SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

THREE YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY

FACULTY: SCIENCE AND TECHNOLOGY

(Courses effective from Academic Year 2024-25)
Under NEP 2020

SYLLABUS

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THREE YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY

FACULTY: SCIENCE AND TECHNOLOGY

Sant Gadge Baba Amravati University

FACULTY: Science and Technology

(Three Years- Six Semesters Bachelor's Degree Programme)

Preamble:

Welcome to the Undergraduate Program in Botany, an immersive and comprehensive journey into the world of plant sciences. At the heart of this program lies a commitment to nurturing a deep understanding and appreciation of the plant kingdom, from the molecular to the ecosystem level. This curriculum is thoughtfully designed to blend rigorous scientific inquiry with practical applications, ensuring our students emerge as well-rounded, skilled, and knowledgeable botanists.

This program offers a rich tapestry of courses that cover a wide spectrum of botanical sciences. From exploring the theoretical foundations in plant science and delving into the diversity of microbial life to hands-on experimentation in plant pathology and advanced studies in genomics, proteomics, and metabolomics, the program provides an all-encompassing educational experience. These major courses are complemented by specialized vocational skill courses and skill enhancement courses, meticulously structured to bridge the gap between academic learning and vocational expertise. Students engage in in-depth studies of medicinal plant cultivation and processing, seed development technology, and nursery and garden management, seamlessly connecting these skills to practical vocational applications like commercialization, supply chain management, and entrepreneurship.

In addition to the core and vocational curricula, this program offers elective courses in critical areas like plant systematics, physiology, molecular biology, and fungal systematics, further broadening our students' scientific horizons. A unique feature of this program is the course on "Sacred Plant Heritage of Maharashtra", which integrates the rich botanical heritage of the region with the broader Indian Knowledge System, offering students a unique perspective on the cultural and historical significance of plants.

The graduates are not just academically proficient; they are also equipped with practical skills, an ethical mindset, and the capability to innovate and adapt in the dynamic field of botany. They emerge as individuals who are ready to contribute to scientific research, industry, environmental conservation, and academia. This program is an invitation to embark on a journey of discovery, learning, and growth in the fascinating world of plants, preparing students to become leaders and innovators who will shape the future of botanical sciences and contribute positively to society and the environment.

Core Competencies:

Based on the guidelines provided by the University Grants Commission under the National Education Policy 2020, the Graduate Attributes for the Discipline of Botany for the Undergraduate Program at Sant Gadge Baba Amravati University can be defined as follows:

Plant Identification and Comparison: Ability to recognize and differentiate between major plant groups, such as Algae, Fungi, Angiosperms, and Gymnosperms.

Understanding Plant Evolution and Diversity: Comprehend the evolutionary process and genetic diversity, analyzing plant functions and metabolism at various biological levels.

Adaptation, Development, and Behavior Analysis: Insight into the adaptation, development, and behavioral aspects of different life forms.

Ecosystem Understanding: Grasping the interconnectedness of life, tracing energy and nutrient flow, and understanding ecological relationships.

Analytical and Problem-Solving Skills

Research and Practical Problem Addressing: Utilization of scientific methods for hypothesis formulation, data collection, and critical analysis.
Critical Thinking: Enhanced understanding of fundamental concepts and their application in scientific principles, fostering problem-solving capabilities.

Digital Proficiency

Integration of Digital Tools: Acquiring digital skills and amalgamating fundamental concepts with modern technological tools.

Ethical and Psychological Development

Ethical and Moral Values: Strengthening ethical and moral principles, coupled with psychological resilience.

Teamwork

Collaboration Skills: Developing abilities to work efficiently in teams for institutional, industrial, and societal contributions.

Independent Learning

Self-directed Learning: Acquiring knowledge and skills for higher studies, competitive examinations, and employment readiness.

Additional Learning Outcomes

Critical Evaluation: Ability to critically assess plant information, understanding their classification and phylogenetic position.
Creative Problem Solving: Independently formulating solutions through interdisciplinary experiences.
Taxonomical Interpretation: Skill in using taxonomical information for plant classification.
Scientific Method Application: Proficiency in applying scientific methods to botanical questions.
Communication Skills: Effective presentation of scientific hypotheses and data, both orally and in written formats.
Literature Review: Ability to access and evaluate primary literature in Botany.
Application of Mathematical and Physical Principles: Using mathematical tools and physical principles in biological contexts.
Ecological Interconnectedness: Explaining ecological relationships and energy and nutrient flow in the environment.
Experimental Proficiency: Demonstrating expertise in experimental techniques and methods within Botany.

Curriculum Framework

Multidisciplinary and Holistic Education: Offering a comprehensive, in-depth, and focused curriculum that is student-centric and outcome-based.
Innovation and Curiosity: Promoting experiential learning, hands-on training, field studies, and internships to foster innovation and curiosity.
Adaptation to Modern Technology: Keeping abreast with the latest developments in plant sciences and technology.
Career Readiness: Equipping students with knowledge, competencies, and professional skills for the job market.
These attributes are designed to create well-rounded, skilled, and knowledgeable graduates who are ready to contribute effectively in their chosen careers and as responsible citizens.

Graduate Attributes

Graduate Attributes for a Botany program encapsulate the essential qualities, skills, and understandings that a student is expected to acquire throughout their academic journey. These attributes are meticulously designed to prepare graduates for diverse roles in scientific research, industry, environmental conservation, and academia. They reflect a blend of theoretical knowledge, practical skills, technological proficiency, and ethical understanding. Importantly, these attributes also foster a mindset of lifelong learning, adaptability, and innovation. Graduates are expected to not only excel in their scientific endeavors but also contribute positively to societal and environmental challenges. By integrating knowledge from various sub-disciplines of Botany and related fields, students are equipped to approach complex problems holistically and innovatively, making them valuable assets in any professional setting they choose to pursue.

Graduate Attributes specifically with the Major Courses, Vocational Skill Courses, Skill Enhancement Courses, and Elective Courses you've listed. This will provide a comprehensive picture of the attributes expected from students graduating from this Botany program.

1. **Advanced Scientific Understanding:** Develop an in-depth understanding of plant science, including theoretical foundations, microbial diversity, plant pathology, cryptogams and phanerogams, economic Botany, and advanced fields like genomics, proteomics, and metabolomics.
2. **Practical and Laboratory Skills:** Gain hands-on experience in practical techniques in microbial studies, plant pathology, cell biology, cytogenetics, and various experimental approaches, preparing students for real-world scientific challenges.
3. **Technological and Analytical Proficiency:** Achieve expertise in using modern technologies in plant science. This includes proficiency in bioinformatics, genetic engineering, molecular biology, and data analysis techniques, crucial for research and industry applications.
4. **Entrepreneurial and Business Skills:** Develop skills in commercialization, medicinal plant cultivation and processing, supply chain management, seed development technology, entrepreneurship, and nursery and garden management, preparing students for business ventures in Botany.
5. **Environmental Stewardship and Ethical Considerations:** Cultivate an understanding of the ecological and ethical implications of plant sciences, especially in areas like genetic engineering, conservation, and sustainable use of plant resources.
6. **Interdisciplinary Integration and Innovation:** Ability to integrate knowledge from plant systematics, physiology, molecular biology, and fungal systematics, and apply innovative solutions to challenges in the field of Botany.
7. **Communication and Collaboration Skills:** Develop strong communication skills for conveying complex botanical concepts clearly and collaborating effectively in interdisciplinary teams.
8. **Global Perspective and Societal Impact:** Awareness of the global and societal impact of plant sciences, including the role of plants in addressing issues like food security, medicine, and climate change.
9. **Critical Thinking and Problem Solving:** Foster critical thinking and problem-solving skills, essential for tackling complex scientific questions and challenges in Botany.
10. **Research and Inquiry:** Encourage a strong foundation in research methodology and inquiry, essential for contributing to the growing body of knowledge in plant science and related fields.

The course "Sacred Plant Heritage of Maharashtra," deeply rooted in the Indian Knowledge System, offers an enriching study of the traditional and sacred botanical heritage specific to the Maharashtra region of India. This course delves into the rich tapestry of cultural, spiritual, and medicinal significance of plants that are integral to the local traditions and practices. Students will explore the historical context, religious importance, and the ethnomedicinal uses of these plants, gaining insights into how they have been revered and utilized over centuries. Through field visits, interaction with local communities, and studying ancient texts, students will learn how these plants are not only

a part of the state's ecological biodiversity but also a vital component of its cultural identity and traditional wisdom. This course, therefore, bridges the gap between conventional botanical studies and the rich, often unexplored, indigenous knowledge systems of India.
These attributes ensure that graduates are not just academically proficient but also equipped with practical skills, an ethical mindset, and the ability to adapt and innovate in the dynamic field of Botany.

The structure of the Vocational Skill Courses and Skill Enhancement Courses in this Botany program is strategically designed to provide students with a comprehensive skill set that aligns directly with viable vocational pathways. For instance, the course on "Medicinal Plant Cultivation and Processing" lays the foundational skills necessary for understanding the nuances of cultivating and processing medicinal plants. This knowledge is then extended and applied in the course "Commercialization of Medicinal Plant and Products," enabling students to grasp the business aspects of the medicinal plant industry, including market analysis, product development, and sales strategies.

Similarly, the course on "Seed Development Technology" equips students with the technical know-how in seed science and technology. This knowledge is complemented by the "Supply Chain Management in Seed Products" course, which teaches students the logistics and management skills required to effectively distribute seed products in the market. This integrated approach ensures that students not only learn the scientific and technical aspects of Botany but also gain expertise in the business and management side of the industry.

In the realm of horticulture, the course "Skilling Botanists for Nursery and Garden Management" provides practical skills in nursery operations and garden management. This is synergistically linked with the vocational course "Nursery and Garden Management," focusing on the entrepreneurial aspects of running a nursery or garden business, including financial management, marketing, and customer relations.

Moreover, specialized courses like "Entrepreneurship for Botanists" and "ECO Friendly Plant Products" open further avenues for career opportunities. "Entrepreneurship for Botanists" encourages an entrepreneurial mindset, preparing students to start their ventures or innovate within existing organizations in the botanical field. "ECO Friendly Plant Products" course focuses on sustainable and environmentally friendly practices in product development, aligning with the growing global trend towards green solutions.

This cohesive and integrated educational approach ensures that students are not only well-versed in theoretical and practical aspects of Botany but also equipped with the necessary skills to turn their knowledge into successful vocational pursuits. This alignment of skills with vocational outcomes is key to providing students with a clear and achievable career path post-graduation.

Program Outcomes

Program Outcomes for an Undergraduate Botany Program, especially one with a comprehensive curriculum like the one, involves articulating the specific knowledge, skills, and attitudes students are expected to possess upon graduation. Following are the Program Outcomes:

1. **Scientific Knowledge and Understanding:** Graduates will demonstrate a thorough understanding of plant biology, including the study of microbial diversity, plant pathology, botany (Cryptogamic, Phanerogamic), and advanced topics like genomics, proteomics, and metabolomics.
2. **Practical and Experimental Skills:** Graduates will acquire hands-on skills in various laboratory techniques and experimental approaches in plant science, enabling them to conduct scientific investigations effectively.
3. **Technological Proficiency:** Graduates will be adept in using modern technologies and tools relevant to botany and plant sciences, including bioinformatics, genetic engineering, and analytical software.
4. **Environmental Awareness and Sustainability:** Graduates will understand the ecological and environmental impact of plants and plant-based industries and will be knowledgeable about sustainable practices in botany.
5. **Entrepreneurial and Business Acumen:** Graduates will possess skills in entrepreneurship and business management, particularly in areas such as medicinal plant commercialization, seed product management, and nursery and garden management.
6. **Interdisciplinary Integration:** Graduates will be able to integrate knowledge across various sub-disciplines of botany, applying them to solve complex problems in plant science and related fields.
7. **Communication Skills:** Graduates will develop strong communication skills, capable of effectively conveying botanical concepts and findings to diverse audiences, both in academic and industry settings.
8. **Ethical and Societal Understanding:** Graduates will have a deep appreciation of the ethical implications and societal importance of plant sciences, particularly in areas like genetic engineering and conservation.
9. **Research Competence:** Graduates will be proficient in scientific research methodologies, enabling them to contribute to the expansion of knowledge in plant sciences.
10. **Global Perspective and Societal Contribution:** Graduates will recognize the global challenges and opportunities in botany and will be prepared to contribute to societal needs and environmental conservation efforts.
11. **Career Readiness and Adaptability:** Graduates will be ready for a variety of career paths in botany and related fields, equipped with the adaptability and lifelong learning skills necessary to navigate a dynamic professional landscape.
12. **Innovation and Problem-Solving Skills:** Graduates will have the ability to apply creative and critical thinking to innovate and solve problems in the field of botany.

These Program Outcomes ensure that graduates from the Botany program are not only academically proficient but also ready to apply their knowledge and skills in practical, research, and entrepreneurial settings, contributing positively to the field of plant sciences and the broader community.

THREE YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY under **FACULTY: SCIENCE AND TECHNOLOGY**

Board of Studies in Botany (Including Environmental Science and Seed Technology)

1.	**Agnihotri Dr. Adarsh Kumar,** Principal Scientific Officer, Bio-processing & Herbal Division, Mahatma Gandhi Institute for Rural Industrialization, Maganwadi, Wardha
2.	**Dagwal Dr M. J.** Radhabai Sarada Mahavidyalaya, Anjangaon Surji
3.	**Deosthale** Dr. S. M. B. B. Arts & N.B. Commerce & B.P. Science College, Digras
4.	**Dongarwar, Dr. Nitin M.** Department of Botany, Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
5.	**Dr. Dipak K. Koche,** Shri. Shivaji College of Arts, Commerce & Science, Akola
6.	**Gawande Dr. P. A.** Dept. of Botany, Sant Gadge Baba Amravati University, Amravati

7.	**Hande Dr. Dilip Vinayakrao** Shri Pundlik Maharaj Mahavidyalya, Nandura Rly
8.	**Kadu Dr. Suruchi R.,** Brijlal Biyani Science College, Amravati.
9.	**Khedkar Dr. Dinesh** Shri Shivaji Science College, Amravati
10.	**Khodke Dr. Suchita Pravin** Vinayak Vidnyan Mahavidyalaya, Nandgaon Kh.
11.	**Maggirwar Dr. Rekha** Shri Shivaji Science College, Amravati
12.	**Mangale Dr. Vijay** Art, Commerce and Science College, Chikhaldara
13.	**Nathar Dr. Sou. V. N.** Dept. of Botany, Sant Gadge Baba Amravati University, Amravati
14.	**Shahejad Dr. M. A.** SPM Gilani Arts Commerce College, Ghatanji, District -Yavatmal
15.	**Wankhede Dr. Tushar Bhimrao** J. D. Patil Sangaludkar Mahavidyalaya, Daryapur

THREE YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY under **FACULTY: SCIENCE AND TECHNOLOGY**

Committees Constituted by BoS (Botany Including Environmental Science and Seed Technology) for Curriculum Development in Botany for Semester I and II

FOUNDATIONS OF PLANT SCIENCE AND CAREER DEVELOPMENT
Dr. D. D. Khedkar (C)
Dr. P. A. Pawade
Dr. S. J. Ishwarkar
Dr. D.M. Ratnparkhi
Dr. Mangesh Bobade
Dr. P. D. Deshmukh
Mr. Ankit Kale
Mr. Avinash Darsimbe
Advisory Members;
Dr. N. H. Sahare
Dr. P. G. Bansod

MICROBIAL DIVERSITY
Dr. D. K. Koche (C)
Dr. R. P. Sirsat
Dr. V. S. Patil (Dandge)
Dr. V. N. Badgujar
Dr. Anjali Thakare
Dr. Ananat Morey
Dr. Kishor Theng
Dr. Anand Oke
Dr. Suvarna Dakhore
Advisory Members:
Dr. Manik Dhore
Dr. A. V. Padghan

TECHNIQUES IN MICROBIAL STUDIES AND PLANT DISEASES
Dr. D. D. Khedkar
Dr. D. K. Koche

CRYPTOGAMIC BOTANY
Dr. S. M. Deosthale (C)
Dr. K. S. Sontake
Dr. P.Y. Anasane
Dr. Parvin A. Theng
Dr. Mohammed Nafees Iqbal
Dr. Ashay Muneshwar
Dr. N. S. Gopkar
Dr. Swati Tathod
Dr. K. P. Suradkar
Advisory Members:
Dr. S. I. Kamble

PHANEROGAMIC BOTANY
Dr. D. V. Hande (C)
Dr. A.V. Padghan
Dr. V. P. Deshmukh
Dr. Sanjay Satpute
Dr. Kakode K. U.
Dr. Pankaj Kashte
Dr. Suchita Dighe
Dr. Shrikant Patil
Advisory Member
Dr. G. B. Hedawoo

