fatty acids, storage and membrane lipids, phospholipids and cholesterol, Composition and synthesis of lipoproteins and their transport in the body.	
	4.4	Oxidation of fatty acids (beta & alpha) and Synthesis of lipids.	
		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. Saheb L. Shinde and Parshuram V. Pawar. Plant Physiology, Biochemistry and Biotechnology. Vidyawati publication Latur.
4. Wolfe S.L 1993 Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
5. Rost, T. Etal 1998. Plant Biology. Wadsworth Publishing Company, California, USA.
6. Krishnamurthy, K.V 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
7. Buchanan B.B, Gruissm W. and Jones R.L 2000. Biochemistry and Molecular.
8. Biology of Plant. American Society of Plant Physiologist, Maryland, USA.
9. De D.N 2000. Plant Cell Vacuoles : An Introduction. CISRO Publication, Collingwood, Australia.
10. Kleinsmith L.J and Kish V.M 1995. Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York, USA.
11. 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.
12. David Freifelder 1996. Essentials of Molecular Biology, Panima Publishing Company, New Delhi.
13. Brow T.A 2007 Genomes – 3 – Garland Science House, New York.
14. Malacinski G.M 2006 (Fourth Edition). Freifelders Essentials of Molecular Biology, Narosa Publishing House, New Delhi.
15. Rastogi V.B Concepts in Molecular Biology.
16. Watson J.D Etal. Molecular Biology of Gene. Forth Edition, Benjamin and Cummings Publishing Co., California.

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

Major Core Theory Course

Course Code – SBOTC 552

Title of the Course: BIOTECHNOLOGY AND GENETIC ENGINEERING

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

Course objectives:

1. To study and impart knowledge about the plant biotechnology
2. To inspire students to study diversity of plant forms

Course outcomes:

1. Understand the basic principle and process of plant tissue culture.
2. Application of plant tissue culture on large scale and industrial application.
3. understand the technique and process of cloning.

CurriculumDetails: SBOTC 552: Biotechnology and Genetic Engineering

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0		**Module I: BIOTECHNOLOGY - I**	**11**
	1.1	**Introduction**: Scope and importance of Biotechnology, History of Plant Tissue Culture,	
	1.2	Cellular Differentiation and Totipotency, Culture Media, Aseptic Culture Technique.	
	1.3	**Organogenesis:** Techniques and Utility of Organogenesis, Callus Cultures, Characteristics of Organogenesis, Factors Affecting Organogenesis.	
	1.4	**Micropropagation:** Explants used in micropropagation, Stages in micropropagation. Advantages and Disadvantages of micropropagation**.** Somaclonal variation and its Applications	
2.0		**Module II: BIOTECHNOLOGY –II**	**11**
	2.1	**Protoplast Culture**: Isolation of Protoplast, Methods of protoplast culture, Applications of Protoplast Culture.	
	2.2	**Somatic Hybridization:** Protoplast Fusion, Poly Ethelene Glycol (PEG) Treatment, Regeneration of Hybrid Plants, Applications of Somatic Hybridization, Making of Synthetic Seeds and their Applications	
	2.3	**Haploid Culture:** Anther, Pollen and Ovule Culture Application of Anther and Microspore Culture Merits & Demerits and Limitations, Applications of Ovule Culture	
	2.4	**Applications of Plant Tissue Culture:** Production of Disease Resistant Plant,Embryo Culture, Production of Secondary Metabolites and Germplasm Storage.	

3.0		**Module III: GENETIC ENGINEERING**	**11**
	3.1	Techniques in Molecular Genetics: Basic techniques, Restriction digestion, production of recombinant DNA molecules, amplification using vectors,	
	3.2	Construction of genomic libraries, cDNA libraries and screening DNA libraries for genes of interest; The manipulation of cloned DNA sequences: in vitro, using phagemid vectors;	
	3.3	*In vitro*site-specific mutagenesis, Molecular analysis of Genes and Chromosomes: PCR, Physical maps of DNA molecules based on RFLP and Fine structure maps,	
	3.4	Regulation of expression, Genome sequencing strategies and programs, methods for sequencing, microarrays and their applications; gene tagging; gene and promoter trapping; knockout and knock-down mutants	
4.0		**Module IV: r-DNA TECHNOLOGY**	**12**
	4.1	Restriction and nucleic acid modifying enzymes; restriction mapping	
	4.2	Vectors in gene cloning and their choice; plasmids, phages, cosmids, plant viruses, synthetic DNA vectors;	
	4.3	Isolation of specific genes from bacteria and higher plants; cloning; Comparative genomics of model plants and related crop species;	
	4.4	RNA and gene silencing, genome imprinting, small RNAs and their biogenesis, role of small RNAs in heterochromatin formation and gene silencing	
		Total	**45**

