DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

NAAC- 'A $^{+}$' Grade

CIRCULAR NO.SU/ B.Sc./NEP-2020/91/2026

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Boards/Committees and recommended by the Faculty of Science & Technology, **Academic Council at its meeting held on 02nd June 2026 has accepted** the following **Revised syllabi of Bachelor of Science & Basket** under the Faculty of Science & Technology **as per Norms of National Education Policy-2020 and as per Government Letter dated 13 March 2024** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc.Botany	Vth and VIth semester
2.	B.Sc.Biotechnology	Vth and VIth semester
3.	B.Sc.Zoology	Vth and VIth semester
4.	B.Sc.Agrochemical and Fertilizer	Vth and VIth semester
5.	B.Sc.Geology	Vth and VIth semester
6.	B.Sc.Environmental Science	Vth and VIth semester
7.	B.Sc.Home Science	Vth and VIth semester
8.	B.Sc.Diary Science and Technology	Vth and VIth semester
9.	B.Sc.Automobile Technology	Vth and VIth semester
10.	B.Sc.Physics	Vth and VIth semester
11.	B.Sc.Chemistry	Vth and VIth semester
12.	B.Sc.Analytical Chemistry	Vth and VIth semester
13.	B.Sc.Polymer Chemistry	Vth and VIth semester
14.	B.Sc.Electronics	Vth and VIth semester
15.	B.Sc.Forensic Science & Cyber Security	Vth and VIth semester
16.	B.Sc.Microbiology	Vth and VIth semester
17.	B.Sc.Fisheries Science	Vth and VIth semester
18.	B.Sc.Mathematics	Vth and VIth semester
19.	B.Sc.Forensic Science	Vth and VIth semester
20.	B.Sc.Information Technology	Vth and VIth semester
21.	B.Sc.Horticulture	Vth and VIth semester
22.	B.Sc.Networking & Multimedia	Vth and VIth semester
23.	B.Sc.Biochemistry	Vth and VIth semester
24.	B.Sc.Industrial Chemistry	Vth and VIth semester
25.	B.Sc.Bioinformatics	Vth and VIth semester

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26.	**B.Sc.Instrumentation Practice**	**Vth and VIth semester**
27.	**B.Sc.Non-Conventional and Conventional Energy**	**Vth and VIth semester**
28.	**B.Sc.Statistics**	**Vth and VIth semester**
29.	**B.Sc.Computer Science**	**Vth and VIth semester**
30.	**Bachelor of Computer Application**	**Vth and VIth semester**

This is effective from the Academic Year 2026-27 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/AC.No.06/4498-113
Date:- 12.06.2026.

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Deputy Registrar,
Syllabus Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

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2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CHHATRAPATI SAMBHAJINAGAR- 431001

Faculty of Science and Technology

B.Sc. Degree Programme

(Three Year / Four Years (Hons) /Four Years (Hons with Research)

Course Structure and Curriculum

(AS PER NEP-2020)

Subject: BOTANY

For

B. Sc. Third Year

(Semester- V and VI)

Professor Bhaskar Sathe,
Dean,
Faculty of Science & Technology,
Dr.Babasaheb Ambedkar
Marathwada University,
Chhatrapati Sambhajinagar
6/2/06/2026

Effective From

Academic Year 2026-2027

BOARD OF STUDIES IN BOTANY

Prof. Dr. ARVIND S. DHABE
Chairman
Board of Studies in Botany,
Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad - 431004

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PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Structure of B. Sc. (Three/Four Years Honours/Honours with Research Degree) Program with Multiple Entry and Exit Options

B. Sc. Third Year: 5 th Semester Subject: Botany

	Course Type	Course Code / Examination Code	Course Name	Course	Teaching Scheme (Hours/Week)		Credits assigned		Total Credits
					Theory	Practical	Theory	Practical	
1	Major (Core) Mandatory DSC	BOT/DSC/T/300 SAC03013005T	Cell Biology	Theory Course	2		2		2+2+2+2 = 08
		BOT/DSC/T/301 SAC03013015T	Diversity of Angiosperms-I	Theory Course	2		2		
		BOT/DSC/P/326 SAC03013265P	Cell Biology	Practical based on BOT/DSC/T/300		4		2	
		BOT/DSC/P/327 SAC03013275P	Diversity of Angiosperms-I	Practical based on BOT/DSC/T/301		4		2	
2	Discipline specific electives (Choose any one from BOT/DSE/T/300 and BOT/DSE/T/301) and corresponding practical's.	BOT/DSE/T/300 SBC03013005T	Plant pathology	Theory Course to be chosen from other discipline of same faculty	2		2		2+2 = 04
		BOT/DSE/T/301 SBC03013015T	Plant Biotechnology	Discipline specific electives					
		BOT/DSE/P/300 SBC03013005P	Practical based on BOT/DSE/T/300	Discipline specific electives					
		BOT/DSE/P/301 SBC03013015T	Practical based on BOT/DSE/T/301	Theory Course to be chosen from other discipline of same faculty		4		2	
3	Minor Course (Choose any two from pool of courses) It is from different discipline of the same faculty	BOT/Mn/T/300 SCC03013005T	Seed Technology	Theory Course to be chosen from other discipline of same faculty	2		2		2+2 = 04
		BOT/Mn/T/301 SCC03013015T	Economic Botany						
4	VSC (Vocational Skill Courses) (Choose any one from BOT/VSC/T/ 300 and BOT/VSC/T/ 301) and corresponding Practical's	BOT/VSC/T/300 SEC03013005T	Hydroponics	Theory Course	2				2+2 = 04
		BOT/VSC/T/301 SEC03013015T	Horticulture	Theory Course	2				
		BOT/VSC/P/326 SEC03013265P	Hydroponics	Practical based on BOT/VSC/T/300		4		2	
		BOT/VSC/P/327 SEC03013275P	Horticulture	Practical based on BOT/VSC/T/301		4		2	
5	OJT//CEP/CC/ RP (Choose any one from pool of courses)	SUB/CC/P/0226 SJC03013265P		Field Project/Community engagement and service		4		2	02
					15	14	15	07	22