HANDS-ON EXPLORATION OF CRYPTOGAMS, PHANEROGAMS AND PALEOBOTANY
Dr. S. M. Deosthale
Dr. D.V. Hande

FUNDAMENTAL LIFE PROCESSES IN PLANTS
Dr. Pendam S. T. (C)
Dr. Thorat S. B.
Dr. S. K. Lande
Dr. Nilesh Kakade
Dr. Khandare N. A.
Advisory Members:
Dr. Suryakant Kanherkar

PLANT HEALTH CARE
Dr. T. B. Wankhade (C)
Dr. N. H. Shahare
Dr. Ravi Dhande
Dr. S. M. Patole
Dr. Y. P. Patil (Malkapur)
Mr. Gokul Bajaj
Dr. Nutanvarsha Deshmukh
Mr. Himanshu Jaiswal
Dr. Vivek Narkhedkar
Advisory Members:
Dr. G. C. Kamble

KITCHEN GARDENING
Dr. S. R. Kadu (C)
Dr. Ajay Rajurkar
Dr. K. M. Thorat
Dr. Simeet Rokade
Dr. S. P. Kalbende
Dr. Umesh More
Mr. G. C. Bajaj
Dr. Jayashri More
Advisory Members:
Dr. V. U. Pochhi

FLORICULTURE AND VALUE ADDITIONS
Dr. R. C. Maggirwar (C)
Dr. G. B. Hedawoo
Dr. A. T. More
Dr. Bhade D. L.
Dr. Shaikh Farah Tahesin
Dr. S. P. Patil
Dr. K. S. Sontakke
Dr. S. P. Patharkar
Dr. S. V. Pundkar
Dr. Pranjali Deshmukh
Dr. Sumit Chaudhari
Advisory Members:
Dr. D. S. Talwankar

AYUSH **Dr. S. P. Khodke (C)** Dr. R. B. Kalbande Dr. Minal Keche Dr. Ravindra Dhore Dr. S. S. Mhasal Dr. Mahendra Bhise Dr. D. S. Pawar Mr. Shilanand Hiwrale Dr. Sneha Ingale Dr. Amrapali Bhagat **Advisory Members:** Dr. U. R. Kokate
COMMERCIALIZATION OF MEDICINAL PLANT AND PRODUCTS **Dr. Santosh Suradkar (C)** Dr. Mangesh Dagwal Dr. K. M. Ranjalkar Dr. Mahendra Salve Dr. Shidas Aher Dr. Umesh Kanherkar Dr. Yugandhara Gulhane Dr. Manoj Kakpure Dr. M. U. Ghurde **Advisory Member:** Dr. S. S. Ingale

MEDICINAL PLANT CULTIVATION AND PROCESSING **Dr. Mangesh Dagwal (C)** Dr. G. D. Wadankar Dr. Pramod Khadse Dr. Umesh Kanherkar Dr. Yugandhara Gulhane Dr. Manoj Kakpure Dr. M. U. Ghurde Dr. P. G. Khapekar **Advisory Member:** Dr. S. V. Satpute
SUPPLY CHAIN MANAGEMENT IN SEED PRODUCTS **Dr. Mukund M. Dhore (C)** Dr. Sujata Shende Dr. P. D. Wanjare Dr. V. D. Samarth Dr. Suchita Dighe **Advisory Member:** Dr. A. N. Deore
SEED DEVELOPMENT TECHNOLOGY **Dr. M. A. Shahezad (C)** Dr. N. S. Dharkar Dr. Pankaj Kahate Dr. Vijay Watile Dr. Vinod Chavhan Dr. Ravindra Mate Dr. Pravin R. Sardar **Advisory Member:** Dr. Mukund M. Dhore

Teaching and Learning Scheme: for the Degree of Bachelor of Botany as Major

Sant Gadge Baba Amravati University, Amravati

FACULTY: SCIENCE AND TECHNOLOGY

Teaching and Learning Scheme: for the Degree of Bachelor of Botany as Major and $ as Minor

TLE Scheme for FIRST YEAR: SEMESTER – I

Mode of Teaching	Vertical No.	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major / Minor	Theory1	107201	Foundations of Plant Science and Career Development	2	2	6
			Lab/Practical-1	107202	Foundations and Prospects of Plant Science	2	4	
	b.	Minor / Major	Theory1	-	-	2	2	6
			Lab/Practical-1	-	-	2	4	
	c.	Generic/Open Elective	Theory1	107203	Plant Health Care	2	2	4
			Theory2	107204	Kitchen Gardening	2	2	
	d.	VSC	-	-	-	-	-	4
		SEC	Lab/Practical-2	107205	Medicinal Plant Cultivation and Processing	2	4	
	e.	AEC - English	Theory		Refer University basket	1	1	6
		AEC –MIL	Theory		Refer University basket	1	1	
		IKS-Generic	Theory		Refer University basket	2	2	
		VEC	Theory		Refer University basket	2	2	
	f.	CC	Outdoor		Separate SOP will be released	2	4	4
		TOTAL				22	30	30

$ Minor Subject opted by the Student

TLE Scheme for FIRST YEAR: SEMESTER – II

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major / Minor	Theory2	107206	Fundamental Life Processes in Plants	2	2	6
			Lab/Practical-3	107207	Hands on Exploration of Life Processes	2	4	
	b.	Major / Minor	Theory2		-	2	2	6
			Lab/Practical-5		-	2	4	
	c.	Generic/ Open Elective	Theory3	107208	Floriculture and Value Additions	2	2	4
			Theory4	107209	AYUSH	2	2	
	d.	VSC	Lab/Practical-6	107210	Commercialization of Medicinal Plant and Products	2	4	8
		SEC	Lab/Practical-7	107211	Seed Development Technology	2	4	
	e.	AEC - English	Theory		Refer University basket	1	1	4
		AEC –MIL	Theory		Refer University basket	1	1	
		VEC	Theory		Refer University basket	2	2	
	f.	CC	Outdoor		Separate SOP will be released	2	4	4
		TOTAL				22	32	32

$ Minor Subject opted by the Student

*** Important:**

- VSC Should be Complementary to Major/Minor
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for SECOND YEAR: SEMESTER – III

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major	Theory3	107212	Microbial Diversity	2	2	8
			Theory4	107213	Cryptogams and Gymnosperms	2	2	
			Lab/Practical-8	107214	Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms	2	4	
		IKS-Major Specific	Theory	107215	Sacred Plant Heritage of Maharashtra	2	2	
	b.	Minor	Theory3	107216	Plant Diversity, Conservation and Forensic Botany	2	2	6
			Lab/Practical-9	107217	Practical Approach towards Plant Diversity, Conservation and Forensic Botany	2	4	
	c.	Generic/Open Elective	Theory5	107218	Traditional Health Care	2	2	2
	d.	VSC	Lab/Practical-10	107219	Supply Chain Management in Seed Products	2	4	4
	e.	AEC - English	Theory		Refer University basket	1	1	2
		AEC –MIL	Theory		Refer University basket	1	1	
	f.	FP/CES	Project		Refer University basket	2	4	8
		CC	Outdoor		Separate SOP will be released	2	4	
		TOTAL				22	30	30

TLE Scheme for SECOND YEAR: SEMESTER – IV

Mode of Teaching	Vertical No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major	Theory5	107220	Botanical Wealth – Economic Botany, Ethnomedicine and Phytochemistry	2	2	8
			Theory6	107221	Cellular Frontiers in Botany - Cell Biology, Cytogenetics and Molecular Biology	2	2	
			Lab/Practical-11	107222	Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies	2	4	
	b.	Minor	Theory4	107223	Plant Propagation and Growth	2	2	4
			Lab/Practical-12	107224	Investigations of Plant Life Sketch	2	2	
	c.	Generic/ Open Elective	Theory6	107225	Plant Products	2	2	2
	d.	VSC	Lab/Practical-13	107226	Nursery and Garden Management	2	4	8
		SEC	Lab/Practical-14	107228	Skilling Botanists for Nursery and Garden Management	2	4	
	e.	AEC - English	Theory		Refer University basket	1	1	2
		AEC –MIL	Theory		Refer University basket	1	1	
	f.	FP/CES	Project		Separate SOP will be released	2	4	8
		CC	Outdoor		Separate SOP will be released	2	4	
		TOTAL				22	32	32

*** Important:**

- VSC Should be Complementary to Major
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for THIRD YEAR: SEMESTER – V

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major	Theory7	107229	Theoretical Foundations in Plant Morphology, Anatomy, Embryology, and Pharmacognosy	2	2	20
			Theory8	107230	Innovative technologies of the Plant Breeding, Biotechnology and Green Revolution	2	2	
			Theory9	107231	Physiological Advances	2	2	
			Lab/Practical-15	107232	Practical Insights in Plant Anatomy, Embryology, Pharmacognosy and Green Revolution	2	4	
			Lab/Practical-16	107233	Laboratory Skills Innovative Technologies in Biotechnology, Plant Breeding and Physiological Processes	2	4	
		Major (Elective) Any one Elective group of Courses shall be opted	Theory	107234	Plant Systematics - 1	2	2	
			Lab/Practical	107235	Lab-Based Learning of Plant Systematics - 1	2	4	
			Theory	107236	Molecular Biology - 1			
			Lab/Practical	107237	Lab-Based Learning of Molecular Biology - 1			
			Theory	107238	Plant Physiology - 1			
			Lab/Practical	107239	Lab-Based Learning of Plant Physiology - 1			
			Theory	107240	Fungal Systematics - 1			
			Lab/Practical	107235	Lab-Based Learning of Fungal Systematics - 1			
	b.	Minor	Theory5	107236	Herbal Medicinal Plant Wealth of India	2	2	6
			Lab/Practical-18	107237	Lab Techniques in Herbal Medicines	2	4	
	c.	Generic/Open Elective	-	-	-	-	-	-
	d.	VSC	Lab/Practical-19	107238	Eco-Friendly Plant Products	2	4	4
		SEC	-	-	-	-	-	
	e.	VEC	-	-	-	-	-	0
	f.	FP/CES	Project		Separate SOP will be released	2	4	4
		CC	-	-	-	-	-	-
		TOTAL				**22**	**34**	**34**

TLE Scheme for THIRD YEAR: SEMESTER – VI

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Fieldv	a.	Major	Theory10	107239	Genomics, Proteomics and Metabolomics	2	2	18
			Lab/Practical-20	107240	Experimental Approaches in Genomics Proteomics and Metabolomics	2	2	
			Theory11	107241	Soil Science and Plant Nutrition	2	4	
			Lab/Practical-21	107242	Experimental Approaches in Soil Science and Plant Nutrition	2	4	
		Major (Elective) Any one Elective group of Courses shall be opted	Theory2	107243	Plant Systematics - 2	2	2	
			Lab/Practical-22	107244	Lab-Based Learning of Plant Systematics -2	2	4	
			Theory	107245	Molecular Biology - 2			
			Lab/Practical	107246	Lab-Based Learning of Molecular Biology -2			
			Theory	107247	Plant Physiology -2			
			Lab/Practical	107248	Lab-Based Learning of Plant Physiology -2			
			Theory	107249	Fungal Systematics -2			
			Lab/Practical	107250	Lab-Based Learning of Fungal Systematics -2			
	b.	Minor	Theory6	107251	Genetic Engineering and AI in Plants	2	2	6
			Lab/Practical-23	107252	Experimental Modifications and AI in Plants	2	4	
	c.	Generic/ Open Elective	-			-	-	0
	d.	VSE	Lab/Practical-24	107253	Entrepreneurship for Botanists	2	4	4
	e.	VEC			Refer University basket			
	f.	Internship / Apprenticeship	OJT		Refer University basket	4	8	8
		FP/CES	Project		Separate SOP will be released	-	-	
		-	-	-		-	-	-
		TOTAL				22	36	36

Notes:

a. The strength of the batch of the Practical for UG Classes shall be 16 with an addition of 10% with the permission of Hon'ble Vice Chancellor. The number of the students required to constitute a batch or calculate the workload shall be in accordance with the relevant Government Resolution in force at the time, applicable to specific time, region, course type, mode of instruction, and other pertinent factors.

b. 1 Credit shall mean 1 Hour Teaching per Week per Semester (Total 15 Hrs/ Semester), the duration of 1 Teaching Period will be 60 Minutes. For Practical 1 Credit shall mean 2 Hour Teaching per Week per Semester (Total 30 Hrs/ Semester).

c. For Examination and Evaluation of Theory Courses, 40 % Marks shall be assigned to Internal Examination and 60% Marks shall be assigned to end-semester external university examination.

d. **Co-curricular Courses:** Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III, IV, V and VI**.** These courses may be taught by Physical Education Director or may be assigned to Language Teacher by the Principal of HEI based on the expertise of the concerned.

e. **Value Education Courses** to be selected from the Basket of Courses provided by the University. These courses may be assigned to the Language Teacher by the Principal of HEI based on the expertise of the concerned.

f. **Generic / Open Elective Courses (GE/OE):** Courses to be selected from the Basket of Courses provided by the University

g. **Abbreviations:** Department Specific Core: DSC, Department Specific Elective: DSE, FSC: Faculty Specific Core, FSE: Faculty Specific Elective, Indian Knowledge System: IKS, Inter Faculty Specific Core: IFSC, Inter Faculty Specific Elective: IFSE, Theory: Th, Practical/Practicum: Pr, Environment Studies: ES, Pre-requisite Course mandatory if applicable: Prq, Laboratory: Lab (Practical), Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community Engagement and Service: CES; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP; MIL: Modern Indian Language

Examination and Assessment Process:

i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.

ii. Exit options are provided with Certificate, Diploma and Basic Bachelor's degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor's degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.

iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on 'Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table -

Table: Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination, Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
a	Major	External & Internal	30	9	20	6	50	20	25	10	25	10	50	20
b	Minor		30	9	20	6	50	20	25	10	25	10	50	20
c	Generic/ Open Elective		30	9	20	6	50	20	--	--	--	--	--	--
d	VSC	Internal	--	--	--	--	--	--	--	--	50	20	50	20
	SEC	Internal	--	--	--	--	--	--	--	--	50	20	50	20
e	AEC (Eng. & One MIL Composite)	External & Internal	30	9	20	6	50	20	--	--	--	--	--	--
	IKS (Generic)	External & Internal	30	9	20	6	50	20	--	--	--	--	--	--
	VEC	External & Internal	30	9	20	6	50	20	--	--	--	--	--	--
f	Internship/ Apprenticeship	Internal	Assessment of these verticals shall be based on various activities/practices. It shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											
	FP/CEP													
	CC													

Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
   - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
   - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
   - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.

ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.

iii. Total Performance in CAT (i.e. 40 %) shall be based on the **best two out of three** in CAT examinations

iv. Internal assessment shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule –

Sr. No.	Name of the Examination	End Sem Examination	Supplementary Examination*
1	Semester-I, III, V and VII	Winter	Summer
2	Semester-II, IV, VI and VIII	Summer	Winter

***** The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. **However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination.** The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
   a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
   b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
   c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

THREE YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY

FACULTY: SCIENCE AND TECHNOLOGY

SEMESTER – I

The Vertical	Type of Course	Course Code	Course Name
Major / Minor	Theory1	107201	Foundations of Plant Science and Career Development
	Lab/Practical-1	107202	Foundations and Prospects of Plant Science
Minor / Major	Theory1	-	-
	Lab/Practical-1	-	-
Generic/Open Elective	Theory1	107203	Plant Health Care
	Theory2	107204	Kitchen Gardening
VSC	-	-	-
SEC	Lab/Practical-2	107205	Medicinal Plant Cultivation and Processing
AEC - English	Theory		Refer University basket
AEC –MIL	Theory		Refer University basket
IKS-Generic	Theory		Refer University basket
VEC	Theory		Refer University basket
CC	Outdoor		Separate SOP will be released

Major/Minor Theory- Foundations of Plant Science and Career Development

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	107201	Foundations of Plant Science and Career Development	2	30	2 Hrs	30 (Ext)+20 (Int)

Course Objectives:

1. To Provide a Comprehensive Understanding of Plant Biology and Botany
2. To Develop Practical Skills in Plant Science Research and Application
3. To Explore the Role of Plants in Society and Industry
4. To Prepare Students for Career and Further Educational Opportunities

Course Outcomes:

After successful completion of this course students will be able to –

CO 1: Students will be able to recall key historical milestones in botany, basic concepts of plant diversity, taxonomy, and systematics, and foundational knowledge of plant physiology and cell biology.

CO 2: Students will demonstrate an understanding of how plants interact with their environment, the role of plants in agriculture and various industries, and the impacts of plants on environmental issues such as climate change and pollution.

CO 3: Students will apply their knowledge of plant sciences to explore opportunities for advanced studies and careers in the corporate world, including preparation for competitive examinations and understanding the skills required in plant-based industries.

CO 4: Students will analyze and critically evaluate modern concepts in plant sciences such as CRISPR/Cas9, synthetic biology, and the application of AI in plant phenotyping, along with the ethical and legal aspects of these innovations.

CO 5: Students will be able to assess the effectiveness of innovative plant science technologies like artificial photosynthesis, hydrogen fuel harvesting, and plant-based meat alternatives, and make informed judgments about their potential impact on society and the environment.