SELECTED READINGS:

1. George, E.F., Hall, M.A., & De Klerk, G.J. (2008). Plant Propagation by Tissue Culture (3rd ed.). Springer.
2. Gamborg, O.L., Miller, R.A., & Ojima, K. (Eds.). (1976). Plant Tissue Culture Methods. National Research Council of Canada.
3. Thorpe, T.A. (Ed.). (2007). Plant Tissue Culture: Development and Biotechnology. Academic Press.
4. Bhojwani, S.S., & Razdan, M.K. (1996). Plant Tissue Culture: Theory and Practice. Elsevier.
5. Litz, R.E. (Ed.). (1986). Biotechnology in Agriculture and Forestry: Plant Tissue Culture (Vol. 1). Springer.
6. Trigiano, R.N., & Gray, D.J. (Eds.). (2010). Plant Tissue Culture Concepts and Laboratory Exercises (2nd ed.). CRC Press.
7. Davey, M.R., Anthony, P., & Power, J.B. (Eds.). (2007). Plant Cell Culture: Essential Methods. Wiley-Blackwell.
8. Lindsey, K., & Jones, M.G.K. (Eds.). (1989). Plant Tissue Culture Manual. Springer.
9. Dixon, R.A., & González, J.A. (Eds.). (1994). Plant Cell Culture: A Practical Approach. Oxford University Press.
10. Sharp, W.R., Evans, D.A., Ammirato, P.V., & Yamada, Y. (Eds.). (1980). Handbook of Plant Cell Culture (Vol. 1). Macmillan.
11. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., &Losick, R. (2013). Molecular Biology of the Gene (7th ed.). Pearson.
12. Primrose, S.B., & Twyman, R.M. (2002). Principles of Gene Manipulation and Genomics (7th ed.). Wiley-Blackwell.

13. Old, R.W., & Primrose, S.B. (1994). Principles of Gene Manipulation: An Introduction to Genetic Engineering (5th ed.). Blackwell Science.
14. Winans, S.C., & Bassler, B.L. (2008). Chemical Communication among Bacteria. ASM Press.
15. Voet, D., Voet, J.G., & Pratt, C.W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.
16. Sambrook, J., & Russell, D.W. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.). Cold Spring Harbor Laboratory Press.
17. Setlow, J.K. (Ed.). (2002). Genetic Engineering: Principles and Methods (Vol. 24). Springer.
18. Brown, T.A. (2002). Genomes (2nd ed.). Oxford University Press.
19. Maloy, S., & Hughes, K. (2002). Brenner's Encyclopedia of Genetics (2nd ed.). Academic Press.
20. Glick, B.R., & Pasternak, J.J. (2003). Molecular Biotechnology: Principles and Applications of Recombinant DNA (3rd ed.). ASM Press.

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

Elective Theory Course

Course Code – SBOTE 551

Title of the Course: ADVANCE ANGIOSPERM SYSTEMATICS

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

Course objectives:

1. To understand Taxonomic evidences with Modern trends
2. To study the application of various tools for taxonomic studies
3. To study the interrelationships of families included in the order

Course outcomes:

1. Students will able to understand modern trends in taxonomy
2. Identify the angiosperm plants with the help of taxonomic tools
3. Acquaint interrelationships of families with in the orders.