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Structure of B. Sc. (Three/Four Years Honours/Honours with Research Degree)
Program with Multiple Entry and Exit Options
B. Sc. Third Year: 6 th Semester Subject: Botany

	Course Type	Course Code	Course Name	Course	Teaching Scheme (Hours/Week)		Credits assigned		Total Credits
					Theory	Practical	Theory	Practical	
1	Major (Core) Mandatory DSC	BOT/DSC/T/350 SAC03013506T	Genetics	Theory Course	2		2		2+2+2+2+2 = 10
		BOT/DSC/T/351 SAC03013516T	Plant Disease management	Theory Course	2		2		
		BOT/DSC/P/376 SAC0301376P	Genetics	Practical based on BOT/DSC/T/350		4		2	
		BOT/DSC/P/377 SAC03013776P	Plant Disease management	Practical based on BOT/DSC/T/351		4		2	
		BOT/DSC/T/352 SAC03013526T	"Traditional Plant Knowledge and Ethnobotany"	Theory Course	2		2		
2	Discipline specific electives DSE- Major Electives (Choose any one from pool of courses)	BOT/DSE/T/350 SBC03013506T	Diversity of Angiosperms -II	Theory Course to be chosen from other discipline of same faculty	2		2		2+2 = 04
		BOT/DSE/T/351 SBC03013516T	Plant breeding	Theory Course to be chosen from other discipline of same faculty	2		2		
		BOT/DSE/P/376 SBC03013766P	Diversity of Angiosperms -II	Practical based on BOT/DSE/T/350		4		2	
		BOT/DSE/P/377 SBC03013776P	Plant breeding	Practical based on / BOT/DSE/T/351		4		2	
3	Minor Course (Choose any two from pool of courses) It is from different discipline of the same faculty	BOT/Mn/T/350 SCC03013506T	Seed Industry and Marketing Management	Theory Course to be chosen from other discipline of same faculty	2		2		2+2 = 04
		BOT/Mn/T/351 SCC03013516T	Ethnobotany	Theory Course to be chosen from other discipline of same faculty	2		2		
4	OJT/FP/CEP/ CC/RP (Choose any one from pool of courses)	BOT/OJT/P/376 SJC03013766P	On Job Training			8		4	04
		BOT/RP/P/376 SJC03013766P	Research Project			8		4	
									22
	Exit Option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor								

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2) Discipline Specific Elective (DSE) Choose any one form pool of Course

i. **BOT/DSE/T/300:** This is a 2-credit theory course corresponding to Discipline Specific Elective (DSE)
ii. **BOT/DSE/T/301:** This is a 2-credit theory course corresponding to Discipline Specific Elective (DSE)
iii. **BOT/DSE/P/300:** This is a 2-credit practical course based on **BOT/DSE/T/300**
iv. **BOT/DSE/P/301:** This is a 2-credit practical course based on **BOT/DSE/T/301**

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3) Minor Course: It is from different discipline of the same faculty

i. **BOT/Mn/T/300:** This is a 2-credit theory from different discipline of the same faculty
ii. **BOT/Mn/T/301:** This is a 2-credit theory from different discipline of the same faculty

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4) VSC (Vocational Skill Courses):

Choose any one from pool of courses. These courses should be based on Hands-on Training corresponding to Major (core) subject.

BOT/VSC/T/300: This is a 2 credit theory course-based Hands-on Training corresponding to Major (core) subject

BOT/VSC/T/301: This is a 2 credit theory course-based Hands-on Training corresponding to Major (core) subject

BOT/VSC/P/326: This is a 2 credit practical course based on **BOT/VSC/T/300**

BOT/VSC/P/327: This is a 2 credit practical course based on **BOT/VSC/T/301**

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5) SUB/CC/P/0226: This is a 02 credit Practical Training filed project course

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Semester-6th

1) Major (Core) subject is mandatory.

i. **BOT/DSC/T/350:** This is a 2-credit theory course corresponding to Major (core) subject
ii. **BOT/DSC/T/351:** This is a 2-credit theory course corresponding to Major (core) subject
iii. **BOT/DSC/P/376:** This is a 2-credit practical course based on **BOT/DSC/T/350**
iv. **BOT/DSC/P/377:** This is a 2-credit practical course based on **BOT/DSC/T/351**
v. **BOT/DSC/T/352:** This is a 2-credit theory course corresponding to Major (core) subject

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2) Discipline Specific Elective (DSE) Choose any one form pool of Course

v. **BOT/DSE/T/350:** This is a 2-credit theory course corresponding to Discipline Specific Elective (DSE)
vi. **BOT/DSE/T/351:** This is a 2-credit theory course corresponding to Discipline Specific Elective (DSE)
vii. **BOT/DSE/P/376:** This is a 2-credit practical course based on **BOT/DSE/T/350**
viii. **BOT/DSE/P/377:** This is a 2-credit practical course based on **BOT/DSE/T/351**

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3) Minor Course: It is from different discipline of the same faculty

iii. **BOT/Mn/T/350:** This is a 2-credit theory from different discipline of the same faculty
iv. **BOT/Mn/T/351:** This is a 2-credit theory from different discipline of the same faculty

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4) OJT – On Job Training This is a 4-credit on job training course corresponding to Major (core) subject

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Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.

2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mind set, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

- **PO2. Environment and sustainability**: Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.

- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.

- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.

- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO6. Project management and finance**: Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.

- **PO7. Life-long learning**: Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

Programme Specific Outcomes (PSOs):

Botany specific PSOs

PSO1. **Domain knowledge:** Apply the knowledge of fundamental and advanced areas of Pant Science for the well being of the human.

PSO2. **Understanding the various Plant Groups:** The basic knowledge and evolution of different plant groups like Bacteria, Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms an Angiosperms will be given to students.

PSO3. **Understanding structures of plant body:** The detailed morphological, anatomical, palynological, embryological structures will give the understanding about the plant body.

PSO: **Understanding processes in plant body:** The mechanism of anabolic and catabolic activities, cell divisions and growth in plant bodies will be explained to increase the production of Crop plants.

PSO5: **Understanding properties and uses of plants to maintain health:** The properties and uses of common medicinal plants, spices, Vegetables etc. will be explained to maintain the good health.