CO 6: Students will synthesize their knowledge and skills to develop original ideas or approaches in plant sciences, potentially leading to entrepreneurial opportunities or novel research projects. They will also demonstrate proficiency in communicating their scientific ideas effectively through writing and presentations.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	1.1: Bridging Knowledge of Lower Classes, Historical context of Botany and its importance in the modern world, Basics of Diversity, Taxonomy and Systematics	8	8	Suitable pedagogical strategies are separately annexed
	1.2: Plant interactions with their environment, (including ecosystems), Fundamentals of Physiological Process (Photosynthesis, respiration, plant hormones, and growth regulation)			
	1.3: Cell and Molecular Biology for Understanding plant cell structure, organelles, Differences from other living cells, Transformation of Phenotype from Genotype			
	1.4: Plant Breeding and Genetic Engineering, Mendelian inheritance, Modern plant breeding techniques, Creation of Genetically Modified Crops			

Unit II	2.1: Agricultural Botany, Role of plants in Agriculture, crop improvement programs, and Sustainable practices.	7	7	
	2.2: Plants as an Industry, Biomolecular, Food, Medicinal, Biofuels, Biomaterials, etc.			
	2.3: Environmental Botany, Impact Assessment, Climate Change and Pollution			
	2.4: Ultramodern Concepts in Plant Sciences, CRISPR/Cas9 and Advanced Genetic Editing, Synthetic Biology, Plant Neurobiology, Phenomics and High-Throughput Plant Phenotyping using Artificial Intelligence (AI)			
Unit III	3.1: Opportunities for Higher Studies in Master and Doctoral, Top Institutes of India and Abroad	8	8	
	3.2: Readiness for entry in to Corporate World of Industries, Plant based industries and their skills demands			
	3.3: Exploration of various lines of Research, prominent research institutes of National and International repute and their research contributions			
	3.4: Competitive Examinations for Plant Sciences, Entrance Exams for Higher Studies, International Flyers, and Entry in Services (Public and Corporate)			
Unit IV	4.1: Innovation in Plant Sciences like - Artificial Photosynthesis, Hydrogen Fuel Harvesting, Edible Vaccines, Phytoremediation, Biofortification, Plant-based Meat Alternatives, Responsive “Smart” Plants, etc.	7	7	
	4.2: Entrepreneurship Opportunities, Scope and Projections, Local and international Business (Case Study - One Each)			
	4.3: Communication Skills viz. Writing scientific papers, presenting research, and public speaking			
	4.4: Fellowships and Scholarships for Botany students.			

References:

DIGITAL RESOURCES:

- http://www.theplantlist.org/ A comprehensive database of plant taxonomy and systematics.
- https://www.plantae.org/ Webinars and educational resources on various plant biology topics.
- https://www.ibiology.org/plant-biology/ iBiology Plant Biology Talks and lectures by leading researchers in plant cell and molecular biology.
- https://www.nature.com/subjects/plant-sciences Access to articles and latest research in plant science.
- http://www.fao.org/elearning/#/elc/en Courses on crop improvement and genetic engineering by FAO e-learning Centre.
- https://gmoanswers.com/ Resource for information on genetically modified crops.
- AgriMOOC by AgriLife Learn: Online courses on modern agriculture, crop improvement, and sustainability.
- https://www.sare.org/ Resources and courses on sustainable agricultural practices especially for Sustainable Agriculture Research & Education.

- https://www.biotecharticles.com/ Articles on plant biotechnology in various industries.
- https://plantbasednews.org/ Latest news and developments in plant-based industries.
- https://www.environmentalscience.org/ E-content on environmental botany and related topics.
- https://www.ted.com/topics/climate+change Inspirational TED Talks on Climate Change and talks related to plants and environmental issues.
- Synthetic Biology MOOC by edX: Online course on synthetic biology, including plant applications.
- https://www.plantae.org/research/crispr/ Information and updates on CRISPR technology in plants as Plantae's CRISPR Resources.
- https://www.scholarship-positions.com/ Information on scholarships for higher studies in plant sciences.
- https://www.linkedin.com/learning/ Courses on career development and industry readiness on LinkedIn Learning.
- https://www.researchgate.net/ Platform to explore research papers and contributions from various institutes on ResearchGate.
- https://www.kaggle.com/ Data science competitions and datasets relevant to plant sciences.
- https://ocw.mit.edu/index.htm Free course materials on topics like innovation and entrepreneurship by MIT OpenCourseWare.
- https://www.scidev.net/global/ Articles on science communication and the ethics of scientific research by SciDev.Net.

REFERENCE BOOKS, TEXT BOOKS, RESEARCH ARTICLES:

- Acquaah, G. (2012). Principles of Plant Genetics and Breeding (2nd ed.). Wiley-Blackwell.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.
- Anonymous. (2020). Biology - Standard Twelve. Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune
- Anonymous. (2020). Biology - Standard XI. Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune
- Anonymous. (2022). Biology Text Book for Class XI. National Council of Educational Research and Training, 2006. https://ncert.nic.in/textbook.php?kebo1=ps-19
- Anonymous. (2022). Biology Text Book for Class XII. National Council of Educational Research and Training, 2006. https://ncert.nic.in/textbook.php?lebo1=0-13
- Bock, R. (2016). Genome Editing in Plants. Academic Press.
- Chrispeels, M. J., & Sadava, D. E. (2014). Plants, Genes, and Crop Biotechnology (2nd ed.). Jones & Bartlett Learning.
- Day, R. A., & Gastel, B. (2012). How to Write and Publish a Scientific Paper (7th ed.). Greenwood.
- Murphy, D. J. (2014). Plant Products and the New Technology. Oxford University Press.
- Ort, D. R., & Yocum, C. F. (2015). Advances in Photosynthesis and Respiration. Springer.
- Raven, P. H., Evert, R. F., & Eichhorn, S. E. (2012). Biology of Plants (8th ed.). W.H. Freeman.
- Rollin, B. E. (2014). Science and Ethics. Cambridge University Press.
- Smith, T. M., & Smith, R. L. (2015). Elements of Ecology (9th ed.). Pearson.
- Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). Plant Physiology and Development (6th ed.). Sinauer Associates.
- Willis, K. J., & McElwain, J. C. (2014). The Evolution of Plants. Oxford University Press.
- Lambers, H., Chapin III, F. S., & Pons, T. L. (2008). Plant Physiological Ecology. Springer.

- Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). Biochemistry & Molecular Biology of Plants. Wiley-Blackwell.
- Acquaah, G. (2012). Principles of Plant Genetics and Breeding. Wiley-Blackwell.
- Chrispeels, M. J., & Sadava, D. E. (2014). Plants, Genes, and Crop Biotechnology. Jones and Bartlett.
- Murphy, D. J. (2014). Plant Products and the New Technology. Oxford University Press.

National Case Studies:

- Patanjali Ayurved Limited
- Amul's Fodder Development Programs
- Nurture.Farm:
- Barrix Agro Sciences
- Tata Coffee's Sustainable Practices
- Padma Shri Subhash Palekar's Zero Budget Natural Farming (ZBNF)
- Sikkim's Organic Farming Revolution
- Punjab's Happy Seeder Innovation for Stubble Management
- Kerala's Jackfruit Revolution by James Joseph

International Case Studies:

- Netherlands' Greenhouse Horticulture
- Australia’s Bush Heritage:
- Israel's Agricultural Innovation
- China’s Medicinal Plant Industry and Traditional Chinese Medicine
- Costa Rica’s Reforestation Efforts and Ecotourism

Model Questions:

Short Type Questions

1. Describe how the understanding of plant taxonomy and systematics has evolved from historical times to the modern era.
2. Explain how plant hormones affect growth regulation in response to environmental stimuli.
3. Outline the role of sustainable practices in modern agricultural botany.
4. Identify two key industries that significantly benefit from plant biomolecular research.
5. List two renowned institutes in India known for their advanced research in plant sciences.
6. Describe a key skill demanded by plant-based industries in today's corporate world.
7. Explain the concept of biofortification and its significance in addressing nutritional deficiencies.
8. Discuss one local and one international business that have successfully incorporated plant science innovations.

Long Type Question

1. Discuss the role of cell and molecular biology in understanding the transformation of phenotype from genotype in plants, with specific examples.
2. Evaluate the impact of climate change on plant species diversity and the role of environmental Botany in assessing this impact.
3. Discuss the role of prominent research institutes in shaping the future of plant science research, with examples of their contributions.
4. Elaborate on the importance of communication skills in disseminating plant science research, including both written and verbal forms.

Multiple Choice Questions (MCQs)

1. Which Mendelian principle is demonstrated when different genes independently separate from each other during the formation of gametes?

A) Law of Segregation B) Law of Independent Assortment C) Law of Dominance D) Law of Uniformity

2. Genetically Modified Crops are primarily created to:

A) Increase shelf life B) Enhance nutritional content C) Improve resistance to pests D) All of the above

3. CRISPR/Cas9 technology is primarily used for:

A) Plant breeding B) Genome editing C) Enhancing photosynthesis D) Producing biofuels

4. Phenomics in plant science typically involves:

A) Studying plant genetics B) Analyzing plant phenotype using AI C) Mapping plant ecosystems D) Developing synthetic biology applications

5. Entrance exams for higher studies in plant sciences often test knowledge in:

A) Plant physiology and biochemistry B) Agricultural economics C) Basic mathematics D) World history

6. A career in public services related to plant science may involve roles in:

A) Biotechnology firms B) Agricultural policy development C) Corporate sales D) IT services

7. Ethical considerations in plant genetic engineering include concerns about:

A) Food safety B) Environmental impact C) Cross-breeding with wild species D) All of the above

8. Legal aspects in plant sciences primarily deal with:

A) Patent laws B) Labor laws C) Taxation D) Import/export regulations

Pedagogical Strategies

To effectively teach and evaluate the course "Foundations of Plant Science and Career Development," a blend of classical and contemporary pedagogical strategies is essential. These strategies should be tailored to enhance the delivery and comprehension of the course content within each unit, aligning with the educational objectives and learning outcomes.

Teachers may adopt any one of the strategies suggested below as the time, space and classroom situations permits -

Unit I: Foundations of Botany and Plant Biology

1. Flipped Classroom Approach:
- Pre-class Assignments: Reading materials and video lectures on basic botany concepts.
- In-class Activities: Discussion forums, Q&A sessions, and interactive quizzes.

2. Project-Based Learning:
- Students can undertake projects on local flora, analyzing diversity, taxonomy, and systematics.
- Field trips to botanical gardens for practical taxonomy exercises.

3. Case Studies and Problem-Based Learning:
- Use case studies to explore historical and modern developments in botany.
- Problem-solving sessions focused on ecological challenges and physiological processes of plants.

4. Laboratory Work and Hands-on Experiments:
- Practical sessions on cell and molecular biology, including microscopy and genetic experiments.
- Experiments to observe physiological processes like photosynthesis and respiration.

Unit II: Applied Plant Sciences and Industry Perspectives

1. Interactive Lectures with Guest Speakers:
- Invite industry experts to discuss the role of plants in various industries.
- Seminars on agricultural botany and sustainable practices.

2. Group Projects and Collaborative Research:
- Students work in groups on projects related to environmental botany, crop improvement, or plant-based industries.
- Collaborative research projects using online databases and scientific literature.

3. Simulation and Modeling:
- Use of software tools to simulate genetic editing and plant breeding techniques.
- AI and Machine Learning models to understand phenomics and high-throughput phenotyping.

4. Virtual Field Trips and E-learning Tools:
- Virtual tours of biotech companies and agricultural fields.
- Online resources and interactive modules for learning advanced concepts.

Unit III: Career Development and Research Opportunities

1. Workshops and Career Counseling Sessions:
- Workshops on career planning, higher study opportunities, and understanding the corporate world in plant sciences.
- Counseling sessions focusing on skill development for industry readiness.

2. Mock Interviews and Resume Building Workshops:
- Practice sessions for competitive examinations and entrance tests.
- Guidance on building a professional resume and portfolio.

3. Research Paper Analysis and Group Discussions:
- Analyzing and discussing research papers from leading plant science institutes.
- Group discussions on various lines of research and their contributions.

4. Networking Events and Industry Visits:
- Organize networking events with alumni and professionals in the field.

- Visits to research institutes and corporate offices in the plant science sector.

Unit IV: Innovation, Communication, and Ethics in Plant Sciences

1. Case-Based Learning and Role-Playing:
- Case studies on innovations in plant sciences.
- Role-playing exercises to explore ethical dilemmas and legal aspects in biotechnology.

2. Entrepreneurship Workshops:
- Workshops on starting a business in plant-based industries, including case studies and market analysis.
- Pitching sessions for hypothetical start-up ideas.

3. Communication Skills Development:
- Training sessions on scientific writing, public speaking, and presentation skills.
- Conduct mock conferences where students present research papers or reviews.

4. Debate and Discussion Forums:
- Organize debates on controversial topics like GMOs, biofortification, and plant-based meat alternatives.
- Discussion forums to reflect on ethical, legal, and societal implications of plant science innovations.

Each of these strategies aims to engage students actively, foster critical thinking, and provide practical skills relevant to their future careers in plant sciences. Integrating these diverse teaching methods will cater to different learning styles and ensure a comprehensive understanding of the course material.

Lab / Practical – I: Foundations and Prospects of Plant Science

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	107202	Foundations and Prospects of Plant Science	2	60	4 Hrs	25 (Ext)+25 (Int)

Course Objectives:	**1. Interdisciplinary Integration and Application:** To foster an interdisciplinary approach by integrating principles from botany, microbiology, biotechnology, and environmental sciences. This will be achieved through collaborative projects and assignments that require students to apply concepts from these varied disciplines to solve complex problems in plant and microbial sciences. The aim is to encourage a holistic understanding of science that transcends traditional disciplinary boundaries, in line with NEP 2020's emphasis on broad-based, flexible learning. **2. Skill Development through Hands-On and Experiential Learning:** To prioritize hands-on learning and practical skills development through extensive lab work, field visits, and the use of modern technologies like AI in plant sciences. This objective is designed to ensure that students not only understand theoretical concepts but are also proficient in practical applications and laboratory techniques. This aligns with NEP 2020's focus on skill development, ensuring that graduates are well-prepared for the workforce and research opportunities. **3. Promotion of Critical Thinking and Ethical Reasoning:** To encourage critical thinking and ethical reasoning among students by engaging them in discussions and debates on contemporary issues in plant sciences, such as the use of GMOs, biopiracy, and the ethical implications of genetic engineering. Assignments and projects will be designed to challenge students to consider and evaluate the social, ethical, and environmental impacts of scientific advancements. This objective aligns with NEP 2020's emphasis on developing critical thinking and ethical and moral reasoning.
Course Outcomes:	**Integrated Course Outcomes for Lab Course based on Major Theory Papers** CO 1: Students will gain hands-on experience in both plant and microbial sciences, mastering techniques such as microscopic examination of plant cells and microbial structures, DNA extraction, and the study of photosynthesis and microbial diversity. CO 2: Engage in analytical exercises to interpret data from plant-based experiments, like respiration and seed germination, as well as microbial studies, including the observation of Bacteria, Fungi, and Viruses, fostering a deep understanding of biological processes. CO 3: Critically evaluate the impact and ethical considerations of modern biotechnologies such as genetic engineering, CRISPR in plants, and bacteriophage therapy, integrating knowledge from both plant and microbial sciences.

	CO 4: Encourage creativity by having students develop innovative research proposals or projects that blend concepts from plant and microbial sciences, such as using AI for plant phenotyping or designing experiments for studying plant-microbe interactions. CO 5: Develop communication skills through group activities like debates on GMOs and bio-piracy, presentations on disease management strategies, and collaboration in laboratory settings, ensuring an equitable emphasis on topics from both courses. CO 6: Apply theoretical knowledge to real-world situations through activities like field visits to botanical gardens or microbial cultivation projects, and engage in problem-solving exercises such as diagnosing plant diseases and designing Ecofriendly disease management strategies.