Curriculum Details: SBOTE 551: Advance Angiosperm Systematics

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module I: MODERN TRENDS IN TAXONOMY**	**12**
	1.1	Numerical taxonomy, Chemotaxonomy, Cytotaxonomy, Palynology, and Embryology in relation to taxonomy.	
	1.2	Molecular Systematics: Molecular diagnostic tools, Restriction fragment length polymorphism (RFLP's), Random amplified polymorphic DNA (RAPD), applications of RFLP and RAPD in molecular systematics.	
	1.3	Phytochemistry in relation to taxonomy. Biosystematics: Steps, Categories and applications.	
	1.4	Serology and taxonomy: history, precipitation reaction, techniques. Application of serological data in plant systematics	
2.0		**Module II: TOOLS OF SYSTEMATICS BOTANY**	**10**
	2.1	Herbarium techniques- Objectives and function, Roles of herbarium; collecting, mounting, labelling, filling and maintenance of herbarium specimens. Virtual herbaria.	
	2.2	Taxonomic literature- Floras, E-Flora, Manuals and monographs, Taxonomic revisions, Taxonomic Databases,	
	2.3	Methods of Plant Identification, Taxonomic keys: Indented bracketed keys and numbered keys.	
	2.4	DNA Fingerprinting; DNA Barcoding: Basic steps and applications in taxonomy.	
3.0		**Module III: ANGIOSPERM SYSTEMATICS – I**	**10**
	3.1	Comparative account of floral morphology, interrelationship of plant families belonging to following orders as per Engler and Prantl's system of classification **Centrospermae:** Chenopodiaceae, Amaranthaceae, Aizoaceae, Portulacaceae and	

		Caryophyllaceae	
	3.2	**Rosales:** Podostemaceae, Crassulaceae, Hamamelidaceae, Rosaceae, Leguminosae	
	3.3	**Sapindales:** Anacardiaceae, Celastraceae, Salvadoraceae, Sapindaceae, Balsaminaceae	
	3.4	**Tubiflorae:** Convolvulaceae, Boraginaceae, Verbenaceae, Scrophulariceaeae, Bignoniaceae	
4.0		**Module IV: ANGIOSPERM SYSTEMATICS – II**	
	4.1	Comparative account of floral morphology, interrelationship of plant families belonging to the order as per Engler and Prantl's system of classification **Helobiae:** Potamogetonaceae, Najadaceae, Allismataceae, Butomaceae, Hydrocharitaceae	**13**
	4.2	**Spathiflorae:** Araceae and Lemnaceae	
	4.3	**Farinosae:** Eriocauliaceae, Bromeliaceae, Commelianaceae, Potenderiaceae	
	4.4	**Scitaminae:** Musaceae, Zingiberaceae, Cannaceae, Marantaceae	
		Total	**45**

SELECTED READINGS:

1. Cook T (1903). The Flora of Presidency of Bombay, Vol. I (Indian Reprint) Bishen Singh, Mahendra Pal Singh, Dehradun.
2. Cronquist A J (1988). Evolution and Classification of Flowering Plants, 2nd edn, N Y Botanical Garden.
3. Cronquist, A. 1981. An Integrated system of Classifications of flowering plants. Columbia University Press, New York.
4. Davis P H and Heywood V H (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd.
5. Gurcharan Singh. 2004. Plant Systematics: Theory and practice Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi
6. Jain S. K. and Rao R. R. Handbook of Field and Herbarium Methods, Today and Tomorrow Publishers, New Delhi.
7. Judd, Campell,Kellogg and Stevens (2007) Plant Systematics – A phylogenetic approach. Sinauer Pub.U.S.A. 3rd edition
8. Lawrence George H. M. 1951. Taxonomy of Vascular plants Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi.
9. Mondal A. K. 2014. Advances in Plant taxonomy. New Central Book Agency (P) Ltd., London
10. Naik V N (1984). Taxonomy of Angiosperms, TMH, New Delhi.
11. Pandey A. K. and Shruti Kasana. 2021. Plant Systematics. Jaya publishing House, Delhi.
12. Sharma O. P. 2003. Plant Taxonomy. Tata McGraw-hill Publishing Company Limited, New Delhi, India.
13. Shivrajan V. V. 1984. Introduction to Principles of Plant Taxonomy, Oxford and IBH publications, New Delhi.
14. Sneath, P.H.A. & R.R.Sokal, Numerical Taxonomy. W.H.Freeman. & Co. San Fransisco.
15. Mondal A. K. 2014. Advances in Plant taxonomy. New Central Book Agency (P) Ltd., London.
16. Pandey A. K. and Shruti Kasana. 2021. Plant Systematics. Jaya publishing House, Delhi.

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

Elective Theory Course

Course Code – SBOTE 552

Title of the Course: PHYSIOLOGICAL PLANT PATHOLOGY AND PLANT DISEASES

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

Course objectives:

1. To understand the physiological changes in host due to infection.
2. To know which type of enzymes and toxins are involved in pathogenesis.
3. To impart knowledge of plant pathogens, diseases and management of plant diseases by different methods.