PSO6. **Enriching knowledge related with Agriculture:** Use of established knowledge regarding mannuaring, composting, use of Biofertilizers and ecofriendly Insecticides and pesticides for the sustainable development.

B. SC. III YEAR, SEMESTER – V

DSC-15: Cell Biology
Course Code: BOT/DSC/T/300
Examination Code: SAC03013005T
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30

Learning Objectives (Theory)

After completing the Cell Biology theory course students will be able to:

1.Know the structure and functions of prokaryotic and eukaryotic cells.

2. Describe the structure and functions of different cell organelles and cell components .

3. Explain the mechanisms of cell division, regulation of the cell cycle and cell communication.

4. Know the structure of membranes, mechanisms of transport and metabolism of cells.

5. Use the principles of cell biology in the study of growth, development, heredity and contemporary biological research.

Course Outcomes (Theory)

Upon successful completion of this course, students will be able to:

1. Explain the structural organization of cells and their organelles.

2. Contrast and compare the structure of prokaryotic and eukaryotic cells.

3. Explain the process of mitosis, meiosis and regulation of the cell cycle.

4. Explain membrane transport.

Module No.	Topic/Actual content of the syllabus	Hours
Unit I	**Cell Biology:** 1. Structure of Prokaryotic cell (Bacterial cell) and Eukaryotic cell (plant cell) 2. Cell wall and Plasma membrane: Structure and functions 3. Cell organelles: Structure and functions of Golgi complex, Mitochondria, Chloroplast, Ribosomes, Endoplasmic reticulum, Lysosomes 4. **Nucleus**: Structure and Functions	10
Unit -II	**Cell division:** 1. **Cell cycle** -G1 phase, S phase, G2 phase and M phase 2. **Mitosis** – definition, process and significance. 3. **Meiosis**-definition, process and significance.	05
Unit-III	**Chromosome:** 1. Definition, morphology-size, shape, number, Structure: Chromatids, chromonema, chromomere, centromere, kinetochore, secondary constriction, Satellite, telomere, heterochromatin, euchromatin, Nucleosome model, Functions of chromosome 2. **Giant chromosomes:** Polytene and Lampbrush chromosome 3. **Chromosomal aberrations:** Structural: deletion, duplication, inversion and translocation. 4. **Numerical**: Euploidy and Aneuploidy (2n + 1) trisomy 5. **Nucleic acids:** 1. **DNA**: Definition, structure, chemical composition, Watson and Crick's model, Functions of DNA. 2. **Replications of DNA:** conservative, semi conservative anddispersive. 6. **RNA:** Structure, types and functions.	15

Suggested Readings:

1. Cell biology -genetics-molecular biology: Kar, Dipak Kumar
2. Cell biology genetics molecular biology Edition: 2nd Kar, Dipak Kumar , Halder, Soma.
3. Cell biology, genetics, molecular biology, evolution and ecology: Verma, P. S, Agarwal, V. K .S. Chand New Delhi.
4. Cell and Molecular Biology, Concepts and Experiments: Gerald Karp, John Wiley & Sons, Inc.
5. Cell & Molecular Biology. E.D.D De Robertis& E.M.F De Robertis, Waverly publication .
6. Molecular Cell Biology Lodish, H., Baltimore, D; fesk, A., Zipursky S.L., Matsudaride, P. and Darnel. American Scientific Books. W.H. Freeman, New York
7. Problems in Genetics, M. P. Kulthe, N. G., Kashid and U. P. Mogle RUT Printer and Publisher, Jalna.
8. The cell: A molecular approach. Geoffrey M Cooper, Robert E Hausman, ASM press,2009.
9. Cytology Genetics & Evolution. P.K. Gupta,RastogiPublication,Meerut.
10. A Textbook of Practical Botany, Vol I.Bendre and Kumar (1997)., Rastogi Publications, Meerut.
11. Modern Practical Botany Vol. II, Pandey B. P. (2019) ,S. Chand and Company
12. College Botany Vol. III; S. SundaraRajan (2000) ,Himalaya Publishing House, Mumbai
13. Cell Biology: C. B. Powar: Himalaya Publishing House. Delhi

DSC-16: Taxonomy of Angiosperms
Course Code: BOT/DSC/T/301
Examination Code: SAC03013015T
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30)

Learning Objectives: By the end of this course, students will be able to:

1. To introduce students to the diversity and classification of angiosperms.
2. To study the morphological and floral characteristics of different angiosperm families.
3. To develop the ability to identify plants based on vegetative and reproductive features.
4. To understand the economic importance and ecological role of angiospermic plants.
5. To provide knowledge about taxonomic principles and phylogenetic relationships among angiosperms.

Learning Outcomes
Course Outcomes: After successful completion of this Course, students will be able to:

1. Explain the diversity and systematic classification of angiosperms.
2. Identify important angiosperm families using diagnostic morphological characters.
3. Describe floral structures, floral formulae, and floral diagrams of studied families.
4. Evaluate the economic and medicinal importance of various angiospermic plants.
5. Apply taxonomic knowledge in plant identification, herbarium preparation, and biodiversity studies.

Module No.	Topic/Actual content of the syllabus	Hours
Unit -I	Taxonomy a. Definition, Aims of Taxonomy, b. Functions of Taxonomy – • Identification and its methods; • Nomenclature- Local names, Vernacular names, Common names, Scientific names – Binomial names; • Classification – types of systems – Artificial, Natural, Phylogenetic systems, broad outline of APG IV system c. Phases of Taxonomy – Pioneer phase, Consolidation phase, Biosystematic phase and Encyclopaedic phase d. Character – definition, its expressions, Analytical and Synthetic characters, Qualitative characters and Quantitative characters e. Morphology of Inflorescence, Flower and Fruits. f. Floral formula and Floral diagram	10
Unit-II	a. Biodiversity – Definitions and types b. Types of biodiversity: Species, genetic, ecological, agricultural diversity;	10