Contents	**Incorporation of Pedagogies**
Practical and Activities based on Major Theory Paper 1 Foundations of Plant Science and Career Development: **Major Experiments:** **Conduct at least Seven Exercises from the following:** 1. Microscopic Examination of Plant Cells and Tissues such as – Epidermal, Parenchyma, Sclerenchyma, Collenchyma, Xylem, Phloem, etc. 2. Study of different groups of plants on the basis of thallus structure- Algae, Fungi, Bryophytes and Pteridophytes 3. To study the vegetative and Floral parts of Monocot and Dicot Plant (One each) 4. To study Morphology and Taxonomy of any five medicinal plants (locally available) 5. To study the phenomenon of photosynthesis under different light conditions 6. To Study the Terrestrial an Aquatic Ecosystem (One Each) 7. To Study the Phenomenon of respiration using different substrates 8. Extraction of the DNA by Crude Method 9. To Study of the Process of Seed Germination 10. To Conduct Self and Cross Pollination 11. Phenological study of Any One Plant Species 12. Discuss and analyze case studies of CRISPR use in plants 13. To Study any one Patent Granted in the Plant Sciences 14. To Study any one Research Paper Published in the Plant Sciences **Minor Experiments:** **Conduct at least Three Exercises from the following:** 1. To study plant cell and organelles through model or animation or image. 2. Virtual protocol of Genetic Engineering for desired trait induction 3. To Develop a Mock Business Plan for a plant-based startup 4. Application of Artificial Intelligence (AI) in Plant Sciences 5. To study Ecosystem model depicting energy transformations 6. To simulate the role of Plants Hormones in Plant Growth 7. Construction of the Model: Plants as an Industry	Suitable pedagogical strategies are separately annexed

Activities: **Conduct Any One or Two Activities from the following-** 1. Organize debates or discussions on ethical dilemmas in plant sciences, such as GMOs or biopiracy 2. Analyze and present case studies on topics like Artificial Photosynthesis / Hydrogen Harvesting from Photosynthesis, Biofortification 3. Use AI software tools for image-based plant phenotyping to study plant traits. 4. Simulate the industrial processes for essential oils extraction / pigments / flavors from plant materials 5. Field visits to sustainable Business Ventures for Cultivation of the Medicinal Plants / Plant Product / Extraction Industry, etc.	

Digital Resources:

- Amrita Vishwa Vidyapeetham & Virtual Labs - MHRD. (n.d.). Amrita Virtual Lab. Retrieved from http://vlab.amrita.edu/
- BioInteractive. (n.d.). Howard Hughes Medical Institute. Retrieved from https://www.biointeractive.org/
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Question Paper for External Practical Course on Foundations and Prospects of Plant Science

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. I (Botany), SEMESTER – I (NEP)				
Lab/ Practical-1	Course Code: 107202	Foundations and Prospects of Plant Science	**Max Marks: 25**	**Time: 4 Hrs.**

Q.No.	**Exercise**	**Marks**
1.	Identification of the Cell types from the given Plant Sample	**5**
2.	Perform any One Exercise from Physiological Experiments	**5**
3.	Perform any One Exercise from Molecular Biology or AI	**5**
4.	Perform any One Exercise from Morphology and Taxonomy of any Medicinal plant.	**5**
5.	External Viva Voce	**5**

Assessment Rubric for Internal Practical Course on Foundations and Prospects of Plant Science

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. I (Botany), SEMESTER – I (NEP)			
Lab/Practical-1	Course Code: 107202	Foundations and Prospects of Plant Science	**Max Marks: 25**

S. No.	**Assessment Criteria**	**Marks**
1	Record/ Assignments	**5**
2	Attendance	**5**
3	Participation in Activity/ Field visit	**5**
4	Students overall performance	**5**
5	Internal Viva Voce	**5**

GOEC Theory: Plant Health Care

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	107203	Plant Health Care	2	30	2 Hrs	30 (Ext)+20 (Int)

Course Objectives:	1. To Learn about significance of plant health 2. To learn about techniques of plant health care
Course Outcomes:	CO 1: Students will be able to Recognize importance of plant health management. CO 2: Students will be able to classify plant diseases. CO 3: Students will apply knowledge to cure plant diseases and deficiency disorders. CO 4: Students will be able to categorize types of pest and weeds. CO 5: students will be able to plan strategies of integrated pest management. CO 6: Students will be able to develop their own plant pathology lab.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Plant Health care and Plant Diseases**	8	8	Suitable pedagogical strategies are separately annexed
	1.1 Introduction to Plant health care and its objectives in Home Garden, Kitchen Garden, Horticulture and Agriculture. Definition and concept of Plant disease.			
	1.2 Terminologies in plant Pathology – Host, Pathogen, Pathogenicity, Pathogenesis, Symptoms, Infection, Inoculation, Isolation, Incubation period, Etiology, Susceptibility, Immunity, Hypersensitivity and Resistance.			
	1.3 Classification of Plant Diseases – Based on a) Pathogens, b) Symptoms, c) Mode of transmission of pathogens through seed, soil, air and insects.			
	1.4 Factors affecting plant health.			
Unit II	**Plant nutrients and Diseases**	7	7	
	2.1 Pest-disease: definition, causes of pest outbreak, losses caused by insect pests, Categories of pests: Major pests, minor pests. Symptoms of damage and Management of some pests diseases.			
	2.2 Plant Diseases: Brief account on major types of plant diseases caused by Fungi, Bacteria and Viruses.			
	2.3 Role of Essential Nutrients in plant growth & development, critical nutrients, Critical concentration, nutrient toxicity.			
	2.4 Nutrient deficiencies diseases: 1) stunted growth; 2) chlorosis; 3) interveinal chlorosis; 4) necrosis.			
Unit III	**Methods of Management of Insect pests and diseases.**	8	8	
	3.1 **Chemical Methods:** Brief account and uses of Bactericides, Fungicides, Insecticides and Nematicides**.**			

	3.2 Biological Control: Introduction, biological control of Insect pests and diseases.			
	3.3 Legal (Plant - quarantine): Introduction, domestic quarantine and need of plant Quarantine in India			
	3.4 Weeds – types and classification; invasive species; weed control, common weeds of important medicinal plants.			
Unit IV	**Integrated Plant management**	7	7	
	4.1 Introduction to principles of integrated plant disease management			
	4.2 Scope and importance of integrated pest management (IPM).			
	4.3 Tools of pest management, their description and usage in IPM programs.			
	4.4 Biological and biotechnological approaches in disease management. Crop Resistance: General account of use of resistant varieties			
	4.5 Green pesticides / Botanical Pesticide: Definition, Preparation of pesticide from Neem, Chrysanthemum, and Tobacco. Advantages of use of Botanical pesticide or green pesticide			

Suggested Activities:

1. **Garden Walk:** Organize a field trip to a local garden (could be a home garden, kitchen garden, or agricultural field) to identify various plants and discuss their health care requirements, focusing on the objectives of plant health care in different settings.
2. **Symptom Analysis Workshop:** Students will examine plant specimens or images showing various disease symptoms and practice identifying the diseases based on the terminologies learned (e.g., pathogenicity, symptoms, infection).
3. **Pathogen Classification Activity:** Using a mix of multimedia resources and real specimens, students classify plant diseases based on pathogens, symptoms, and mode of transmission, creating a visual chart or digital presentation.
4. **Environmental Factors Lab:** Experiment to understand how different environmental factors (e.g., humidity, temperature, soil pH) affect plant health, focusing on a selected few plant species.
5. **Pest and Disease Management Planning:** Students will select a crop and research pest-disease management strategies, creating a management plan that addresses identification, causes, and management of pests and diseases.
6. **Nutrient Deficiency Experiment:** Set up an experiment to study the effects of nutrient deficiencies on plant growth. Students will grow plants under controlled conditions with varying levels of critical nutrients and document the symptoms.
7. **Disease Case Studies:** Analyze case studies of major plant diseases caused by fungi, bacteria, and viruses, focusing on symptoms, transmission, and impact on plant health.
8. **Chemical vs. Biological Control Debate:** Facilitate a debate or discussion on the use of chemical versus biological control methods, encouraging students to research and present arguments based on scientific evidence and case studies.
9. **Weed Identification and Control Activity:** Organize a field trip or laboratory session for students to identify common weeds and invasive species, followed by a workshop on modern weed control techniques, including both chemical and non-chemical methods.
10. **Green Pesticide Workshop:** Students participate in a workshop to prepare and test botanical pesticides from Neem, Chrysanthemum, and Tobacco, evaluating their effectiveness in pest control compared to synthetic pesticides.

These activities are designed to engage students in practical and theoretical aspects of plant health care and disease management, fostering a comprehensive understanding of the subject matter through active learning and application.

References:

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2. Dasgupta, M K 1988: Principles of Plant Pathology. Allied Publishers Pvt. Ltd., Calcutta
3. Mandahar, C L, 1987: Introduction of Plant Virus
4. Chatterjee,P.B. 1997. Plant Protection Techniques. Bharati Bhawan(Publishers and Distrbutors), Patna
5. Matthews,G.A. 1979, Pesticide Application Method. Longman, London.
6.Sill, W.H(Jr.), (1985). Plant Protection: An Integrated interdisciplinary Approach (India ed.) Kalyani Publishers, Ludhiana.

Model Questions:

Short Type Questions

1. Write note on classification of plant diseases.
2. Write down the tools of pest management
3. write note on significance of plant health
4. Define essential elements and nutrient deficiencies.
5. Enlist the factors affecting plant health.
6. Add detailed note on Crop Resistance
7. Add note on viral plant diseases.
8. Add note on fungal plant diseases.
9. Add note on organic fertilizers.

Long Type Question

1. Explain Chemical and Biological way of disease management.
2. What are the organic fertilizers? Describe the role of organic fertilizers in plant health care.
3. Explain Integrated pest management in detail.
4. Describe biological and biotechnological approaches in disease management.

Multiple Choice Questions (MCQs)

1. **What is the term used to describe the ability of a pathogen to cause disease in a host plant?**

A) Pathogenicity
B) Pathogenesis
C) Symptoms
D) Etiology

2. **Which term refers to the period between pathogen invasion and the appearance of disease symptoms in a plant?**

A) Inoculation
B) Isolation
C) Incubation period
D) Immunity

3. **Which category of pests causes the most significant damage among plants?**

A) Major pests
B) Minor pests
C) Insects
D) Bacteria

4. **What are the primary types of plant diseases caused by pathogens?**

A) Fungi, insects, and Bacteria
B) Fungi, Bacteria, and Viruses
C) Viruses, insects, and nematodes
D) Insects, Bacteria, and nematodes

5. Which method of pest control involves the use of Bactericides, Fungicides, and Insecticides?

A) Chemical Methods
B) Biological Control
C) Plant Quarantine
D) Weed Control

6. What is the primary purpose of domestic quarantine in plant health care?

A) Introduction of new species
B) Regulating trade
C) Managing biological control
D) Protecting native plants

7. What is the primary emphasis of Integrated Pest Management (IPM)?

A) Exclusively using biological control
B) Minimizing chemical use
C) Eradicating all pests
D) Using only resistant plant varieties

8. Which approach in disease management involves using substances derived from Neem, Chrysanthemum, and Tobacco?

A) Chemical pesticides
B) Biological control
C) Crop resistance
D) Botanical pesticides

Pedagogical Strategies:

1. Concept Mapping and Mind Mapping:

- For Unit Understanding: Create concept maps or mind maps illustrating relationships between concepts like pathogens, symptoms, modes of transmission, and factors affecting plant health. This visual aid helps in understanding and memorization.

2. Interactive Group Discussions:

- For Classification and Terminologies: Organize group discussions focusing on terminologies and classification of plant diseases based on pathogens, symptoms, and modes of transmission. Encourage debates on their significance in plant health care.

3. Case Studies and Real-life Examples:

- For Plant Nutrients and Diseases: Use case studies to illustrate the impact of nutrient deficiencies on plants, linking them to specific diseases like stunted growth, chlorosis, etc. Real-life examples can enhance understanding.

4. Hands-on Practical Activities:

- For Methods of Management: Conduct experiments or demonstrations showcasing the application of chemical methods (safely), biological control, and plant quarantine. This practical engagement reinforces theoretical concepts.

5. Problem-solving Exercises:

- For Integrated Plant Management: Design problem-solving exercises where students integrate knowledge of disease management principles to address hypothetical plant health issues. Encourage critical thinking.

6. Visual Learning Tools:

- For Essential Nutrients and Diseases: Use visual aids like charts, diagrams, and videos to demonstrate the role of essential nutrients in plant growth and connect them to nutrient deficiency diseases.

7. Collaborative Research Projects:

- For Biological and Biotechnological Approaches: Assign research projects exploring biotechnological approaches or the development of resistant varieties. Encourage collaboration and presentations.

8. Field Visits and Guest Lectures:

- For Weeds and Invasive Species: Plan field trips to identify common weeds, invasive species, and their impact on plant health. Invite experts for guest lectures.

GOEC Theory- Kitchen Gardening

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	107204	Kitchen Gardening	2	30	2 Hrs	30 (Ext)+20 (Int)

Course Objectives:	1. To Learn about techniques of Kitchen Gardening 2. To learn about importance and types of vegetable, fruit, and medicinal plant cultivation.
Course Outcomes:	CO 1: Students will be able to illustrate the importance of kitchen gardening and their products. CO 2: Students will be able to understand methods of establishing kitchen gardens. CO 3: Students will apply knowledge to Water, fertilize, prune, maintain, and harvest produce from their home garden. CO 4: Students will be able to categorize fruit and vegetables according to season. CO 5: students will be able to plan crop rotation as per the season. CO 6: Students will be able to develop start their own kitchen garden

Unit System	Contents	Workload Allotted (Hrs.)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	1.1: History and Development of Gardening in India; Case Studies on AID India's Kitchen Garden Project, Adivasi women's kitchen gardening project in Western Ghats	8	8	Suitable pedagogical strategies are separately annexed
	1.2: Introduction to kitchen gardening, Gardening tools, Basic materials & machinery required for kitchen garden.			
	1.3: Current status of vegetables in India, cultivation of vegetables, limitations in vegetable cultivation			
	1.4 Scope of Kitchen Gardening. Kitchen gardening products.			
Unit II	2.1: Preparation of Garden site: Selection, size, place of site, Containers, garden equipment	7	7	
	2.2: Organic Farming Approach for Kitchen Garden Sowing, maintenance and harvest practices for roots and tubers, green leafy and green vegetables			
	2.3: Economic Evaluation of Kitchen Garden in order land, tillage, and production.			
	2.4: Different Operations for Maintaining Kitchen Garden viz- Land preparation, Planting, Weeding, Mulching, Irrigation, Stalking, Fencing, Harvesting, Plant protection			
Unit III	3.1: Classification of vegetables (according to a source of plant parts and season) 1. Tropical vegetables- sweet potato, eggplant, tomato, okra, spinach etc., 2. Subtropical vegetables- Onion, garlic, sweet corn, pumpkin etc., 3. Temperate vegetables- Cabbage, cauliflower, peas, radish, carrot, beet etc.	8	8	
	3.2: **Fruits:** 1. Tropical fruits- Dragon fruit, Passion fruit, Jackfruit, Papaya etc., 2. Subtropical fruits- Banana, mango, guava, pineapple etc., 3.			

	Temperate fruits- Apple, plum, pear, strawberry, grapes, blueberries etc.			
	3.3: Medicinal plants: 1. Aloe Vera, 2. Ashwagandha, 3. Brahmi 4. Tulsi, 5. Turmeric, 6. Shatavari, etc.			
	3.4: Micro-greens production, Hydroponics, Vertical farming, Landscaping, and kitchen garden.			
Unit IV	**Maintenance & Importance**	7	7	
	4.1: **Tips for Maintaining a Kitchen Gardening:** It includes Vertical growth, triangle shaped planting, use of seasonal plants, harvesting period, shade growing, Rainwater harvesting, and Companion plants.			
	4.2: **Importance of organic fertilizers in gardening** Composition of organic fertilizers, Benefits of organic fertilizers.			
	4.3: Types and use of growth regulators in Kitchen gardening, water management, Weed Management, & Nutrient management.			
	4.4: **Importance of kitchen gardening** Kitchen gardening includes the following importance. Recycling of Vegetables and Plant Scraps, Sustainable gardening, Healthier eating, Stress relief, Environmental benefits, financial savings, Fresh Organic Harvest, Nutritious Diet, Purification of Surrounding Air			

Activities:

1. **Historical Garden Analysis:** Research and present a case study on the history and development of gardening in India, focusing on significant projects like AID India's Kitchen Garden Project or the Adivasi women's kitchen gardening project in the Western Ghats.

2. **Garden Tool Workshop:** Host a hands-on workshop where students learn to use different gardening tools and machinery, understanding their purposes and maintenance requirements for effective kitchen gardening.

3. **Vegetable Cultivation Project:** Each student or group selects a vegetable to cultivate from start to finish, documenting the process, challenges, and solutions, including limitations in vegetable cultivation and how they overcame them.

4. **Organic Farming Practicum:** Implement an organic farming approach in a small garden plot or container, applying sowing, maintenance, and harvest practices for various types of vegetables, emphasizing green leafy and root vegetables.

5. **Economic Analysis Assignment:** Students conduct an economic evaluation of a kitchen garden project they design, considering land, tillage, production costs, and potential financial savings, leading to a presentation of their findings.

6. **Garden Maintenance Simulation:** Through a series of practical sessions, students engage in different operations for maintaining a kitchen garden such as land preparation, planting, weeding, mulching, irrigation, and harvesting.

7. **Vegetable and Fruit Classification Exercise:** Organize a classification exercise where students classify a variety of vegetables and fruits according to the source of plant parts, season, and whether they are tropical, subtropical, or temperate.

8. **Medicinal Plant Workshop:** Create a workshop focusing on the cultivation, uses, and benefits of medicinal plants such as Aloe Vera, Ashwagandha, and Tulsi. This can include practical planting sessions and discussions on their health benefits.