Course outcomes:

1. The students will be realize about physiological and molecular changes brought about in host plants
2. Student will think how to prevent the production of enzymes and toxins of plant pathogens.
3. Students will know common plant pathogens, symptoms, etiology, disease cycle and management of major diseases of crop plants.
4. Students will know the concept post harvest diseases of fruit & their management.

Curriculum Details: SBOTE552: Physiological Plant Pathology and Plant Diseases

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Module I: Physiological and Molecular Changes in Diseased Plants**	**12**
	1.1	**Physiological changes :** Composition of Plant cell wall, Changes in host cell walls, Effect of pathogens on permeability of cell membranes,	
	1.2	Effect of infection on Photosynthesis, Respiration, Translocation of water and Nutrients.	
	1.3	Effect of infection on Phenol metabolism and plant growth regulators. (Auxins, Gibberellins, Cytokinins and Ethylene) in diseased plants.	
	1.4	Changes in the Molecular level-Nucleic acid metabolism, Protein. Effect of pathogens on Transcription and Translation.	
2.0		**Module II: Enzymes and Toxins in Plant Pathogenesis**	**10**
	2.1	**Enzymes in Pathogenesis:** Cellulolytic enzymes- Types, mode of action and Role. Pectolytic enzymes: Types, mode of action and role in pathogenesis.	
	2.2	Macerating enzymes, General account of Hemicellulases, Lignolytic enzymes, Proteolytic enzymes and Lipolytic enzymes	
	2.3	**Toxins in Pathogenesis**: Classification of Toxins- Pathotoxins, Vivotoxins and Phytotoxins, Chemical nature and mode of action of Victorin, Lycomarasmin, Fusaric acid, Wild fire toxin.	
	2.4	General account of Pyricularin, Alternaric acid and Cercosporin..Effect of toxins on plant tissues, General account of Aflatoxins.	

3.0		**Module III: Diseases of Important Cereals, Pulses, Oil seeds & Vegetables**	
	3.1	History, symptomology, causal organism, etiology and management of the following diseases: **Cereals**: **Jowar**: Grain smut, head smut, rust, **Bajra**: Green ear/ downy mildew, ergot, rust, **Rice**: Brown leaf spot	**10**
	3.2	**Pluses**: **Pigeon pea**: Wilt, sterility mosaic, **Bean**: bean mosaic, **Black gram**: Powdery mildew, **Soybean**: Rust.	
	3.3	**Diseases of Important Oil Seeds:** History, symptom logy, causal organism, etiology and management of the following diseases: **Oil seeds**: **Ground nut**: Leaf spot, rust, **Sesame**: Sesamum phyllody, **Mustard**: White rust, **Sunflower**: Leaf spot	
	3.4	**Vegetables**: **Tomato**: Early blight, leaf curl, **Potato**: late blight, **Brinjal**: Little leaf, **Chilli**: Die back, leaf curl, **Bhendi**: Yellow vein mosaic, powdery mildew.	
4.0		**Module IV: Diseases of Fruit Plants & Post Harvest Management**	
	4.1	History, symptomology, causal organism, etiology and management of the following diseases: **Banana-**Sigatoka leaf spot bunchy top disease. **Citrus-** Canker, gummosis, greening.	**13**
	4.2	**Grapes**-Powdery mildew, downy mildew, anthracnose or bird's eye disease, **Papaya-** Mosaic,leaf curl, **Pomgranate**- Alternaria fruit spot, bacterial blight.	
	4.3	**Post Harvest Diseases of Fruits :** Concept of post harvest disease, causes of post harvest disease, factors governing post harvest problems, principles of post-harvest management,	
	4.4	**Mango**-Anthracnose, black mould. **Banana**- Anthracnose, black end. **Citrus**-Blue mould, green mould. **Grape**-Grey mould, blue mould. **Pomgranate**-Soft rot, **Papaya**-Fusarium rot, Rhizopus rot.	
		Total	**45**

SELECTED READINGS:

1. Agrios GN. (2005). Plant Pathology. 5th Ed. Academic Press, New York.
2. Deverall BJ. (1977). Defence Mechanisms in Plants. Cambridge Univ. Press, Cambridge, NewYork.
3. Dhingra OD & Sinclair JB. (1986) .Basic Plant Pathology Methods. CRC Press, London,Tokyo.
4. Gawai D. U.(2018).Physiological and Molecular Plant Pathology Agrotech Press,Jaipur
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6. Kosuge, T., and Nester, E. W., eds. (1984)."Plant-Microbe Interactions: Molecular and Genetic Perspective," Vol. 1. Macmillan, New York.
7. Mahadevan, A. and R. Shridhar, 1982. Methods in physiological plant pathology
8. Markham, J. E., and Hille, J. (2001).Host-selective toxins as agents of cell death in plant-fungus interactions.Mol. Plant Pathol. 2, 229–239.
9. Mehrotra RS &Aggarwal A. (2003).Plant Pathology.2nd Ed. Oxford & IBH, New Delhi.