	Biodiversity status in India; endemism and its types, hot spots of biodiversity in India; IUCN categories of threatened species, threats to biodiversity, Climate change and its consequences with examples. c. **Conservation of biodiversity:** Major causes for loss of biodiversity, listing of threatened ecosystems; Conservation measures: - ex-situ: Botanic Garden, Seed bank, Cryobank, Gene bank; in-situ: Establishment, aims and objectives of Wild Life Sanctuaries, National Parks, Mangroves, Reserve forests.	
Unit-III	Study of diversity of following families with reference to the APG IV system of classification. 1. Magnoliaceae 2. Annonaceae 3. Brassicaceae 4. Liliaceae 5. Arecaceae 6. Poaceae	**10**

Suggested Reading:

1. Biodiversity, E.O. Wilson, Academic Press
2. Biodiversity and Conservation, K.V. Krishnamurthy, Oxford University Press
3. Fundamentals of Ecology, Eugene P. Odum and Gary W. Barrett Cengage Learning
4. Plant Taxonomy, O. P. Sharmam, McGraw Hill Education
5. Taxonomy of Vascular Plants – G H M Lawrence, Scientific Publisher Jodhpur
6. Taxonomy of Angiosperms – Naik, V. N. Tata McGraw Hill, New Delhi, 1984
7. Taxonomy of Angiosperm, Umesh P. Mogle, RUT Printer and Publisher, Jalna
8. Plant Systematics Gurcharan Singh CRC Press
9. Taxonomy of Angiosperms, V. Singh, D.K. Jain, P.K. Jain, Rastogi Publications
10. An Introduction to Plant Taxonomy, Charles Jeffrey Cambridge University Press
11. Angiosperm Phylogeny Group Classification (APG IV) Angiosperm Phylogeny Group Published in Botanical Journal of the Linnean Society, 2016
12. A Text Book of Economic Botany – A V S S Samba Murty and N S Subramaniam, Wiley Eastern Limited , 1989
13. Plant Systematics and Evolution Walter S. Judd et al. Sinauer Associates

DSC-17: Cell Biology
Course Code: BOT/DSC/P/326 (Based on DSC15)
Examination Code: SAC03013265P
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30)

Cell Biology (Practical Course)

Course Objectives

1. To develop practical skills in handling laboratory instruments and techniques used in cell biology.
2. To enable students to prepare, observe, and identify different cell structures using microscopic methods.
3. To provide hands-on experience in cell staining, cell division studies, and cytological preparations.
4. To familiarize students with experimental techniques related to cell organelles, membrane transport, and biomolecules.
5. To cultivate scientific observation, data recording, interpretation, and laboratory safety practices in cell biology experiments.

Course outcomes

After successful completion of the practical course, students will be able to:

1. Perform basic cell biology laboratory techniques and operate microscopes effectively.
2. Prepare and identify stages of mitosis and meiosis through temporary and permanent slides.
3. Demonstrate staining techniques and analyze cellular components and organelles accurately.
4. Conduct experiments related to cell permeability, osmotic phenomena, and biomolecular analysis.
5. Interpret experimental results, maintain practical records, and apply laboratory skills in biological research and higher studies.

1	Study of the cell structure from onion leaf or *Tradescantia* leaf
2	Preparation of cytological (AA, FAA etc.) fixatives and stains(acetocarmine, aceto-orcein).
3	Study of electron micrographs of eukaryotic cell and different cell organelles
4	Preparation of slides for the study of mitosis (root tips of onion)
5	Preparation of slides for the study of meiosis (*Rhoeo*, *Aloe* or Onion flower buds)
6	Preparation of ideogram from the given micrograph of karyotype
7	Preparation of wool models of mitosis, meiosis, cell structure,Chromosome, DNA and RNA.

DSC-18: TAXONOMY OF ANGIOSPERMS
Course Code: BOT/DSC/P/327 (Based on DSC16)
Examination Code: SAC03013275P
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30)

Objectives of Practical Course

1. To obtain practical knowledge about the morphology and diversity of the Angiospermic plants.
2. To train students in identification and classification of angiosperms by diagnostic characters.
3. To give practical training in the collection, preservation and preparation of plant specimens for the herbarium.
4. To familiarize students with floral dissection, floral formula, floral diagram and microscopic observations of angiosperms.
5. To develop skills of scientific observation, recording and interpretation related to diversity and taxonomy of angiosperms.

Course Outcomes (Practical)

Students will be able to after successful completion of the practical course:

1. Identify and classify common angiosperm families based on vegetative and floral characteristics.
2. Draw floral formulae and floral diagrams and do floral dissection accurately.
3. Collect, preserve and prepare herbarium specimens using standard methods.
4. Study of morphological differences and modifications in different groups of angiosperms. Practical skills in plant taxonomy, specimen handling and scientific documentation.

Sr No	Title of experiment
I	I. Study of Herbarium Techniques , Preparation and preservation of herbarium specimens
II	II. Preparation and use of indented and bracketed keys.
III	III. Study of vegetative & floral morphology, Floral dissection and preparation of floral formula and floral diagrams of selected following families.
1	Magnoliaceae
2	Annonaceae
3	Brassicaceae
4	Liliaceae
5	Arecaceae
6	Poaceae

NOTE-

- Submission of practical journal, herbarium sheets, and field report are mandatory Observation and identification of local angiosperm diversity during field visits.

DSE-01: Plant Pathology
Course Code: BOT/DSE/T/300
Examination Code: SBC03013005T
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30)

Learning Objective:

- To relate plant pathology with allied disciplines like microbiology and agriculture
- To study life cycles of plant pathogens and host defense responses and biochemical mechanisms, gene-for-gene relationship, mechanisms of pathogen variation and evolution, epidemiological models
- To understand the mechanisms of infection and colonization, genetics of plant resistance, disease development in populations, disease assessment and diagnostic techniques
- To analyse the role of environment and nutrition in disease development to analyze pathogen strategies like toxin production

Learning Outcomes

- Explain types, causes, and symptoms of plant diseases
- Describe pathogen life cycles and infection processes, principles of disease epidemiology and diagnostics
- Understand host-pathogen interactions and defense mechanisms
- Explain genetic basis of resistance and pathogen variability
- Identify plant diseases based on symptoms
- Interpret disease progression and epidemiological data