9. **Innovative Gardening Techniques Demo:** Demonstrate and then practice innovative gardening techniques such as micro-greens production, hydroponics, and vertical farming, offering students a glimpse into the future of sustainable gardening.

10. **Sustainable Practices Project:** Students undertake a project to implement sustainable gardening practices, such as rainwater harvesting, the use of organic fertilizers, growth regulators, water, weed, and nutrient management in a kitchen garden setting. This project could culminate in a showcase day where students present their sustainable kitchen garden models and discuss their approaches to healthier eating, stress relief, environmental benefits, and financial savings.

These activities are designed to provide a comprehensive and practical learning experience, covering the theoretical aspects of kitchen gardening as well as hands-on practices that prepare students for real-world applications and innovations in gardening and sustainable agriculture.

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- Veeraraghavathatham, D., Jawaharlal, M., & Ramadas, S. (1991). A guide on vegetable culture. A.E. Publication.

Digital Resources:

- AID India, Pycrofts Road First Street, Royapettah, Chennai - 600014. Tamil Nadu, India. https://aidindia.in/
- Adivasi women's kitchen gardening, Western Indian state of Maharashtra, the Bhimashankar Wildlife Sanctuary (BWS) https://www.iccaconsortium.org/2022/10/23/study-kitchen-garden-women-knowledge-bhimashankar-wildlife-sanctuary/

Model Questions:

Short Type Questions

1. What are Microgreens?
2. Explain Different Methods of Kitchen gardening.
3. Explain the environmental benefits of Kitchen Gardening?
4. what is weed management?
5. Differentiate vegetables based on Season.
6. Explain any two medicinal plants & their importance.
7. Explain Vertical Gardening.
8. How the nutrient requirement of the family can be satisfied by Kitchen Garden?

Long Type Question

1. Explain in detail the different methods of establishing a Kitchen Garden.
2. What are organic fertilizers? Describe the role of organic fertilizers in kitchen gardening.
3. What is Hydroponics? Explain the technique of hydroponics?
4. What are the Artificial Gardens?

Multiple Choice Questions (MCQs)

1. By what name is kitchen garden also known as?

(a). Home garden
(b). Nutrition garden
(c). Vegetable garden
(d). All of the above

2. Which type of vegetable plants are ideal for a kitchen garden?

(a). Short duration vegetable crop
(b). Long duration vegetable crop
(c). Mid duration vegetable crop
(d). None of the above

3. What is the main purpose of a kitchen garden?

(a). Self-satisfaction
(b). Commercial sucess
(c). Both a and b
(d). None of the above

4. Which vegetable variety is ideal?

(a). Early variety
(b). Late variety
(c). Both a and b
(d). Mid season variety

5. Which of the following is a part of KG?

(a). Garden path and irrigation canal
(b). Site for compost and store
(c). Place for fruit plants and ornamental garden
(d). All of the above

6. In which direction should the garden be established?

(a). East-north
(b). West-north
(c). East-south
(d). West-south

7. Which type of fruit-plants are ideal for a kitchen garden?

(a). Late maturing varieties
(b). Early maturing varieties
(c). Mid maturing varieties
(d). None of the above

8. What should be the required characteristic of a fruit plant?

1. It should be a dwarf variety
2.Less bearing fruit plant
3.Heavy bearer fruit plant
4. Less fruiting duration

(a). 1, 2 and 3
(b). Only 2 and 3
(c). Only 3 and 4
(d). 1, 2 and 4

Pedagogical Strategies:

1. **Field Visits and Case Studies:** Hands-on visits to successful kitchen gardens and projects, like those involving community initiatives, to bridge theory with real-world application. This encourages a deep understanding of gardening's practical and social aspects.

2. **Interactive Workshops on Tools and Techniques:** Engaging workshops where students get their hands dirty using gardening tools, understanding soil preparation, planting, and maintenance. This hands-on approach solidifies the practical skills necessary for successful gardening.

3. **Project-Based Learning for Garden Creation:** Students create their own mini kitchen gardens, applying concepts from site selection to organic farming practices. This comprehensive project integrates learning objectives into a tangible outcome.

4. **Thematic Gardens for Learning Plant Classification:** Developing sections within a garden to explore the diversity of plant life, from medicinal plants to different vegetable and fruit types. This living lab offers insights into plant care, environmental needs, and the benefits of biodiversity.

5. **Sustainability Projects:** Initiatives that focus on sustainable practices, such as composting, rainwater harvesting, and recycling. These projects highlight the environmental and economic benefits of kitchen gardening, fostering a sense of responsibility towards sustainable living.

6. **Expert Talks and Community Engagement:** Inviting experts to share insights on organic fertilizers, growth regulators, and innovative farming techniques. Additionally, community garden initiatives can serve as a capstone project, emphasizing teamwork, community service, and the practical application of gardening skills.

By focusing on these strategies, teachers will not just teaching gardening; they are nurturing minds to think critically, act sustainably, and appreciate the profound connection between nature and human well-being. Each approach is a step towards a more self-sufficient, environmentally conscious, and healthier society.

Skill Enhancement Course- Medicinal Plant Cultivation and Processing

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	107205	Medicinal Plant Cultivation and Processing	2	60	4 Hrs	50

Course Objectives:	1. To create opportunities for medicinal plant grower/student startup 2. To understand cultivation and processing skills of medicinal plants. 3. To promote cultivation of authentic species required for preparation of Ayurvedic, Yoga & naturopathy, Unani, Homeopathy and Siddha formulations. 4. To create awareness and involve local people in contract farming through various pharmacy companies.
Course Outcomes:	After Completing the Course, the Students will be able to – CO 1: Identify and select site and quality planting material for medicinal plant cultivation CO 2: Undertake cultivation practices for medicinal plants CO 3: Demonstrate the propagation and harvesting techniques CO 4: Apply good harvesting practices and access the quality of medicinal plant produce CO 5: Analyze and compare subsidy and funding agencies for cultivation of medicinal plant CO 6: Design the calendar for cultivation and processing of medicinal plant

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Basic concept of cultivation of Medicinal Plant**	15	12	Suitable pedagogical strategies are separately annexed
	1.1: Scope, Status and need of medicinal plants cultivation in India			
	1.2: Morphology and parts used of common/ cultivated medicinal plants.			
	1.3: Trade in medicinal plant- usage cum market demand			
	1.4: Good Agricultural Practices (GAP): Scope, principles and standards			
Unit II	**Site selection, planting material & propagation techniques**	15	12	
	2.1 Site selection & Soil conditions			
	2.2 Planting material – Seeds, Root and Stem cutting & rhizome			
	2.3Proper identification and selection			
	2.4 Plant Propagation and Technique in Cultivation			
Unit III	**Management for cultivation**	15	12	
	3.1 Process of Field/ land preparation			
	3.2 Sowing and transplanting methods			
	3.3 Use of Manures and Fertilizers			
	3.4 Irrigation & protection			
Unit IV	**Processing & traceability of medicinal Plants**	15	14	
	4.1 Harvesting- Season for collection,			
	4.2 Primary processing- Washing, cleaning, sorting, and drying			

	4.3 Storage, Packaging, Transportation and Traceability			
	4.4 Subsidy, Funding agencies, Role of contract farming for cultivation and opportunities for medicinal plant grower			

Practical:

Conduct at least THREE Exercises from Each Unit of the following:

Unit I:

1. Study on Quality Control and Research Contributions in Medicinal Plants.
2. Preparation and Analysis of Locally Available/Cultivated Medicinal Plants List.
3. Characterization and Identification of Five Local/Cultivated Medicinal Plants.
4. Development of a Cultivation Site Map for Medicinal Plants.

Unit II:

5. Soil Analysis for Medicinal Plant Cultivation.
6. Collection and Selection of Planting Material for Five Medicinal Plants.
7. Propagation Techniques for Selected Planting Materials.
8. Land Preparation Techniques for Medicinal Plant Cultivation.
9. Experimentation with Plant Propagation Using Cutting and Seed Methods.

Unit III:

10. Study of the land preparation for cultivation of the Medicinal Plants
11. Study of the Sowing methods
12. Study of the transplantation methods
13. Method Assessment of Different Manures and Fertilizers on Medicinal Plants.
14. Determination and Experimentation of Water Demand for Medicinal Plant Cultivation.
15. Implementation and Evaluation of Plant Protection Techniques.

Unit IV:

16. Identification and Harvesting Techniques for Medicinal Plant Parts.
17. Application of Various Cleaning Methods for Different Medicinal Plant Species.
18. Packaging Techniques for Harvested Medicinal Plant Material.
19. Preparation of a Medicinal Plant Cultivation and Processing Calendar.
20. Analysis of Funding Opportunities from Government & Non-Government Agencies for Medicinal Plant Cultivation.

Activities (Any two from the following):

Field visits

1) Visit to nearest biodiversity rich center.
2) Visit to medicinal plant garden.
3) Visit to different nurseries of medicinal plant.
4) Visit to medicinal plant cultivated farm (locally available)
5) Visit to soil testing/ seed testing laboratories/ research institute.

Other activities –

1) Cultivation of minimum 5 medicinal plant in the college campus
2) Packaging of any 2 harvested medicinal plant material with label.
3) Preparation and submission of records of any one medicinal plant cultivated in college campus as per the GAP standard.

Collaboration/ MoU-

Conduct above activities in Collaboration / MoU with any medicinal plant nursery/ NGO/ Institute

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Digital Resources:
Web links

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2. eCharak. (n.d.). Know about medicinal plants. Retrieved January 9, 2024, from https://echarak.in/echarak/knowaboutmedicinalplants.do?proind=Z
3. National Medicinal Plants Board. (n.d.). Medicinal plants cultivation. Retrieved January 9, 2024, from https://nmpb.nic.in/content/medicinal-plants-cultivation
4. World Health Organization. (n.d.). Monographs on selected medicinal plants. Retrieved January 9, 2024, from http://who.int/medicines/library/trm/medicinalplants/monographs.shtml

E- Contents –

- http://m.youtube.com/watch?v=WyOZ14ufzkk
- http://m.youtube.com/watch?v=I25E78MSLWU
- http://m.youtube.com/watch?v=IHiIdoQaIIA
- http://m.youtube.com/watch?v=4UKDhLCHJdg
- http://m.youtube.com/watch?v=WyOZ14ufzkk
- http://m.youtube.com/watch?v=FJUiTnW-4aI
- http://m.youtube.com/watch?v=2HJjJ1ojY2A

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- Medicinal Plants Database. (n.d.). Retrieved January 9, 2024, from https://mpd.aripune.org

Career Opportunities and Scope:

- Employment in various research institutes and Pharmacy companies Self-employment through –
- Nursery of Medicinal plants.
- Commercially cultivated Medicinal plant.
- Production of Certified plant saplings and seeds.
- Involvement of locals in Contract manufacturing through various pharmacy companies.
- Trained Consultants for Medicinal plant gardens/ nursery Can avail National Medicinal Plant Board Scheme for Medicinal plant nursery and cultivation

Pedagogical Strategies:

1. **Field Experiences and Botanical Excursions:** Direct immersion in environments where medicinal plants are cultivated. This could include visits to local farms practicing sustainable agriculture, botanical gardens, or research institutions. Students can observe and engage with the entire process from cultivation to harvesting, providing real-world context to the theoretical knowledge of medicinal plants' scope, status, and cultivation practices.

2. **Interactive Workshops on Plant Morphology and Propagation:** Hands-on workshops where students learn to identify and use different parts of medicinal plants, along with techniques for planting material preparation (seeds, cuttings, rhizomes) and propagation. Activities like dissecting plants to study their morphology, and practicing propagation techniques, solidify understanding and skills in a tangible, memorable way.

3. **Research Projects on Medicinal Plant Trade and Market Demand:** Assign students to conduct research projects that explore the trade dynamics and market demand for medicinal plants. This could involve analyzing trade data, interviewing stakeholders in the medicinal plant supply chain, or developing case studies on successful medicinal plant marketing strategies. Such projects encourage students to connect economic concepts with the cultivation and trade of medicinal plants.

4. **Practical Application of Good Agricultural Practices (GAP):** Engage students in a project where they apply GAP principles to a real or simulated medicinal plant cultivation scenario. This could include designing a cultivation plan that incorporates sustainable soil management, irrigation, manure, and fertilizer use, as well as pest and disease management strategies. The project could culminate in a presentation or report that evaluates the application of GAP standards in their project, fostering critical thinking and practical skills.

5. **Capstone Project on Processing and Traceability:** A comprehensive project where students apply knowledge from harvesting, processing, storage, packaging, and transportation to create a traceable supply chain for medicinal plants. This project can involve partnerships with local medicinal plant growers or use of simulation tools to design a supply chain model. Incorporating elements like digital traceability systems, sustainable packaging solutions, and analysis of subsidy and funding opportunities, this project would offer students a holistic view of the challenges and opportunities in the medicinal plant industry.

Assessment Rubric for INTERNAL PRACTICAL Course on Medicinal Plant Cultivation and Processing

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. I (Botany), SEMESTER – I (NEP)				
Lab/ Practical-1	Course Code: 107205	Medicinal Plant Cultivation and Processing	Max Marks: 50	Time: 4 Hrs.

S.No.	**Assessment Criteria**	**Marks**
1	Performance of Any One Exercise from the List of Experiments	**10**
2	Performance of the Task on Any One of the List of Activities	**10**
3	Record/ Assignments	**10**
4	Attendance	**5**
5	Participation in Activity/ Field visit	**5**
6	Students overall performance	**5**
7	Internal Viva Voce	**5**

SEMESTER – II

Type of Course	Course Code	Course Name
Theory2	107206	Fundamental Life Processes in Plants
Lab/Practical-4	107207	Hands on Exploration of Life Processes
Theory2		-
Lab/Practical-5		-
Theory3	107208	Floriculture and Value Additions
Theory4	107209	AYUSH
Lab/Practical-6	107210	Commercialization of Medicinal Plant and Products
Lab/Practical-7	107211	Seed Development Technology

Major / Minor Course: Fundamental Life Processes in Plants

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	107206	Fundamental Life Processes in Plants	2	30	2 Hrs	30 (Ext)+20 (Int)

Course Objectives:	1. To illustrate knowledge of plant life process. 2. To deliver molecular understanding of primary and secondary metabolic processes. 3. To present perspectives of the current tools for application in biological system for physiological research. 4. To demonstrate the concept using different activities for building capacity.
Course Outcomes:	After Successful completion of the course, the student will be able to - CO-1: Understand Plant physiology, a sub discipline of Botany concerned with functional aspects of plants. CO-2: Remember all internal metabolic activities of plants. CO-3: Understand Photosynthesis, Transpiration, Respiration, reproduction, and plant growth process. CO-4: Explain the growth and development of plants using additional resources available on the internet using modern ICT tools.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Fundamentals of Plant Life**	8	8	Suitable pedagogical strategies are separately annexed
	1.1: Importance of Water: Role in plant growth and survival; Imbibition, Diffusion, Osmosis, Plasmolysis			
	1.2: Water-Absorbing Systems of the Plants; Organs Structures and their role in water Absorption			
	1.3: Basic Mechanism of Transpiration; Thermoregulation			
	1.4: Essential Elements (Macro and micronutrients) for plant growth; Mechanism of Nutrient uptake			
Unit II	**Basic Unit of Life: Plant Cell**	7	7	
	2.1: Basics of Plant cell and tissues – structure and function.			
	2.2: Cell organelles: Structure and function of the cell wall, plasma membrane, Mitochondria and Chloroplast.			
	2.3: Cell Differentiation and apoptosis in Plant development			
	2.4: Integration Metabolic Processes - Anabolism and Catabolism			
Unit III	**Reproduction in plant**	8	8	
	3.1: Vegetative reproduction in plants (Cutting, budding, grafting, Rhizome)			

	3.2: Flower Structure and organs			
	3.3: Pollination - Mechanisms and types			
	3.4: Fertilization and Seed Development			
Unit IV	**Plant Growth**	7	7	
	4.1: Growth – Defination, characters and growth phases (Sigmoid curve)			
	4.2 Plant Hormones: Physiological role & applications of Auxin, Gibberllins, Cytokinin and Ethylene			
	4.3: Basics of Photoperiodism and Vernalization			
	4.4: Factors Affecting Plant Growth and Development (Water, temperature and soil)			

Activities:

1. Kitchen Imbibition Experiment: Observe imbibition by soaking dry beans or peas in water and measuring their size increase over time.
2. Homemade Water Absorption Model: Create a model using a sponge, straw, and a glass of water to demonstrate how roots absorb water.
3. DIY Transpiration Experiment: Cover a leafy branch of a houseplant with a clear plastic bag and observe condensation to understand transpiration.
4. Edible Cell Model: Use fruits, jelly, and candies to build a model of a plant cell, representing different organelles.
5. Onion Cell Microscopy: Observe onion skin under a microscope or a magnifying glass to identify cell structures.
6. Apoptosis in Leaves Observation: Collect different leaves showing signs of aging or damage and discuss the concept of cell apoptosis.
7. Flower Dissection: Dissect a flower from a home garden or a bought bouquet to study its reproductive organs.
8. Pollination Simulation: Use a paintbrush to transfer pollen from one flower to another, simulating insect pollination.
9. Seed Germination Observation: Plant various seeds in cups and observe their germination and early growth stages.
10. Plant Growth Diary: Document the growth of a houseplant or a sprouting seed, recording observations and measurements.
11. Effect of Light on Plant Growth: Grow plants in different light conditions (sunlight, shade, artificial light) to observe variations in growth.
12. Kitchen Scrap Regrowth: Regrow kitchen scraps (like carrot tops, lettuce bases) in water to observe root development and new growth.