10. Pandey B.P.(2016) Plant pathology .S.Chand & Co.Pvt.LtdNew delhi-110055
11. Pathak V.N. (1984). Laboratory Manual of Plant Pathology.Oxford & IBH, New Delhi.Gurr SJ, Mc
12. Pathak V N and Khatri.Fundamentals of Plant Pathology.
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14. Parker J. (2008).Molecular Aspects of Plant Diseases Resistance.Blackwell Publ.
15. Rangaswami, G., D.J. Bagyaraj. Agricultural Microbiology: - prentice Hall of India .Pvt .Ltd. New Delhi.110001
16. Rangaswami, G and A. Mahadevan (2006). Diseases of Crop Plants in India.Prentice Hall of India Pvt. Ltd. New Delhi 110001.
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19. Sharma P.D. Plant Pathology: Rastogi Publication, Shivaji Road Meerut. 25002 (India)
20. Pandey, B.P. Plant Pathology, Pathogens And Plant Diseases,.S.Chand and Company Pvt.Ltd.Ramngar, New Delhi 110055
21. Shrivastav, A.K. Principles of plant pathology & Diseases.Pragati Prakashan, Meerut.

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

Elective Theory Course

Course Code – SBOTE 553

Title of the Course: SEED TECHNOLOGY-II

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

Course objectives:

1.To study and impart knowledge about hybrid seed production, seed packaging, seed processing
2. To get knowledge about the process of seed certification
3. To know about different types of seed treatment methods
4. To know different seed borne diseases of important crops

Course outcomes:

1. Students will get to study knowledge about hybrid seed production, seed packaging, Seed processing
2. Student will get knowledge about the process of seed certification
3. Student will get knowledge about different types of seed treatment methods
4. Students will recommend the control measures for seed borne diseases

Curriculum Details: SBOTE 553: Seed Technology-II

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0		**Module I: SEED PRODUCTION**	
	1.1	Principles of seed production-Genetic and Agronomic. Methods of hybrid seed production. Measures considered during hybrid seed production programme	
	1.2	Use of male sterility and self compatibility in hybrid seed production, Production of Nucleus, foundation, certified and breeder's seeds	**12**
	1.3	Methods of hybrid seed production in pulses (pigeon pea, Green gram), Oil seeds (Groundnut, Sunflower) in fibers (Cotton, Jute) in vegetatively propagated crops (Sugarcane, potato)	
	1.4	Concept of seed village, seed production agencies National seed corporation (NSC), Indian council of agriculture research (ICAR), Indian agriculture research institute (IARI)	
2.0		**Module II: SEED PROCESSING AND CERTIFICATION**	
	2.1	Seed processing : Seed drying- Drying principles and methods- Sun drying, Bin-batch dryer, Wagon batch dryer, Bin layer, Column batch	
	2.2	Seed cleaning equipments and their function : Scalper debearder, Scarifier, Huller, Seed cleaner and grader, specific gravity separator, indented cylinder	**10**
	2.3	Seed packaging and handling , types of packaging material, selection	

		of packaging material, steps in packaging of seeds	
	2.4	Seed certification : Definition, history, objectives schemes, minimum seed certification standards. Legislation and law World wide organizations involved in seed : ISTA, AOSA, AOSCA, WTO	
3.0		**Module III: MANAGEMENT OF SEED BORNE PATHOGENS**	
	3.1	Field and storage fungi, harmful effects of storage fungi- Physical and biochemical changes, Enzymes in seed deterioration, types of mycotoxins and their effect on animal and human health	
	3.2	Seed treatment – Importance and methods (Physical, Chemical and biological) Seed treatment equipments : Shury seed treatter, Mist-o-matic seed treater	**10**
	3.3	Use of pesticides, botanicals, mycotoxins for seed treatment. Principles of fumigation and safe use of fumigants.	
	3.4	Important storage pests, their identification, monitoring and detection, nature and extent of damage	
4.0		**Module IV: SEED BORNE DISEASES**	
	4.1	Seed borne diseases of Groundnut : Tikka, Rust, Collar rot, root rot	
	4.2	Seed borne diseases of Soybean : Pod blight, rust Cow pea : mosaic , Bean : Anthracnose, bean mosaic	**13**
	4.3	Seed borne diseases of Sunflower: Leaf spot, rust, grey mould	
	4.4	Seed borne diseases of Cotton : Black arm, Anthracnose Sugarcane : Red rot, Whip smut, Grassy shoot	
		Total	**45**