Unit	Topics	Hours
Unit - I	**Fundamentals of phytopathology** • Introduction, Terminology- Host, Inoculum, Penetration, Infection, incubation, Disease, Symptoms, parasite, saprophytes, endophytes, epidemics, Resistance, • Concept of plant diseases, definitions and terminology of Pathogen, Parasite, Virulence, Susceptibility, Tolerance and Resistance • Introduction of IARI and ICRISAT • Significance of plant diseases • History of plant Pathology in India, Contribution of Anton Debary and E. J. Butler **Disease Development** • Concept of Disease cycle, Inoculation, prepenetration, Penetration, infection, Dissemination, Epidemics-forms, Decline Exponential model, • **Epidemiology, Assessment and Forecasting of plant Diseases:** Rate and Range of Epidemics, Elements of Epidemics, Factors affecting the development of Epidemics (host, pathogen, Environmental Factor) • **Measurement of Plant Disease Intensity:** Percentage scale and assessment keys, pattern of Epidemics, measurement of yield Loss, disease incidence, Disease Severity, Percentage of Disease index (PDI),	10
Unit – II	**Defence mechanism:** Concept and definition, physiology of defence in plants. Types of defence mechanisms a) pre-existing structural Induced cellular and induced biochemical changes **Systemic acquired resistance**: PR proteins, lignin synthesis, peroxidase activity, the oxidative burst (ROS generation); synthesis of defence compounds – Phenolics, Phytoalexins **Effect of pathogens on Physiology of Plants and Host parasite interaction** • Translocation of Water and Nutrients, Transpiration, Photosynthesis, Plant respiration • **Genetics of plant Disease:** Gene disease and variations, Plant Resistance, Genetics of Virulence in pathogen and resistance in host plant, Nature of resistance to disease, Pathogenicity genes in plant pathogens. • **Genetics of resistance:** The gene-for-one gene hypothesis (Flor's Theory) Structure and Function of Plant Resistance 'R' genes, Evolution of R	10

	genes. • **Enzyme in Plant Disease:** Role of cell wall-degrading enzymes, Cutinases, pectinases, Cellulases ligninases and other enzymes. **Microbial Toxins:** Host specific and non-host specific toxins • Growth regulators in plant disease	
Unit - III	**Study of Fungal Plant Diseases:** Introduction, Symptoms, Structure of causal organism and disease cycle of following fungal Diseases – 1) Downy Mildew of Grapes 2) Late Blight of Potato 3) Head Smut of Jowar 4) Anthracnose of Chilly 5) Wilt of Pigeon pea 6) Alternaria Leaf spot of crucifer **Study of Non-Parasitic plant Diseases** Introduction impact and abiotic causes of following Mineral deficiencies, Herbicide injury, Study of tip burn of paddy, Mango necrosis, Black heart of Potato	10

Suggested Reading

- **Agrios GN. 2005.** Plant Pathology. 5th Ed. Academic Press, New York.
- **Heitefuss R & Williams PH. 1976.** Physiological Plant Pathology. Springer Verlag, Berlin, New York.
- **Mehrotra RS & Aggarwal A. 2003.** Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi.
  Singh RS 2017. Introduction to Principles of Plant Pathology. 5th edn. MedTech, New Delhi. 11
- **Singh RP 2012.** Plant Pathology 2nd edn. Kalyani Publishers, New Delhi.
- **Singh DP & Singh A. 2007.** Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi.
- **Upadhyay RK & Mukherjee KG. 1997.** Toxins in Plant Disease Development and Evolving
  Biotechnology. Oxford & IBH, New Delhi.
- **Baudoin ABAM, Hooper GR, Mathre DE & Carroll RB. 1990.** Laboratory Exercises in Plant
  Pathology: An Instructional Kit. Scientific Publ., Jodhpur.\
- **Dhingra OD & Sinclair JB. 1986.** Basic Plant Pathology Methods. CRC Press, London, Tokyo.
  Fox RTV. 1993. Principles of Diagnostic Techniques in Plant Pathology, CABI Wallington.
- **Mathews REF. 1993.** Diagnosis of Plant Virus Diseases. CRC Press, Boca Raton, Tokyo.
- **Pathak VN. 1984.** Laboratory Manual of Plant Pathology. Oxford & IBH, New Delhi
- **Forster D & Taylor SC. 1998.** Plant Virology Protocols: From Virus Isolation to Transgenic
  Resistance. Methods in Molecular Biology. Humana Press, Totowa, New Jersey.
- **Noordam D. 1973.** Identification of Plant Viruses, Methods and Experiments. Cent. Agic. Pub. Doc. Wageningen.
- **Trigiano RN, Windham MT & Windham AS. 2004.** Plant Pathology-Concepts and Laboratory Exercises. CRC Press, Florida.
- **Chakravarti BP. 2005.** Methods of Bacterial Plant Pathology. Agrotech, Udaipur.

DSE-02: Plant Biotechnology
Course Code: BOT/DSE/T/301
Examination Code: SBC03013015T
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30)

Course Objectives

1. To introduce students to the basic concepts, scope, and multidisciplinary applications of biotechnology in agriculture, medicine, and industry.
2. To develop an understanding of DNA structure, replication, recombination, and the molecular basis of heredity.
3. To explain the principles and techniques of recombinant DNA technology, including PCR, DNA fingerprinting, gene mapping, and sequencing.
4. To provide knowledge of genetic engineering methods in plants and the role of biotechnology in crop improvement and sustainable agriculture.
5. To familiarize students with plant tissue culture techniques, genome projects, and current biotechnology research initiatives in India and worldwide.

Learning Outcomes

1. Students will be able to describe the scope of biotechnology and explain its importance in modern biological sciences.
2. Students will be able to interpret the structure and function of DNA and explain the mechanisms of replication and recombination.
3. Students will gain practical understanding of recombinant DNA technology tools and their applications in research and diagnostics.
4. Students will be able to compare different methods of gene transfer and evaluate the achievements of plant biotechnology in agriculture.
5. Students will be able to explain tissue culture methods and analyze the significance of genome projects and biotechnology programs for scientific development.