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20. Verma, V. (n.d.). Plant Physiology Verlag (Vol. II). New York.

Model Questions:

Short Type Questions

1. What is Osmosis?
2. Explain structure of flower
3. Explain Vernalization.
4. What is Pollination?
5. Explain the meaning of transpiration.
6. What do you mean by Photoperiodism?
7. Explain Respiration
8. Explain structure of cell.

Long Type Question

1. Explain the mechanism of Transpiration
2.Explain the mechanism of Respiration
3.Explain the sexual reproduction in angiosperm
4.Explain the growth regulator and their types

Multiple Choice Questions (MCQs)

1. In the rainy season, doors get swelled up due to

(a) Transpiration
(b) Imbibition
(c) Diffusion
(d) Respiration

2. Loss of water from plants in the form of water vapor is called_____

a) Surface tension

b) Cohesion
c) Ascent of sap
d) Transpiration

3. Flowers with both androecium and gynoecium are called

a) Bisexual flowers
b) Anther
c) Stamens
d) Unisexual flowers

4. The transfer of pollen from the anther to stigma is called

A) Pollination
b) Fertilization
c) Adoption
d) Diffusion

5. The male reproductive parts of a flower, the stamens, are collectively known as

a) Androecium
b) Filament
c) Anther
c) Gynoecium

6. Name the gas which is important for photosynthesis.

(a) Oxygen
(b) Carbon dioxide
(c) Nitrogen
(d) Carbon Monoxide

6. Leaves are green because they…

(a) Absorb green light
(b) They do not absorb green light but reflect it
(c) They use green light
(d) Absorb and reflect green light

7. Plants purify the air by which process?

(a) Desiccation
(b) Respiration
(c) Photosynthesis
(d) Transpiration

8. The instrument used to measure the growth rate of plants?

(a) Potometer
(b) Auxanometer
(c) Hydrometer
(d) Osmometer

Pedagogical Strategies:

Navigating through the vibrant ecosystem of plant life education, let's cultivate a fertile learning environment with these five experiential and research-based pedagogical strategies:

1. **Interactive Labs and Simulations:** Create a series of lab experiments and computer simulations that allow students to explore the fundamentals of plant life hands-on. For example:
    - Conduct experiments on water's role in plant growth, demonstrating imbibition, diffusion, osmosis, and plasmolysis.

- Use simulations to visualize the water-absorbing systems of plants and the mechanism of nutrient uptake.
- These activities provide a tangible understanding of abstract concepts, making learning both engaging and effective.

2. **Microscopic Investigations:** Equip students with microscopes to examine the basic unit of life—the cell. Through guided activities, they can:
    - Identify types of cell organelles and plant cells, observing cell differentiation and the process of apoptosis.
    - Explore the metabolic processes of anabolism and catabolism, connecting the microscopic world to the plant's overall life processes.
    - This microscopic journey deepens their understanding of plant biology at the cellular level, bridging the gap between theory and observable reality.
3. **Garden-based Learning Projects:** Utilize school gardens or collaborate with local botanical gardens to provide practical experiences in plant reproduction and growth. Activities could include:
    - Observing vegetative, asexual, and sexual reproduction in plants, with hands-on opportunities to pollinate flowers manually.
    - Monitoring the development of plants from germination to maturity, investigating the effects of growth regulators, photoperiodism, and vernalization.
    - These real-world experiences help students connect classroom knowledge with living examples, fostering a deeper appreciation for plant biology.
4. **Research Projects on Plant Growth and Development:** Engage students in research projects that investigate specific aspects of plant growth and development. They could:
    - Experiment with different environmental conditions to study their impact on plant growth, such as varying water levels, nutrient availability, and light exposure.
    - Analyze the role of hormones in plant development or the effects of photoperiodism and vernalization on flowering.
    - These projects encourage critical thinking and scientific inquiry, allowing students to contribute original findings to their understanding of plant biology.
5. **Exploratory Workshops on Miracles of the Plant World:** Host workshops that delve into the fascinating aspects of plant biology, such as:
    - Interactive sessions on the unique survival strategies of plants, the role of plants in ecosystems, and their importance to human life.
    - Discussions and presentations on groundbreaking research in plant science, exploring topics like genetic modification, plants in space, and sustainable agriculture.
    - These workshops inspire curiosity and wonder about the plant world, motivating students to explore biology beyond the curriculum.

Incorporating these strategies transforms the curriculum into a living, breathing ecosystem of knowledge, where students not only learn about plants but also experience the wonder of their world. By engaging with plant life both theoretically and practically, students cultivate a deep-rooted understanding and appreciation for the complexity and beauty of the natural world.

Lab / Practical – II: Hands on Exploration of Life Processes

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	107207	Hands on Exploration of Life Processes	2	60	4 Hrs	25 (Ext)+25 (Int)

Course Objectives:	1. To understand processes for plants survival, including key processes such as imbibition, diffusion, osmosis, and plasmolysis. 2. To explore the basic unit of plant life by examining plant cell structures, organelles, and the roles of different cell types, as well as understanding cell differentiation and metabolic processes. 3. To gain insights into various modes of plant reproduction, including vegetative, asexual, and sexual reproduction, and to understand the anatomy of flowers, pollination mechanisms, and seed development. 4. To analyze the characteristics of plant growth from germination to apoptosis, the role of growth regulators and hormones, and the importance of photoperiodism and vernalization in plant development.
Course Outcomes:	CO 1: Identify and describe key processes related to plant-water relations, such as osmosis, diffusion, and plasmolysis. CO 2: Explain the structure and function of various plant cell organelles and differentiate between types of plant cells. CO 3: Conduct experiments to observe plant cell behavior under different conditions and analyze the mechanisms of nutrient uptake. CO 4: Analyze the processes involved in plant reproduction, including flower structure, pollination, and seed development, and compare different methods of plant reproduction. CO 5: Evaluate the role of growth regulators and environmental factors such as photoperiodism and vernalization in plant growth and development. CO 6: Design and execute experiments to demonstrate key concepts in plant physiology, and synthesize findings to explain complex interactions in plant growth and development.

Major Experiments (Perform any SEVEN)

1. Investigating Imbibition, Diffusion, and Osmosis in Plant Tissues
2. Plasmolysis in Plant Cells: Observing Cell Membrane Behavior
3. Examining Water-Absorbing Structures in Plant Roots
4. Mechanisms of Transpiration and Thermoregulation in Plants
5. Role of Macronutrients in Plant Growth: A Case Study
6. To study the effect of Micronutrient Deficiencies (Iron, Magnessium and Zinc) on Plant growth.
7. Nutrient Uptake Mechanisms: Analyzing Root Functionality
8. Microscopic Analysis of Plant Cell Organelles
9. To study the structural differences between various types of plant cells.
10. Observation of Cell Differentiation and Apoptosis in Plant Development
11. Studying Anabolic and Catabolic Processes in Plant Metabolism
12. To study Vegetative Reproduction in Plants using various plant parts (Stem, leaf and root)
13. Anatomy of Flower Structure and Function of Organs
14. Mechanisms and Types of Pollination: A Practical Approach
15. Process of Fertilization and Seed Development in Plants.
16. To study the effect of nitrogen, phosphorus and potassium on the growth and development of plants.
17. To measure the CO_2 compensation point in a plant.
18. To study different types of flowers based on their reproductive structures.

Minor Experiments (Perform any FIVE)

1. Comparing Imbibition Rates in Different Plant Seeds
2. Diffusion Rates in Various Plant Tissues
3. Water Absorption Efficiency in Different Plant Species
4. To study the Phenomenon of Transpiration.
5. Effect of Macronutrient Deficiency on Plant Growth
6. To study the phenomenon of ascent of sap.
7. Apoptosis Observation in Plant Tissue Culture
8. Asexual Reproduction Techniques in Plants
9. Pollination Mechanisms: Self vs. Cross-Pollination
10. Studying Photoperiodism Effects on Plant Flowering.
11. Study of germination of seeds.
12. To study the T. S. of Ovary.

Activities (Perform any Three)

1. Demonstration of Osmosis Using Potato Cores

2. Creating Models of Water-Absorbing Plant Structures
3. Building a Simple Transpiration Experiment Setup
4. Nutrient Solution Preparation for Hydroponic Plants
5. Constructing Plant Cell Models with Different Organelles
6. Comparative Study of Different Plant Cell Types
7. Simple Experiments Demonstrating Plant Metabolism
8. Setting Up Asexual Propagation Methods in the Lab
9. Flower Dissection and Labeling of Flower Parts
10. Photoperiodism Experiment: Tracking Growth Responses

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E-Contents, E-Books (Free Available or Purchase Links)

- Evert, R. F., & Eichhorn, S. E. (2012). *Raven biology of plants* (8th ed.). Available at: https://www.amazon.com/Raven-Biology-Plants-Ray-F-Evert/dp/146411351X
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Digital Resources like Weblinks

- Plant Cell Biology: A practical guide. (n.d.). Available at: https://www.plantcellbiology.com
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Educational Software, Databases, etc.

- BioCyc: Encyclopedia of genomes and metabolic pathways. Available at: https://biocyc.org/
- KEGG: Kyoto Encyclopedia of Genes and Genomes. Available at: https://www.genome.jp/kegg/
- PDB: Protein Data Bank. Available at: https://www.rcsb.org/
- PlantGDB: The Plant Genome Database. Available at: http://www.plantgdb.org/
- Virtual Lab by Amrita Vishwa Vidyapeetham. Available at: http://vlab.amrita.edu/?sub=3&brch=64

Question Paper for External Practical Course on Foundations and Prospects of Plant Science

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. I (Botany), SEMESTER – I (NEP)				
Lab/ Practical-3	Course Code: 107207	Hands on Exploration of Life Processes	**Max Marks: 25**	**Time: 4 Hrs.**

Q.No.	**Exercise**	**Marks**
1.	Perform Any One Major Experiment based on Physiological Processes	**5**
2.	Perform any One Exercise based on Microscopic observations	**5**
3.	Perform any One Exercise from Minor Experiments	**5**
4.	Spotting (Five Spots carrying 01 March from the entire curriculum)	**5**
5.	External Viva Voce	**5**

Assessment Rubric for Internal Practical Course on Foundations and Prospects of Plant Science

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. I (Botany), SEMESTER – I (NEP)			
Lab/Practical-1	Course Code: 107207	Foundations and Prospects of Plant Science	**Max Marks: 25**

S. No.	**Assessment Criteria**	**Marks**
1	Record/ Assignments	**5**
2	Attendance	**5**
3	Participation in Activity/ Field visit	**5**
4	Students overall performance	**5**
5	Internal Viva Voce	**5**

GOEC Course- Floriculture and Value Additions

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	107208	Floriculture and Value Additions	2	30	2 Hrs.	30 (Ext)+20 (Int)

Course Objectives:	1. To learn cultivation practices in floriculture. 2. To develop proficiency in propagation techniques for flowering plants. 3. To identify the diseases and apply management strategies. 4. To deal in value addition and marketing of floriculture products. 5. To explore career opportunities in Floriculture.
Course Outcomes:	CO 1: Students will be able to understand and remember the scope of floriculture and value additions. CO 2: Students will demonstrate a working knowledge and appreciation of the diversity of plants. CO 3: Students will be able to apply floricultural principles to the successful growth and production of plants. CO 4: Students will acquire the required skills and analyze the economic aspects of the floriculture industry in value addition. CO 5: Students will be able to assess the value additions in floriculture and the potential of flowers in perfume, food, medicinal, and dye making. CO 6: Students will be capable of establishing a floriculture unit from planting to harvest and synthesize value-added products from flower crops for marketing.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**1.1: Introduction to Floriculture:** Definition, Importance, and scope of floriculture, Classification as per flowering season.	8	8	Suitable pedagogical strategies are separately annexed
	1.2: Environmental factors affecting crop growth; Post-harvest handling of Cut Flowers; pre-cooling, pulsing, packing, storage and transportation,			
	1.3: Facilities for commercial flower production; marketing and export potential. Identification of garden tools.			
	1.4: Commercial floriculture in India; Career opportunities in Floriculture			
Unit II	2.1: **Cultivation practices of important flower crops:** **Plant propagation techniques:** Vegetative methods- Rhizome, Corm, Bulb, Sucker, Offset, Tuber, Bulbils, etc. Artificial methods-Budding, Grafting, Cutting, Layering.	7	7	
	2.2: Cultivation of - Rose (*Rosa grandiflora*), Shevanti (*Chrysanthemum ver.*)			
	2.3: Pest and Disease Management of Rose and Shevanti.			

	2.4: Government Schemes, Programmes, and Policies for capacity building of farmers and entrepreneurs.			
Unit III	3.1: **Value Additions:** Concept and importance of value addition in floriculture. Product, Service-oriented, and Customer-Centric value Addition.	8	8	
	3.2: Properties of flowers for perfume and cosmetic production. Extraction techniques and application of floral essences in fragrance and skincare products. Example: - Rose (*Rosa centifolia*).			
	3.3: Product Development and Processing Techniques: Perfumes and Extracts; Processing methods: Cold Storage and Hydration and Conditioning.			
	3.4: Business opportunities in, Cosmetics, Perfumes and Aromatherapy. Resin Art.			
Unit IV	4.1: **Medicinal and Therapeutic Applications:** Extraction methods for creating herbal remedies, teas and natural health products. *Calendula*, *Hibiscus*, Rose	7	7	
	4.2: Culinary Delights: Edible products – "*Gulkand*" (Rose Petal Jam) Making Process, its Nutritional and Medicinal Value.			
	4.3: Natural Dyes from Traditional Flowers Color potentials of flowers. Dye extraction and application on different materials. Example: Chrysanthemum and local flowers e.g. Palas (*Butea monosperma)*.			
	4.4: Case Studies and Practical Applications: Showcasing successful ventures and utilizing these specific flowers for value addition.			

Activities: (Any Five)

1. **Flower Classification Scavenger Hunt:** Students identify and classify different flowers based on habit, life cycle, and flowering season in a garden or campus area.

2. **Cut Flower Workshop:** An interactive session where students practice post-harvest handling techniques like pre-cooling, pulsing, packing, and storage with various flowers.

3. **Tool Identification Relay:** Teams compete to correctly identify and explain the use of different garden tools and implements.

4. **Career Speed Dating in Floriculture:** Professionals from various floriculture careers give short talks, followed by Q&A sessions with students, providing insights into career opportunities.

5. **Propagation Lab:** Students propagate plants using different vegetative methods (like Rhizome, Corm, Bulb) and artificial methods (Budding, Grafting).

6. **Pest and Disease Detective Game:** A role-play activity where students diagnose and propose treatments for pest and disease issues in flower crops.

7. **DIY Floral Essence Extraction:** Extracting essences from flowers like Jasmine and Rose, and discussing their applications in fragrances and skincare products.

8. **Floral Kitchen Workshop:** Preparing edible flower products like "Gulkand" and exploring the culinary uses of flowers in making jams and jellies.

9. **Natural Dyeing Workshop:** Using flowers like Marigold and Cosmos to extract natural dyes and applying them to fabrics.

10. **Business Plan Challenge:** Students develop a business plan for a start-up in areas like cosmetics, perfumes, or aromatherapy using floral products, guided by case studies of successful ventures.

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Model Questions:

Short Answer Type Questions:

1. Define floriculture and explain its importance and scope.
2. Describe the classification of flowers based on habit, life cycle, and flowering season.
3. List and briefly explain different vegetative propagation techniques in floriculture.
4. Discuss the pest and disease management strategies for Jasmine (Jasminum sambac).
5. What is the concept of value addition in floriculture and why is it important?
6. Describe the properties of flowers used in perfume and cosmetic production, with examples.
7. Explain the medicinal and therapeutic applications of Jasmine in herbal remedies.
8. What are the culinary potentials of flowers, and how are they utilized in food products?

Long Answer Type Questions

1. Discuss the environmental factors affecting crop growth in floriculture and elaborate on the post-harvest handling techniques for cut flowers.
2. Provide a detailed overview of the cultivation practices, including plant propagation, for Rose (Rosa grandiflora) and Marigold (Tagetes erecta).
3. Explain the process of extraction and application of floral essences in fragrance and skincare products, with a focus on Jasmine (Jasminum grandiflorum) and Rose (Rosa centifolia).
4. Discuss the case studies and practical applications of traditional flowers in creating natural dyes, highlighting the properties, dye extraction, and application techniques.