SELECTED READINGS:

1. Introduction to Principles of Plant Pathology (3rd edition)-R.S.singh.
2. Plant Pathology - R.S.Mehrotra
3. Principles of Plant Pathology -C.E.Owens
4. Plant Pathology (2nd edition) George N.Agrios.
5. Plant Diseases - R.S.Singh
6. Plant Deseases -G.Rangaswamy
7. D. Lalithakumari (2000): Fungal Protoplast: A Biotechnological Tool: Oxford and IBH Publishing Co.Pvt.Ltd.
8. R.E.F. Mathews (1970) : Plant Virology.
9. S.T.Tilak (1998):Aerobiology. 4. Kenneth M. Smith (1968): Plant Viruses.
10. F.C.Bawden (1964): Plant Viruses and Virus Diseases.
11. Mehrotra R.S.(1980): Plant Pathology
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13. NyVall, R.F.(1979): Field Crop Diseases Handbook.
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15. Padoley, S.K. and P.B.Mistry: A manual of Plant pathology.
16. Gangopadhyay, S.(1984): Clinical Plant Pathology.
17. Principles of plant pathology &Diseases **:**-A.K. Shrivastav, Pragati Prakashan, Meerut
18. Plant Pathology G.P, Gupta, Discovery publishing House,New Delhi, 11002.
19. Plant Pathology: - P.D.Sharma Rastogi Publication, Shivaji Road Meerut. 25002 (India)
20. Plant pathology, pathogens and plant diseases B.P. Pandey,.S.Chand and Company Pvt.Ltd.Ramngar,New Delhi 110055

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22. Barton LV. 1985. Seed Preservation and Longevity. International Books and Periodicals Supply Service, New Delhi.
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28. Chhabra AK. 2006. Practical Manual of Floral Biology of Crop Plants. Dept. of Plant Breeding CCS HAU, Hisar.
29. Desai BB. 2004. Seeds Handbook.
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32. Musil AF. 1967. Identification of Crop and Weed Seeds. Handbook No. 219, USDA, Washington, DC, USA.
33. Poehlman JM &Sleper DA.2006. Breeding Field Crops. Blackwell.
34. Singh BD. 2005. Plant Breeding: Principles and Methods. Kalyani.
35. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani.
36. Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill.
37. Tunwar NS & Singh SV. 1985. Handbook of Cultivars. CSCB, GOI.

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

Publication Ethics Theory Course

Course Code – SBOTPE 551

Title of the Course: PUBLICATION ETHICS

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

Course objectives:

1. To know rules, issues, options, and resources for research ethics.
2. To familiarize with various institutional ethics review boards/academic integrity guidelines.
3. To understand the purpose and value of ethical decision-making.
4. To have a positive disposition towards continued learning about research ethics

Course outcomes:

1. To have a positive disposition towards continued learning about research philosophy & ethics.
2. To know Rules, Regulations, Issues, Options, and Scientific Resources of Research Ethics.
3. To learn the culture of fairness, honesty and integrity in academic communications and to understand the purpose and value of ethical decision-making.
4. Avoid wasteful and duplicate publications & encourage original contributions to advance Academic Research and Scholarship.
5. Acquiring knowledge & professional competence and expertise about Patents, Copyrights, and other forms of Intellectual Property Rights.
6. To promote social good and prevent or mitigate societal hazards through innovative ideas, creativity and research advocacy

CURRICULUM DETAILS: SBOTPE 551: PUBLICATION ETHICS

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0		**Module I: PUBLICATION ETHICS**	
	1.1	Publication ethics: definition, introduction and importance 2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest	**08**
	1.2	Publication misconduct: definition, concept, problems that lead to unethical behavior and vice verse, types	
	1.3	Violation of publication ethics, authorship and contributor ship	
	1.4	Identification of publication misconduct, complaints and appeals. Predatory publishers and journals	
2.0		**Module II: OPEN ACCESS PUBLISHING**	
	2.1	Open access publications and initiatives.	**07**
	2.2	SHERPA/RoMEO online resource to check publisher copyright and self- archiving policies	
	2.3	Software tool to identify predatory publications developed by SPPU	
	2.4	Journal finder/ journal suggestion tools viz. JANE	
3.0		**Module III: PUBLICATION MISCONDUCT**	**07**