Unit-I	**Biotechnology:** **Introduction:** a. Definition, scope and multidisciplinary nature b. Biotechnology in India **DNA structure, replication and recombination:** a. Structure of DNA b. Replication of DNA, Role of DNA polymerase c. Denaturation and renaturation of DNA d. Recombination	10
Unit -2	**Recombinant DNA technology**: a. Introduction, principles and procedure b. Enzymes involved in recombinant DNA technology c. Vectors d. Southern and Northern blotting technique e. Techniques in gene mapping f. DNA fingerprinting g. PCR h. DNA sequencing i. Genomics and DNA libraries	**10**
Unit-3	**Genetic engineering and Plant Tissue culture:** a. Introduction to transgenic plants b. Reporter genes c. Indirect methods of gene transfer d. Direct methods for gene transfer in plants d. Role of agriculture in crop biotechnology e. Achievements in plant biotechnology **Plant tissue culture:**	**10**

	a. Principles of tissue culture b. Terminology in tissue culture c. Cellular differentiation and totipotency d. Organogenesis and embryogenesis e. Protoplast isolation and culture f. Suspension culture g. Meristem culture h. Anther culture i. Applications of tissue culture **Research projects:** a. Human genome project b. DBT Ministry of Science and Technology.	

Suggested Readings:

1. **Biotechnology: Expanding Horizons, Author:** B. D. Singh, **Publication:** Kalyani Publishers
2. **Molecular Biology of the Gene, Author:** James D. Watson et al., **Publication:** Pearson / Benjamin Cummings
3. **Molecular Cell Biology, Author:** Harvey Lodish, **Publication:** W.H. Freeman & Company
4. **Recombinant DNA: Genes and Genomes – A Short Course, Author:** James D. Watson **Publication:** W.H. Freeman & Company
5. **Principles of Gene Manipulation and Genomics, Author:** S. B. Primrose and R. M. Twyman, **Publication:** Blackwell Publishing
6. **Plant Tissue Culture: Theory and Practice, Author:** S. S. Bhojwani and M. K. Razdan **Publication:** Elsevier
7. **Introduction to Plant Biotechnology, Author:** H. S. Chawla, **Publication:** Oxford & IBH Publishing
8. **Genetics: A Conceptual Approach, Author:** Benjamin A. Pierce, **Publication:** W.H. Freeman & Company
9. **Biotechnology, Author:** U. Satyanarayana, **Publication:** Books & Allied Pvt. Ltd.
10. **Plant Biotechnology and Molecular Markers, Author:** P. K. Gupta, **Publication:** Springer

DSE-03: BASED ON DSE-1
Course Code: BOT/DSE/P/326
Examination Code: SBC03013005P
Total Contact Hours: 30. Credit 02. Marks 50 (CA=20, ESE 30)

Practical Course Objectives

After completion of practical course, students will be able to:

1. Understand the basic laboratory techniques used in Plant Pathology and handling of plant disease specimens.
2. Identify important plant diseases based on symptoms, signs, and causal organisms.
3. Develop skills in preparation of culture media, staining, microscopic observation, and isolation of plant pathogens.
4. Acquire knowledge of fungal, bacterial, and viral diseases affecting economically important crops.
5. Understand disease management practices and the role of plant protection measures in sustainable agriculture.

Practical Course Outcomes-:After successful completion of practicals, students will be able to:

1. Demonstrate laboratory skills related to isolation, culturing, and identification of plant pathogens.
2. Recognize common symptoms and signs of major plant diseases in field and laboratory conditions.
3. Prepare temporary slides and identify fungal spores and other pathogenic structures under microscope.
4. Analyze disease incidence and recommend suitable disease control and management methods.
5. Apply scientific approaches for diagnosis and management of plant diseases in agricultural crops.

I	1. Study of Fungal Plant Diseases: Introduction, Symptoms, Structural morphology of causal organism of following fungal diseases a) Downy Mildew of Grapes b) Late Blight of Potato c) Head Smut of Jowar d) Anthracnose of Chilly e) Wilt of Pigeon pea f) Alternaria Leaf spot of crucifer 2. Study of Non-Parasitic plant Diseases; Introduction impact and abiotic causes of following- a) Mineral deficiencies b) Herbicide injury c) study of tip burn of paddy d) Mango necrosis e) Black heart of Potato
II	Preparation of slides of fungi (using infected samples), Identification of structures like spores, hyphae, conidia
III	Microscopic study of infection structures (haustoria, appressoria).
IV	Measurement of Disease Intensity, Use of disease rating scales (0–5 or percentage scale)
V	Calculation of disease incidence, severity percent disease incidence of crop field.

VI	Estimation of phenols from infected vs healthy plants
VII	Estimation of Enzyme activity of infected vs healthy plants
VIII	Estimation of non-reducing sugar from infected vs healthy plants
Field Visit and Disease Survey, of crop fields; to identify common plant diseases, Record the environmental conditions and disease occurrence	

Learning Resources

Text Books

1. Introductory Plant Pathology – R.S. Singh, Oxford & IBH Publishing Co.
2. Plant Pathology – G.N. Agrios, Elsevier Academic Press.
3. Essentials of Plant Pathology – V.K. Gupta & others, APS Publications.
4. Fundamentals of Plant Pathology – S.K. Biswas, Kalyani Publishers.
5. Diseases of Crop Plants in India – G. Rangaswami & A. Mahadevan, PHI Learning.

Reference Books

1. Plant Diseases – R.S. Mehrotra, Tata McGraw Hill.
2. Laboratory Manual of Plant Pathology – K.R. Aneja, New Age International Publishers.
3. Experiments in Plant Pathology – O.D. Dhingra & J.B. Sinclair, CRC Press.
4. Plant Pathology Concepts and Laboratory Exercises – CRC Press.

DSE-04: PRACTICAL BASWD ON DSE -2
COURSE CODE: BOP/DSE/P/327
EXAMINATION CODE: SBC03013015T
TOTAL CONTACT HOURS: 30. CREDIT 02. MARKS 50 (CA=20, ESE

Course Objectives (Practicals)

1. To develop practical skills in plant tissue culture and aseptic laboratory techniques.
2. To understand preparation and application of nutrient media used in biotechnology laboratories.
3. To train students in micropropagation, callus culture, and plant regeneration methods.
4. To provide basic knowledge of molecular biotechnology techniques such as DNA isolation and PCR.
5. To familiarize students with applications of plant biotechnology in agriculture, conservation, and industry.