Multiple Choice Questions (MCQs)

1. What is floriculture?
a. Study of trees:
b. Cultivation of flowers
c. Science of soil:
d. Breeding of vegetables
2. Which of the following is a common disease affecting flowers in floriculture?
a. Rust:
b. Frostbite:
c. Drought:
d. Sunburn
3. Which factor is essential for successful pollination in many flowering plants?
a. Wind
b. Rain:
c. Artificial light:
d. Soil fertility
4. What is the purpose of using mulch in floriculture?
a. Control pests:
b. Conserve water:
c. Increase temperature:
d. All of the above
5. What is the primary focus of understanding customer preferences in the floriculture industry?
A) Creating innovative floral designs
B) Tailoring services to meet customer demands
C) Developing quality control protocols
D) Implementing compliance with industry standards
6. Which aspect is crucial for creating visually appealing floral arrangements?
A) Understanding market demands
B) Compliance with industry regulations
C) Attention to detail and balance
D) Financial management strategies
7. Which flower is the best choice for perfume and cosmetic production due to its aromatic properties?
A) Chrysanthemum
B) Garbera
C) Marigold (*Tagetes erecta*)
D) Jasmine (*Jasminum officinale*)
8. What is the edible product derived from Rose (*Rosa rubiginosa*) that holds nutritional and medicinal value?
A) Chrysanthemum Tea
B) Rosewater
C) Gulkand
D) Marigold Jelly

Pedagogical Strategies:

This course for UG students, implementing innovative pedagogies can significantly enhance the learning experience. Here are five pedagogical approaches that blend well with the course content:

1. **Problem-Based Learning (PBL):** This approach involves presenting students with real-world problems related to floriculture. For instance, they could tackle issues like sustainable cultivation practices or the challenge of extending the shelf life of cut flowers. This method encourages critical thinking, problem-solving skills, and collaborative learning.

2. **Flipped Classroom:** In this model, traditional learning structures are 'flipped'. Students first engage with new content at home, typically through interactive online modules or video lectures. Then, classroom time is devoted to hands-on activities, discussions, and application of knowledge. This approach could work well for sections like plant propagation techniques and pest management, where students can study the theory at home and practice in a lab setting.

3. **Experiential Learning:** Central to floriculture, this pedagogy involves learning through experience. Activities like maintaining a flower garden, participating in flower arrangement workshops, or visiting commercial floriculture setups can be incredibly effective. These experiences not only reinforce theoretical knowledge but also provide valuable practical skills.

4. **Gamification:** Introducing game-like elements in learning can significantly increase engagement. For example, creating a competitive flower identification game, or a simulation game for managing a floriculture business can make learning more interactive and fun. Gamification can be particularly effective in teaching sections like environmental factors affecting crop growth or the business aspects of floriculture.

5. **Interdisciplinary Projects:** Floriculture intersects with many fields such as business, environmental science, and technology. Encourage students to undertake projects that require integrating knowledge from these different areas. For example, a project could involve developing a sustainable business model for a floriculture enterprise, which would require students to apply concepts from botany, business, and environmental sustainability.

By incorporating these pedagogies, the course can become more dynamic, interactive, and aligned with real-world applications, greatly enhancing the educational experience of the students.

GOEC Course- AYUSH

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	107209	AYUSH	2	30	2 Hrs	30 (Ext)+20 (Int)

Course Objectives:	1. **Understand the Historical and Theoretical Foundations of AYUSH:** Students will gain a comprehensive understanding of the concept, evolution, and historical perspectives of AYUSH. This includes exploring its origins, key principles, and comparative analyses with conventional medicines. 2. **Explore the Relationship between Plant Sciences and Ayurveda:** Students will delve into the history, fundamental principles of Ayurveda, and its scope, from the use of crude herbs to advanced micromolecules. This objective aims to enhance understanding of Ayurveda's reliance on botanicals. 3. **Investigate Botanicals in Yoga, Naturopathy, Unani, Siddha, and Homeopathy:** The course will cover the origins, modernization, and role of plants in these traditional practices, focusing on their contributions to physical and mental wellness. 4. **Develop Practical Knowledge and Skills:** Students will learn to identify commonly used herbs, understand their medicinal properties, and appreciate their role in traditional medicine practices, bridging the gap between theoretical knowledge and practical application.
Course Outcomes:	CO 1: **Analytical Understanding of AYUSH and Conventional Medicine:** Students will be able to critically analyze the differences and similarities between AYUSH and conventional Western medicine, including their theoretical foundations and practical applications. CO 2: **Knowledge of Historical Impact:** Students will demonstrate an understanding of the historical significance of AYUSH in healthcare, including key events where traditional practices played pivotal roles in disease management and eradication. CO 3: **Comprehensive Knowledge of Ayurvedic Principles:** Students will have a thorough understanding of Ayurvedic principles such as Panchmahabuta and Tridosha, and the use of herbs in Ayurvedic practices. CO 4: **Application of Botanicals in Traditional Practices:** Students will be able to identify and explain the use of specific plants in Yoga, Naturopathy, Unani, Siddha, and Homeopathy, including their therapeutic benefits and applications in modern wellness. CO 5: **Practical Skills in Herb Identification and Usage:** Students will acquire practical skills in identifying commonly used medicinal herbs, understanding their cultivation methods, and applying this knowledge in creating herbal remedies. CO 6: **Integration of Traditional Knowledge with Modern Practices:** Students will develop the ability to integrate traditional botanical knowledge with contemporary health practices, demonstrating an

	understanding of how ancient techniques can complement modern medicine and wellness approaches.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Historical Perspective: AYUSH**	8	8	Suitable pedagogical strategies are separately annexed
	1.1. Concept and prospective of AYUSH			
	1.2: Historical Perspective, Origins and Evolution of AYUSH			
	1.3: Historical Stories where AYUSH played a pivotal role in healthcare: a. Ayurveda: Eradication of Smallpox in India b. Yoga and Naturopathy: Rehabilitation of Polio Survivors			
	1.4: Historical Stories where AYUSH played a pivotal role in healthcare: c. Unani: Treatment of Malaria d. Siddha: Managing Leprosy in Ancient India e. Homeopathy: Cholera Epidemics in the 19th Century:			
Unit II	**Relation of Plant Sciences with Ayurveda**	7	7	
	2.1: History and Fundamental Principles of Ayurveda			
	2.2: Ayurveda's Scope: From Oral Remedies to Surgery..			
	2.3: Concepts of Panchmahabuta and Tridosha (Vata, Pitta, Kapha)			
	2.4: Commonly used Herbs in local practices of Ayurveda.			
Unit III	**Botanicals in Yoga and Naturopathy**	8	8	
	3.1: History and Modernization of Yoga			
	3.2: Role of plants in Yoga and Stress Management			
	3.3: History and Modernization of Naturopathy			
	3.4: Yoga and Naturopathy: Bridging Ancient Techniques with Modern Wellness, from Physical Fitness to Mental Health			
Unit IV	**Herbal Foundations in Unani, Siddha, and Homeopathy**	7	7	
	4.1: History and Foundations of Unani, Siddha and Homeopathy			
	4.2: Plants in Unani medicine and therapies			
	4.3: Plants in Siddha medicine and treatment			
	4.4: Plants in Homeopathic medicine and treatment			

Activities: (Any Five)

1. **Ayurvedic Cooking Workshop:** Conduct a session where students prepare simple Ayurvedic recipes, learning about the dietary principles of Ayurveda.

2. **AYUSH vs Conventional Medicine Debate:** Organize a structured debate on the differences and similarities between AYUSH and conventional medicine.
3. **Field Trip to Naturopathy Center:** Organize a visit to a local naturopathy center to observe the practical application of the therapies.
4. **Herbal Garden Project:** Students develop a small herbal garden, cultivating commonly used Ayurvedic herbs and learning about their properties.
5. **Homeopathy Dilution Experiment:** An experiment demonstrating the process of diluting substances as used in homeopathic medicine preparation.
6. **Interactive Timeline Creation:** Students create a visual timeline highlighting key events in the history of AYUSH and its evolution.
7. **Role-Play of Historical Cases:** Students enact roles of practitioners and patients in historical cases where AYUSH played a key role, such as smallpox eradication or cholera epidemics.
8. **Siddha Medicine Case Studies:** Students analyze case studies to understand the application of Siddha medicine in various health conditions.
9. **Unani Medicine Preparation Workshop:** A hands-on workshop where students prepare basic Unani medicinal formulations.
10. **Yoga and Meditation Sessions:** Regular yoga and meditation sessions to understand their role in stress management and wellness.

Study Materials:

Books:

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2. Azami, A. A. (1995). Basic Concepts of Unani Medicine: A Critical Study. Department of History of Medicine, Faculty of Medicine, Jamia Hamdard.
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8. Jee, B. S. (1896). A Short History of Aryan Medical Science. Macmillan and Co., Limited.
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16. Sharma, P. (*N.d.*). Classical Uses of Medicinal Plants. Publisher.
17. Sharma, P. (*N.d.*). Indian Medicine in the Classical Age. Publisher.
18. Sharma, R. P. (*N.d.*). Ayurveda Sutra. Publisher.

19. Singh, B. (*N.d.*). A Short History of Aryan Medical Science. Publisher.
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21. Suram Chand, K. (1952). Ayurveda Ka Itihas Vol 1. Retrieved from https://archive.org/details/bfig_ayurveda-ka-itihas-vol-1-by-suram-chandra-1952-shimla-kaviraj-suram-chandra .
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23. Umarov, M., & Yuabov, M. S. Y. (2019). Unani Medicine. Modern Concepts. Primedia eLaunch LLC.
24. Zimer, (*N.d.*). Hindu Medicine. Publisher.

E Books

- A Short Introduction to Siddha Medicine. Publisher. Retrieved from https://www.google.co.in/books/edition/A_Short_Introduction/H9uhs9snzwAC
- An Introduction to Homeopathic Medicine. Publisher. Retrieved from https://www.google.co.in/books/edition/An_Introduction_to_Homeopathic_Medicine/dalJiPcNLqkC
- Ayurveda Revisited. Publisher. Retrieved from https://www.google.co.in/books/edition/Ayurveda_Revisited/fTBOixYXZXcC
- Handbook on Unani Medicines with Formulation, Processes, Uses and Analysis. Publisher. Retrieved from https://www.google.co.in/books/edition/Handbook_on_Unani_Medicines_with_Formula/6kKwDAAAQBAJ
- Naturopathy And Yoga. Publisher. Retrieved from https://www.google.co.in/books/edition/Naturopathy_And_Yoga/w3I9Xx4xZssC
- Practice of Medicine. Publisher. Retrieved from https://www.google.co.in/books/edition/Practice_of_Medicine/Os4rAQAAMAAJ
- Textbook of Homeopathic Theory and Practice. Publisher. Retrieved from https://www.google.co.in/books/edition/Text_book_of_Homeopathic_Theory_and_Prac/IgdMAAAAMAAJ
- The Holistic Principles of Ayurvedic Medicine. Publisher. Retrieved from https://www.google.co.in/books/edition/The_Holistic_Principles_of_Ayurvedic_Med/aexFAAAAYAAJ
- Translational Ayurveda. Publisher. Retrieved from https://www.google.co.in/books/edition/Translational_Ayurveda/kWJ5DwAAQBAJ
- Welcome Homeopathy. Publisher. Retrieved from https://www.google.co.in/books/edition/Welcome_Homeopathy/vLjsfUCQAekC
- World Health Organization. WHO Benchmarks for the Practice of Unani Medicine. Publisher. Retrieved from https://www.google.co.in/books/edition/WHO_benchmarks_for_the_practice_of_Unani/jMNqEAAAQBAJ
- Yoga Naturopathy. Publisher. Retrieved from https://www.google.co.in/books/edition/Yoga_Naturopathy/1WDZEAAAQBAJ

E – Contents:

- Ayur Centre's page on Siddha Medicine: https://www.ayurcentre.sg/ayurveda-wellness/what-is-siddha-medicine
- Britannica's article on Siddha Medicine: https://www.britannica.com/science/Siddha-medicine
- Center for Inquiry's blog on World Homeopathy Week: https://centerforinquiry.org/blog/oh-great-its-world-homeopathy-week/?gclid=EAIaIQobChMI9KyBxNTAgwMVyxqDAx0rjAIjEAAYASAAEgIF5PD_BwE
- Delhi Government AYUSH's page on Yoga and Naturopathy: https://ayush.delhi.gov.in/ayush/yoga-naturopathy
- Information about Siddha from Kerala's ISM: https://www.ism.kerala.gov.in/index.php/about-us/about-ism/about-sidha
- Information about Unani medicine from Kerala's ISM: https://www.ism.kerala.gov.in/index.php/about-us/about-ism/about-unani
- Johns Hopkins Medicine's Ayurveda page: https://www.hopkinsmedicine.org/health/wellness-and-prevention/ayurveda
- NHS's information on Homeopathy: https://www.nhs.uk/conditions/homeopathy/
- NIH article on Yoga and Naturopathy: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5377479/
- ScienceDirect Article on Alternative Medicine: https://www.sciencedirect.com/science/article/abs/pii/S1543115003000309
- Vikaspedia on Unani Medicine: https://vikaspedia.in/health/ayush/unani
- WebMD's page on Ayurvedic Treatments: https://www.webmd.com/balance/ayurvedic-treatments
- Wikipedia's Ayurveda page: https://en.wikipedia.org/wiki/Ayurveda
- Wikipedia's Homeopathy page: https://en.wikipedia.org/wiki/Homeopathy
- Wikipedia's Unani Medicine page: https://en.wikipedia.org/wiki/Unani_medicine

Long questions

1. Explain the different steams of AYUSH
2. Discuss in details Unani and Siddha medicines
3. Investigate the impacts of Yoga and Naturopathy on human health
4. Describe in details Ayurveda & its Branches

Short Questions

1. Summarize types of Yoga
2. Investigate the impacts of herbs in Ayurveda
3. Uses of drugs in herbs in Homeopathy
4. Comments on History of Unani and Siddha
5. Summarize the concept of AYUSH
6. Compare the Homeopathic medicine with Allopathic medicine
7. Assess the role of plants in the formulation drugs used in homeopathic medicine
8. Describe naturopathy and its importance in day to day life.

MCQs for Internal Assessment

1) The Hippocratic theory and Pythagorean theory is the principle of_____
   A) Homeopathy system of medicine
   B) Ayurveda system of medicine
   C) Chinese system of medicine
   D) Unani system of medicine

2) "Like can be treated by like" is the fundamental principle of_____
   A) Homeopathy system of medicine
   B) Ayurveda system of medicine
   C) Chinese system of medicine
   D) Unani system of medicine

3) The Word "Ayurveda" means_____
   A) History of people
   B) Science of life
   C) Science of medicine
   D) Knowledge of crude drugs

4) Panchamahabhuta is related to_____ system of medicine
   A) Homeopathy
   B) Unani
   C) Ayurveda
   D) Yoga

5) Who developed the homeopathic system of medicine
   A) Hippocrates
   B) Galen
   C) C.A. Sydler
   D) Samuel Hanneman

6) Who was the father of Siddha medicine
   A) Chakara
   B) Agastya
   C) Hippocrates
   D) Galen

7) Hypothesis of Ayurveda is _____
   A) Composed of 7 basic elements
   B) Composed of 5 basic elements
   C) Composed of 9 basic elements
   D) Composed of 3 basic elements

8) In Unani system of medicine, treatment is based on
   A) Treatment and Humors
   B) Treatment and Elements

C) Humors and Elements
D) None of the above

Pedagogical Strategies:

1. **Project-Based Learning (PBL):** Encourages students to gain knowledge and skills by working for an extended period to investigate and respond to complex questions, problems, or challenges.

2. **Case-Based Learning:** Involves students in real-world scenarios, encouraging them to analyze, discuss, and engage with practical issues, enhancing critical thinking and problem-solving skills.

3. **Inquiry-Based Learning:** Focuses on questioning, exploring, and posing explanations. It allows students to learn by asking questions, conducting investigations, and reflecting on their discoveries.

4. **Flipped Classroom:** Involves students in active learning through videos and readings outside class, and interactive, collaborative activities during class.

5. **Service-Learning:** Combines learning goals and community service to provide a pragmatic, progressive learning experience while meeting societal needs.