	3.1	Subject specific ethical issues, FFP, authorship	
	3.2	Conflicts of interest	
	3.3	Complaints and appeals: examples and fraud from India and abroad	
	3.4	Use of plagiarism software like Turnitin, Urkund and other open source software tools.	
4.0		**Module IV: DATABASES AND RESEARCH METRICS**	
	4.1	Databases: Indexing databases	**08**
	4.2	Citation databases: Web of Science, Scopus, etc.	
	4.3	Research Metrics: Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score.	
	4.4	Metrics: h-index, g index, i10 index, altmetrics	
		Total	**30**

SELECTED READINGS:

1. The Handbook of Social Research Ethics, Donna M. Mertens, Pauline E. Ginsberg, SAGE (2009).
2. What are Qualitative Research Ethics? Rose Wiles, Bloomsbury (2013).
3. Research Ethics: Cases and Materials, Robin Levin Penslar, eds, Indiana University Press (1995).
4. Research Ethics: A Philosophical Guide to the Responsible Conduct of Research, Gary Comstock, Cambridge University Press (2013)
5. Bird, A. (2006). Philosophy of Science. Routledge.
6. MacIntyre, Alasdair (1967) A Short History of Ethics London
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11. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental
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14. https://doi.org/10.1038/489179a
15. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019),
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M.Sc. Botany, II Year (Semester - IV)

Core Practical Course

Course Code – SBOTP 551

Title of the Course: Based on theory Paper SBOTC 551

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

CurriculumDetails: SBOTP 551: Based on theory Paper SBOTC 551

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Detection of amino acids by chromatography.	2
2.	Extraction of proteins from plant tissue and their quantitative estimation by Lowery's	2
3.	Effect of pH on enzyme activity	2
4.	Effect of temperature on enzyme activity	2
5.	Effect of substrate concentration on amylase activity and determination of its Km value by Michalis – Menton Curve.	2
6.	Estimation of reducing, Non-reducing and total sugars from plant parts	2
7.	Estimation of Ascorbic Acid in the given material.	2
8.	Isolation of Nitrogen fixing bacteria from root nodule	2
9.	Estimation of carbohydrates by suitable method	2
10.	Extraction and estimation of starch from plant material	2
11.	Extraction and estimation of fats from plant material by Soxhlet extractor	2
12.	Analysis of plant proteins by SDS PAGE	2
13.	Visit to research centre/long/short tour.	2
14.	Short tour.	2
15.	Long tour.	2
	Total	**30**

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

Core Practical Course

Course Code – SBOTP 552

Title of the Course: Based on theory Paper SBOTC 552

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

CurriculumDetails: SBOTP 552: Based on theory Paper SBOTC 552

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Study of set up of tissue culture laboratory.	2
2.	Study of various aseptic and sterilization techniques	2
3.	Preparation and sterilization of tissue culture media	2
4.	Inoculation of plant material for callus formation.	2
5.	Demonstration of technique of micro propagation by using different explants (axillary buds and meristem)	2
6.	Isolation of protoplast from different tissues using commercially available enzymes (e.g.Tobacco, Petunia) and estimation of their yield.	2
7.	Demonstration of the technique of anther culture (e.g. Datura)	2
8.	Isolation of DNA from plant material	2
9.	PCR amplification of DNA.	2
10.	Restriction digestion and Electrophoresis of DNA	2
11.	Isolation of plasmid from bacteria	2
12.	Molecular analysis of Genes and Chromosomes by PCR technique.	2
13.	Study of restriction digestion of the plasmid and estimation of the size of various DNA fragments.	2
14.	Visit to plant tissue culture laboratory.	2
15.	Visit to Biotechnology Research centre	2
	Total	**30**