Course Outcomes (Practicals)

After successful completion of the practical course, students will be able to:

1. Perform sterilization, media preparation, and aseptic handling techniques efficiently.
2. Establish and maintain plant tissue cultures under laboratory conditions.
3. Demonstrate skills in callus induction, micropropagation, and plant regeneration.
4. Isolate and analyze plant DNA using basic molecular biology techniques.
5. Understand the role and applications of biotechnology in crop improvement and conservation of plant resources.

1	Principle and working of instruments in biotechnology laboratory - Autoclave / Pressure Cooker, Centrifuge, Hot plate, Water bath, Laminar Air flow, Oven, Microscope, pH Meter, Refrigerator, Magnetic Stirrer, Shaker, Agarose Gel Electrophoresis, etc.
2	Demonstration of sterilization techniques for laboratory glassware.
3	Preparation of sterile culture media :- 1. Nutrient Broth, 2. Potato Dextrose Agar (PDA), 3. Murashige and Skoog (M.S.) Medium, 4. Gamborg's B5 Medium, and 5. White's Medium.
4	Isolation of bacteria and fungi from air samples
5	Demonstration of meristem culture techniques.
6	Demonstration of anther culture techniques.
7	Separation of amino acids using gel electrophoresis.
8	Demonstration of Polymerase Chain Reaction (PCR) technique.

MINOR - 5: SEED TECHNOLOGY

COURSE CODE: BOT/Mn/T/ 300

EXAMINATION CODE:SCC03013005T

TOTAL CONTACT HOURS: 30 ,CREDIT 02 ,MARKS 50 (CA=20, ESE 30)

Learning Objectives

1. Understand the fundamental concepts of seed technology, including seed types, production stages, and their role in modern agriculture.
2. Gain knowledge of seed certification procedures, field inspection methods, and regulatory responsibilities.
3. Develop skills in seed processing, sampling, and storage techniques to maintain seed quality and viability.
4. Learn standard methods of seed testing, including physical purity, moisture, and germination analysis.
5. Analyze basic principles of seed marketing, including cost management, supply-demand dynamics, and institutional frameworks.

Learning Outcomes

After completing this course, students will be able to:

1. Explain seed classes, production systems, and certification processes used in quality seed production.
2. Perform seed processing, sampling, and storage operations using appropriate techniques and equipment.
3. Conduct seed quality tests such as purity, moisture, and germination with proper interpretation of results.
4. Evaluate seed health and quality, and apply measures to maintain standards during storage and handling.
5. Apply principles of seed marketing, including economic analysis and understanding of organizational structures in India.

Module		Hours
I	**Introduction to Seed Technology** • **Concept and Definition:** Definition of seed; role of seed technology in modern agriculture. • **Seed Production:** Detailed study of the stages of Seed Production and multiplication. • **Classes of Seed:** Nucleus seed, Breeder seed, Foundation seed, Certified seed, and Truthful labelled seed. **Seed Certification** • **Certification Basics:** General procedure for seed certification. • **Field Inspection:** Objectives and stages of field inspection. • **Field Count:** Methodologies for conducting a field count to assess off-types, pollen shedders, and diseased plants. • **Regulatory Roles:** The specific duties and responsibilities of a seed inspector.	10
II	**Seed Processing, Sampling, and Storage** • **Seed Processing:** Core concept, underlying principles, and sequential techniques (drying, cleaning, grading, treating). • **Seed Sampling:** Principles of seed sampling, identification of the types of seed samples, and the proper use of sampling equipment. • **Seed Storage:** The need for seed storage, and factors affecting seed storage viability. • **Storage Management:** Methods of protection, conditioning, dehumidification, sanitation, and the strict fumigation of seed stores. Overview of packaging materials.	09

III	**Seed Testing and Quality Control** • **Physical Purity:** Physical purity analysis, precise execution of the ODV (Objective Description of Varieties) test, and standard reporting methods. • **Moisture Testing:** Principles of moisture determination utilizing the Air oven method and modern Moisture meters. • **Germination Testing:** Definition, primary objectives, and scientific principles of germination testing. Execution of standard testing methods including Paper, Sand, and Soil media. **Seed Marketing** • **Market Dynamics:** Basic concepts of seed marketing, analysing supply and demand, and establishing price equilibrium. • **Economics:** Calculating and balancing seed transportation, storage, processing, and packing costs against expected returns. • **Institutional Framework:** The structural organization for seed marketing in India.	11

References

1. Principles of Seed Technology, P. K. Agrawal, Indian Council of Agricultural Research (ICAR), New Delhi
2. Seed Technology, R. L. Agrawal (Ratan Lal Agrawal) Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi Pages: ~685–842 pages
3. Seed Science and Technology Biology Production Quality Editors: Malavika Dadlani & Devendra K. Yadava Springer, Singapore
4. Seed Development OMICS Technologies toward Improvement of Seed Quality and Crop Yield Ganesh K. Agrawal & Randeep Rakwal, Springer Dordrecht
5. Seed Technology, Ratan Lal Agrawal, Oxford & IBH Publishing Company Pvt. Ltd. Pages: ~829 pages
6. Handbook of Seed Testing, P. K. Agrawal, ICAR Practical lab manual for seed testing
7. Principles of Seed Technology – O.P. Agrawal
8. A foundational book covering seed production, processing, and storage in detail.
   Seed Technology – K. Vanangamudi
9. Comprehensive coverage of seed certification, testing, and quality control.
10. Seed Science and Technology – R.N. Basu & M. Dadlani
11. Useful for understanding seed physiology, viability, and storage.
    Advanced / Specialized Books
12. Seed Technology and Its Biological Basis – M. Black & J.D. Bewley
13. Focuses on the biological and physiological aspects of seeds.
14. Handbook of Seed Science and Technology – Amarjit S. Basra
    Detailed reference for advanced concepts and research-level understanding.
15. Seed Processing – E.J. Roberts
16. Covers principles and techniques of seed processing and handling.
17. International Rules for Seed Testing – International Seed Testing Association (ISTA)
18. Standard procedures for seed testing and reporting.
19. Handbook of Seed Testing – P.K. Agrawal
20. Practical guide for laboratory seed testing methods.
21. Indian Standards & Institutional Publications
22. Indian Council of Agricultural Research publications
23. Recommended textbooks and manuals for agricultural courses in India.
24. National Seed Corporation manuals

MINOR-6: ECONOMIC BOTANY

COURSE CODE: BOT/Mn/T/ 301

EXAMINATION CODE: SCC03013015T

TOTAL CONTACT HOURS: 30, CREDIT 02, MARKS 50 (CA=20, ESE 30)

Course Objectives

1. To provide knowledge of the origin, morphology, and classification of major crop groups such as cereals, pulses, oilseeds, fibre, horticultural, ornamental, vegetable, and spice crops.
2. To develop understanding of cultivation practices, production techniques, and harvesting methods for economically important crops like Rice, Wheat, Maize, and Cotton.
3. To create awareness about the uses, economic importance, and role of crop plants in agriculture, industry, and daily life.