Vocational Skill Course- Commercialization of Medicinal Plant and Products

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	107210	Commercialization of Medicinal Plant and Products	2	60	4 Hrs	50

Course Objectives:	1. Understand the utility of Medicinal plants. 2. Understand the packing and bottling of medicinal plant products. 3. Understand the Basics of the Commercialization of Medicinal plants. 4. Explain Knowledge of commercialization of Medicinal plant products.
Course Outcomes:	After studying this course, the students will be able to: CO 1: Apply the various value addition techniques to Medicinal plant products & sell them on higher price in market. CO 2: Investigate the demand of medicinal plant-based products in market. CO 3: Develop a medicinal plant products processing unit or small-scale industry. CO 4: Create employment opportunities in area, rural health services and NGO related with health awareness

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Basics in commercialization of medicinal plants products:**	15	12	Suitable pedagogical strategies are separately annexed
	1.1: Scope and limitations for commercialization.			
	1.2: Marketing and promotion of medicinal plant products.			
	1.3: Value Addition Concept, Standardization and Quality control measures.			
	1.4: Precautions for adulteration and substitutions.			
Unit II	**Powder Based medicinal plant Products**	15	12	
	2.1: Methods of Drying & Moisture Regulation.			
	2.2: Methods of power preparation.			
	2.3: Medicinal plant part (Fruits) used for powder preparation: Identification and utilization of: 1. Amla, 2. Behada, 3. Shikekai 4. Jambhul			
	2.4: Medicinal plant parts (Bark and Whole plant) used for powder preparation: 5. Arjun, 6. Cinnamon, 7. Safed Musali, 8. Mehandi, 9. Ashwagandha, & 10. Sarpgandha.			
Unit III	**Decoction and Juice of plant Products**	15	12	
	3.1: Methods of Decoction and Juice precreation.			
	3.2: Medicinal plant parts used for decoction preparation: Identification and utilization of: 1. Adulsa 2. Anantmul 3. Gulvel / Giloy, 4.Ginger 5.Basil			
	3.3: Medicinal plant parts used for juice preparation: 6. Arjun 7.Neem 8. Aloe			

	9. Brahmi & 10. Bael			
	3.4: Preservative techniques, Bottling, Packing and labelling of medicinal plant products.			
Unit IV	**Essential Oil Based Plant Products**	15	14	
	4.1 Medicinal plant Parts used to extract Essential Oil. Identification and utilization of: 1. Nilgiri, 2. Clove, 3.Fennel, 4.Lemon Grass, 5. Mint			
	4.2: Schemes of Central and State government and Funding Agencies for medicinal plant-based startup.			
	4.3: Guidelines for product preparation, Permission, and Certification.			
	4.4: Business registration, Support services, Profit and Loss.			

Experiments: At least THREE Experiments from Each Unit of following list:

Unit I:

1. Analyze case studies of successful and failed medicinal plant products.
2. Create a marketing plan for a hypothetical medicinal plant product.
3. Standardize a simple medicinal plant extract.
4. Test for common adulterants in herbal products.

Unit II:

5. Dry different plant parts and measure moisture content.
6. Prepare powders from various plant parts.
7. Identification and processing of Amla, Behada, Shikekai, Jambhul.
8. Process and analyze bark and whole plants like Arjun, Cinnamon, etc.

Unit III:

9. Prepare decoctions and juices from selected plants.
10. Work with Adulsa, Anantmul, Gulvel, etc., for decoction.
11. Extract juices from Arjun, Neem, Aloe, etc.
12. Apply different preservative techniques.

Unit IV:

13. Extract essential oils from Nilgiri, Clove, Lemon Grass, etc.
14. Create a mock proposal for funding.
15. Draft a product specification sheet.
16. Develop a basic business plan for a hypothetical product.

Activities (Any two from the following):

1. Group discussion on challenges faced in the market for medicinal plant products.
2. Design promotional materials for medicinal plant products.
3. Visit a local herbal processing unit to understand quality control measures.
4. Create a checklist for identifying pure vs adulterated products.
5. Compare traditional vs modern drying techniques.
6. Analyze the fineness and quality of prepared powders.
7. Study the traditional uses and modern applications of medicinal fruits.
8. Prepare sample powders and test their efficacy.
9. Study the stability and potency of decoctions and juices over time.

10. Compare traditional decoction methods vs modern techniques.
11. Test therapeutic properties and shelf life of plant juices.
12. Design labels and understand legal requirements for packaging.
13. Research and presentation on various government schemes for botanical startups.
14. Workshop on regulatory affairs and certification processes.
15. Interactive session with a botanical startup founder.

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Books:

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- Dhale, D. A. (2022). Medicinal Herbs for Pharma Industry. D.P.S. Publishing House.
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- Ramchandran, S. Handbook of Herbal Medicine: With Special Reference to Pharmacognosticla Studies of Indian Medicinal Plants. Laxmi Book Publication.
- Rajgure-Gulhane Y M and Bhogaonkar P Y (2015). Wild Edibles of Vidarbha (Along with medicinal uses) Nabh Prakashan.

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- Agricorn. (2023, August). Value addition & preservation of food products. Retrieved from https://www.agricorn.in/2023/08/value-addition-preservation-food-products.html
- National Medicinal Plants Board. https://nmpb.nic.in

Research Paper

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Video Resources:

- Solution-Pharmacy. (n.d.). Test for Tannins. [Video]. YouTube. Retrieved from https://www.youtube.com/watch?v=KozFN-mkNLY
- Solution-Pharmacy. (n.d.). Test for Alkaloids. [Video]. YouTube. Retrieved from https://www.youtube.com/watch?v=uMxdSkKcO7U
- Mishra, S. (n.d.). Essential oil extraction. [Video]. YouTube. Retrieved from https://www.youtube.com/watch?v=-mYTaUJtle0
- Entrepreneur India TV. (n.d.). Aloe vera juice making. [Video]. YouTube. Retrieved from https://www.youtube.com/watch?v=3xs8caUl-Kk
- Tazeka Aromatherapy. (n.d.). Steam distillation process. [Video]. YouTube. Retrieved from https://www.youtube.com/watch?v=OVQC-6qIq-Y

Pedagogical Strategies:

1. Case Studies and Role Plays

- Application-Oriented Learning: Utilize case studies of successful and unsuccessful commercial ventures in medicinal plant products. Role plays can help students understand market scenarios and decision-making processes.

2. Industry Visits and Guest Lectures

- Real-World Exposure: Organize visits to medicinal plant processing units or invite industry experts for lectures. This provides practical insights into commercial production, quality control, and marketing strategies.

3. Project-Based Learning

- Hands-On Approach: Assign projects where students create a hypothetical business plan for a medicinal plant-based product. Include market research, product development, and marketing strategies.

4. Interactive Workshops

- Skill Enhancement: Conduct workshops on drying methods, powder preparation, decoction making, and essential oil extraction. Hands-on experience reinforces theoretical knowledge.

5. Collaborative Research Projects

- Exploring Innovations: Assign research projects on innovative methods of preserving medicinal plant products or exploring new markets for these products. Encourage teamwork and critical analysis.

6. Multimedia Presentations and Discussions

- Varied Learning Aids: Use multimedia presentations, documentaries, or infographics highlighting successful commercialization stories. Follow up with discussions to analyze market trends.

7. Industry-Relevant Assignments

- Application of Knowledge: Assign tasks simulating real industry scenarios, such as creating marketing campaigns, developing quality control measures, or drafting business proposals.

8. Field Trips and Experiential Learning

- Observational Learning: Arrange visits to medicinal plant gardens, farms, or nurseries to understand cultivation practices and the value chain.

9. Self-Assessment and Reflection

- Metacognitive Approach: Encourage students to reflect on their learning through journals or portfolios. Self-assessment tools help reinforce understanding.

10. Debates and Seminars

- Critical Thinking: Organize debates or seminars on topics like ethical considerations in commercialization, the role of government policies, or sustainable practices in the industry.

Assessment Rubric for Internal Practical Course on **Commercialization of Medicinal Plant and Products**

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – I (NEP)				
Lab/ Practical-6	Course Code: 107210	Commercialization of Medicinal Plant and Products	**Max Marks: 50**	**Time: 4 Hrs.**
S.No.	**Assessment Criteria**			**Marks**

1	Performance of Any One Exercise from the List of Experiments	**10**
2	Performance of the Task on Any One of the List of Activities	**10**
3	Record/ Assignments	**10**
4	Attendance	**5**
5	Participation in Activity/ Field visit	**5**
6	Students overall performance	**5**
7	Internal Viva Voce	**5**

Skill Enhancement Course - Seed Development Technology

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	107210	Seed Development Technology	2	60	4 Hrs	50

Course Objectives:	1. To create opportunities of self-employment / students' startup through seed technology. 2. To introduce the concepts of experimental design in Seed Technology. 3. To enrich students training and knowledge that would be useful in the seed industry so that the farmers will get quality seeds. 4. To create awareness and involve local people in contract farming through various seed companies.
Course Outcomes:	CO 1: Understand the concept of tools and techniques for seed production, seed quality control and processing CO 2: Demonstrate different methods of hybridization & seed production CO 3: Access the latest technologies used for seeds CO 4: Analyze and compare the seed companies / organization CO 5: Apply the Certification of seed for future uses CO 6: Design the own Plant & Seed Diagnostic Clinic.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**UNDERSTANDING SCOPE OF SEED DEVELOPMENT TECHNOLOGY**	15	12	Suitable pedagogical strategies are separately annexed
	1.1. History, scope and role of Seed development Technology in agriculture.			
	1.2 Indian, International seed industry and Opportunities in Seed development technology.			
	1.3 Seed development program in India (NSC, SSC), any private seed organization (e.g. MAHICO, MAHABEEJ and their role in seed industry etc)			
	1.4 Seed quality control organization in India. Principles of Quality seed production, Role and characteristics of quality seed.			
Unit II	**PRODUCTION TECHNIQUES**	15	12	
	2.1 Structure and Development of Dicotyledonous and Monocotyledon seeds			
	2.2 Selection Methods of Plant Breeding -Concept, procedure, achievements and types.			
	2.3 Hybridization and hybrid seed production – Concept, objectives and Techniques of hybridization: Selection and evaluation of parents, emasculation bagging and tagging, pollination, collection and storage of F 1 seeds and growing of F1 generation.			
	2.3 Hybrid seed production with respect to Source of seed Selection of field (Land requirement)			

	Isolation distance Sowing Cultural practices (Fertigation, Irrigation, plant protection) Rouging Harvesting and threshing.			
	2.4 Development of seeds by Parthenogenesis and Parthenocarpy, Genetic modification for seed quality improvement.			
Unit III	**QUALITY CONTROL**	15	12	
	3.1 Factors affecting seed set – temperature, relative humidity, day length, wind velocity and directions of flowering, anthesis, pollen viability, stigma receptivity, nutrition and irrigation.			
	3.2 Seed health Testing: dry seed examination, storage of reserve food & Chemical composition in seeds field and seed standards; designated diseases, detection methods for seed borne -fungi, bacteria, viruses and nematodes.			
	3.3. Viability, Vigour testing & Seed longevity.			
	3.4 Testing of GM seeds and trait purity, Preparation and dispatch of seed testing report.			
Unit IV	**Unit-IV – PRIMARY PROCESSING**	15	14	
	4.1 Post harvest handling of seeds - threshing methods & drying methods.			
	4.2 Seed for processing principles, Cleaner cum grader, Surface texture separation, Seed treatment.			
	4.3 Seed storage: Construction, operation and maintenance, insulation, storage aeration, air conditioning, dehumidification and stacking, moisture and heat roofing of seed storage structures, seed storage management, Methods to minimize seed aging and deterioration.			
	4.4 Indian Seeds Act, Seed Rules and Seed Order.			

Conduct at least THREE Practicals from each unit:

Unit - I

1. Search and Enlist opportunities in seed development technology in seed industry
2. Collection of information on seed organization
3. Preparation of the Flow Diagram of Seed Development Program in India
4. Study of Product profile of private seed organization
5. Preparation list of Seed quality control organization in India
6. Collection of seed on the basis of characteristics of quality seeds

Unit II

7. Study of the external and internal structures of monocot and dicot seed.
8. Seed sowing for parent selection (using cultural practices)
9. Experiments on selection methods (Pure line selection, Mass selection, and Clonal selection Study of tools and equipment required for plant breeding
10. Emasculation, Self-pollination and cross pollination

11. Bagging and tagging of selected parent plant
12. Demonstration of hybridization techniques in crops (any 2-3)
13. Seed production by parthenogenesis and parthenocarpy
14. Visit of foundation and certified seed plots study of the techniques of seed production

Unit III:

15. Experiments on factors affecting seed germination, temperature, moisture, light
16. Seed health Testing- Test for reserve food
17. Seed Viability Test
18. Seedling vigour & longevity tests
19. Detection of important seed borne fungi-various detection methods,
20. Detection of important seed borne bacteria- various methods.
21. Experiments on artificial seed production

Unit IV:

22. Preparation of seed testing report
23. Study of threshing machine and its use.
24. Methods of seed drying (wet dry seeds)
25. Determination of seed moisture content
26. Study of seed – pre-cleaner, maize sheller & dehusker.
27. Study of air screen cleaner cum grader, magnetic separator
28. Study of seed treatment machines
29. Hands on using methods to minimize seed aging & deterioration (ageing test)
30. Techniques and necessities of the Seed storage

Activities:

1. Field visits to different seed production farms /units, seed Production Company / seed processing & storage complex
2. Preparation of seed bank.
3. Collaboration/ MoU: To undertake activities establish Collaboration / MoU with any Seed company / related NGO/ Institute

Career Opportunities:

- Employment in various research institutes and seed companies
- Self-employment through –
- own Plant & Seed Diagnostic Clinic.
- Production of Certified plant saplings and seeds.
- Involvement of locals in Contract manufacturing through various seed companies.
- Trained Consultants for Seed grading
- Subsidy from various agencies for seed company

References:

1) Agrawal, P. K., & Dadlani, M. (1992). Techniques in seed science and technology (2nd ed.). South Asian Publication.
2) Agrawal, P. K. (Ed.). (1993). Handbook of seed testing. Ministry of Agriculture, Government of India, New Delhi.
3) Agrawal, R. L. (1997). Seed technology (2nd ed.). Oxford & IBH Publishing.
4) Kelly, A. F. (1988). Seed production of agricultural crops. [Publisher information needed].
5) Chhabra, A. K. (2006). Practical manual of floral biology of crop plants. Department of Plant Breeding, CCS HAU, Hisar.

6) Saroli, D. K., Soadia, D. K., Choudhary, B. R., & Singh, D. (2018). Production of quality seed and planting materials. ICAR-Central Institute for Arid Horticulture, Bikaner, Rajasthan.
7) Pandey, (2010). A textbook of botany. S. Chand and Company Ltd., New Delhi.
8) Mathad, R., Vasudevan, S. N., Mathad, N. C., & Patil, S. B. (2013). Traditional seed treatment and storage methods of the Northeastern region of Karnataka. Journal of Asian Agricultural History, 17(3), 233-239.
9) Thooyavathy, R. A., Perumal, K., Suresh, V., & Vijayakshmi, K. (2013). Seed production technique for vegetables. Centre for Indian Knowledge Systems (CIKS), Seed Node of the Revitalizing Rainfed Agricultural Network, Chennai.
10) Copeland, L. O., & McDonald, M. B. (2001). Principles of Seed Science and Technology. Springer.

Digital Resources and E-Contents:

1) National Seed Corporation (NSC): Provides comprehensive information on seed development programs in India. Website: http://www.indiaseeds.com
2) Seed Quality Control Organization in India: Details on seed quality control measures. Resource available at the Ministry of Agriculture and Farmers Welfare: https://agricoop.nic.in
3) (2020). 6 seeds that every kitchen has: Create a kitchen garden from the seeds of your kitchen cabinet. Retrieved from https://www.wehydroponics.com

Web Links for Seed Development and Quality Control:

1) Food and Agriculture Organization (FAO). (n.d.). Seed Quality Control. Retrieved from http://www.fao.org
2) International Seed Testing Association (ISTA): Offers guidelines and standards for seed testing. Website: https://www.seedtest.org

Database Links:

1) Germplasm Resources Information Network (GRIN): https://npgsweb.ars-grin.gov
2) Seeds of India program by ICAR: http://www.icar.org.in

Pedagogical Strategies:

For the effective delivery of the Seed Development Technology curriculum, consider integrating the following modern and innovative pedagogies:

1) **Blended Learning:** Combines online digital media with traditional classroom methods, allowing for both in-person and remote, self-paced learning experiences.
2) **Gamification:** Introduces game design elements in educational contexts to enhance student engagement and motivation.
3) **Flipped Classroom:** Students learn content online by watching video lectures, then apply the knowledge in the classroom through interactive activities.
4) **Problem-Based Learning (PBL):** Students learn about a subject through the experience of solving an open-ended problem presented in trigger material.
5) **Virtual Labs and Simulations:** Utilize software to simulate real-world seed development and testing scenarios, providing hands-on experience without the need for physical materials.

Assessment Rubric for Internal Practical Course on- Seed Development Technology

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. I (Botany), SEMESTER – II (NEP)			
Lab/Practical-7	**Course Code:** 10211	**Seed Development Technology**	**Max Marks: 50**

Q. No.	**Exercise**	**Marks**
1	Demonstration of experiment based on hybridization techniques for seed production (any one):	10
2	To demonstrate the test based on seed quality (any one)	10
3	Comment on method of seed processing (any one method as per the list)	10
4	Overall Performance throughout the semester	5
5	Record Book	5
6	Field visit / Activities under MoU or Collaboration report	5
7	Viva Voce	5
	Total	**50**