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

Elective Practical Course

Course Code – SBOTEP 551

Title of the Course: Based on theory Paper SBOTE 551

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

Curriculum Details: SBOTEP 551: Based on theory Paper SBOTE 551

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Description and identification of flowering plants belonging to different families of the order **Centrospermae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
2.	Description and identification of flowering plants belonging to different families of the order **Rosales** up to genus and species level with their sketches and floral formula and floral diagrams.	2
3.	Description and identification of flowering plants belonging to different families of the order **Sapindales** up to genus and species level with their sketches and floral formula and floral diagrams.	2
4.	Description and identification of flowering plants belonging to different families of the order **Tubiflorae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
5.	Description and identification of flowering plants belonging to different families of the order **Helobiae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
6.	Description and identification of flowering plants belonging to different families of the order **Spathiflorae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
7.	Description and identification of flowering plants belonging to different families of the order **Farinosae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
8.	Description and identification of flowering plants belonging to different families of the order **Scitaminae** up to genus and species level with their sketches and floral formula and floral diagrams.	2
9.	Preparation of Identification keys at Genus level (at least 3)	3
10.	Comparison of different species of a family to calculate similarity coefficient and preparation of dendrograms (Numerical taxonomy).	2
11.	Field work for familiarizing the local flora or to the nearby forest area under the supervision of teachers, and preparation of field notes of collected plants (individually) also documentation of the data should be submitted (Collectively) with photographic presentation (Digital Herbarium).	2
12.	Identification of local plants up to species level with the help of Standard floras	2
13.	At least two local study tours for the study and identification of local flora of the region	2
14.	At least one long botanical excursion, and visits to Botanical Garden, Research institutes, Botanical Survey of India etc.	3
	Total	**30**

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

Elective Practical Course

Course Code – SBOTEP 552

Title of the Course: Based on theory Paper SBOTE 552

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

Curriculum Details: SBOTEP 552: Based on theory Paper SBOTE 552

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Estimation of chlorophyll-a & b, total chlorophylls from diseased and healthy plant parts	2
2.	Detection of sugars from healthy and infected leaves by paper chromatography technique	2
3.	Estimation of total phenols from diseased plant parts	2
4.	Estimation of Pectolytic enzyme activity by Viscometric method	2
5.	Estimation of Cellulolytic enzyme activity by Viscometric method	2
6.	Estimation of CMCase enzyme activity by Dinitrosalicylic Acid (DNS) method	2
7.	Extraction and Separation of Aflatoxins from infected seeds	2
8.	Detection of a specific DNA sequence in DNA samples by Southern Blotting technique.	2
9.	Study of symptoms and causal organism of cereal diseases.	2
10.	Study of symptoms and causal organism of diseases of pulses	2
11.	Study of symptoms and causal organism of oil seed diseases.	2
12.	Study of symptoms and causal organism of vegetable and fruit diseases.	2
13.	Isolation, characterization and maintenance of pathogens from different plant diseases and post harvest fruit diseases.	2
14.	Short tour to visit Plant pathology laboratories, University departments & tissue culture laboratories	2
15.	Long Excursion to visit Research institute /Molecular biology Laboratories	2
		30

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

Elective Practical Course

Course Code – SBOTEP 553

Title of the Course: Based on theory Paper SBOTE 553

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

Curriculum Details: SBOTEP 553 :Lab 1 / Based on theory Paper SBOTE 553

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Seed production in cross pollinated crops with special reference toland, isolation, planting ratio of male and female lines, Hand masculation and pollination in Cotton	2
2.	Effect of drying temperature and duration on seed germination and storability withparticular reference to oil seeds	2
3.	Study of seed extraction methods; seed processing equipments; seed treating equipments; Seed blending, bagclosures	2
4.	Study of orthodox, intermediary and recalcitrant seeds	2
5.	Identification of common seed borne fungi	2
6.	Study of seed borne mycoflora by standard blotter paper method	2
7.	Study of seed borne mycoflora by paper towel method	2
8.	Study of seed borne mycoflora by standard agar plate method	2
9.	Seed treatments (chemical and biological)	2
10.	Detection of aflatoxin contamination in stored seed sample by UV light	2
11.	Effect of toxins on seed germination, leaf necrosis and seedling growth	2
12.	Seed borne diseases of Groundnut : Tikka, Rust, Collar rot, root rotSugarcane : Red rot, Whip smut, Grassy shoot	2
13.	Seed borne diseases of Soybean : Pod blight, rust Cow pea : mosaic , Bean : Anthracnose, bean mosaic	2
14.	Seed borne diseases of Sunflower: Leaf spot, rust, grey mould Cotton : Black arm, Anthracnose	2
15.	At least one long botanical excursion, two local study tours and visits to Industries, Research institutes, Agriculture universities etc.	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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