Learning Outcomes

1. Students will be able to identify and describe the morphology, origin, and classification of important crops including Banana, Mango, and Tomato.
2. Students will gain the ability to explain cultivation practices, production systems, and harvesting techniques of major field and horticultural crops.
3. Students will be able to evaluate the economic uses and importance of crops such as Soybean, Black pepper, and Cotton in agriculture and industry.

Module No.	Topic	Hours
1	Origin, morphology, production, cultivation practices, harvesting and uses of crop plants: 1. **Cereals**: Maize, Rice, Wheat 2. **Pulses**: Begal gram (Chana), Black gram (Udid), Pigeon pea (Tur). 3. **Oil Seed Crops**: Soybean, Mustard and Castor and Sunflower.	10
2	1. **Fibre Crops**: Jute, Sunhemp and Cotton. 2. **Horticultural crops**: Banana, Orange and Mango. 3. **Ornamental crops:** Rose, Marigold and Orchids. 4.	10
3	1. **Vegetable Crops**: Brinjal, Potato, tomato and Onion. 2. **Condiments and Spices:** Cardamom, Black pepper and Chillies. **3. Tannins and dyes:** *Acacia nilotica* Manufacture of ink and dyes **4. Gums and Resins** **5. Rubber**: Introduction, historical account, Sources, rubber properties, Processing, commercial uses of rubber, Extraction of Rubber	10

Suggested Reading

1. **Economic Botany in the Tropics, Author:** S. L. Kochhar, **Publication:** Macmillan India
2. **Economic Botany, Author:** B. P. Pandey, **Publication:** S. Chand & Company
3. **Introduction to Agronomy, Author:** S. S. Panda, **Publication:** Kalyani Publishers
4. **Principles of Agronomy, Author:** T. Yellamanda Reddy and G. H. Sankara Reddy, **Publication:** Kalyani Publishers
5. **Fundamentals of Horticulture, Author:** J. B. Edmond, **Publication:** McGraw Hill
6. **Horticulture at a Glance, Author:** Amar Singh, **Publication:** Kalyani Publishers
7. **Textbook of Field Crops Production, Author:** Rajendra Prasad, **Publication:** ICAR Publications
8. **Plantation Crops, Author:** K. V. Peter, **Publication:** New India Publishing Agency
9. **Spices, Plantation Crops, Medicinal and Aromatic Plants, Author:** K. P. Prabhakaran Nair, **Publication:** Agrobios (India)
10. **Vegetable Crops, Author:** T. K. Bose and M. G. Som, **Publication:** Naya Prokash

VSC-1: HYDROPONICS

COURSE CODE: BOT/VSC/T/300

EXAMINATION CODE: SEC03013005T

TOTAL CONTACT HOURS: 30 -CREDIT 02, MARKS 50 (CA=20, ESE 30)

Learning Objectives

- Understand the fundamental principles of hydroponics and differentiate it from traditional soil-based cultivation.
- Evaluate the efficiency of hydroponic systems in terms of water, nutrient, and energy use compared to conventional farming.
- Gain practical knowledge of different hydroponic systems and their suitability for various crops.
- Develop skills in preparing and managing nutrient solutions, including monitoring and adjusting pH and EC levels.

Course Outcomes

- Explain and apply the scientific concepts underlying hydroponic plant growth and resource optimization.
- Design, set up, and operate basic hydroponic systems for different crops.
- Prepare and manage nutrient solutions while maintaining optimal growing conditions.
- Monitor plant health and effectively manage environmental factors, pests, and nutrient

Module No.	Topics	Hours
I	**Fundamentals of Hydroponics** Definition, history, and the physiological shift from soil to water-based growth. Specific nutrient uptake mechanisms in aqueous environments; why certain crops (Leafy greens, Berries, Herbs) thrive better. Seed selection, germination in nursery trays, and transplanting into hydroponic systems. **Types of Hydroponic Systems:** Nutrient Film Technique (NFT), Deep Water Culture (DWC), Ebb and Flow System, Wick System, Aeroponics, Drip Irrigation System, Vertical Hydroponics, Aquaponics overview, Pros and cons of each system, Selection criteria based on crops and space.	10
II	**Growing Media and Nutrients:** Introduction to growing media (Cocopeat, Rockwool, Perlite, Vermiculite, etc.), Properties and usage of each media, Nutrient solution composition, Macro and micronutrients for plants, Preparation and storage of nutrient solutions, pH and EC management, Nutrient deficiencies and toxicities, Organic vs. synthetic nutrients, Nutrient dosing and automation, Monitoring tools for nutrients.	10
III	**Environmental Control & System Setup:** Environment Control and Greenhouse structure and design basics, Lighting requirements (natural vs. artificial), Temperature and humidity control, Ventilation systems, Water quality and filtration, Pumps, timers and plumbing essentials, Space optimization and layout planning, Safety and hygiene in system setup, Automation and IoT in hydroponics, Troubleshooting system issues. **Crop Life Cycle & Protection** Identifying pests/diseases; Integrated Pest Management (IPM) focusing on biological and organic control. Harvesting techniques, post-harvest handling, and packaging for market.	10

References

1. **Hydroponic Food Production,** Howard M. Resh,: CRC Press, Boca Raton, USA, 2013 (7th Edition)

2. **Soilless Culture Theory and Practice,** Michael Raviv & J. Heinrich Lieth, Elsevier Academic Press, 2008
3. **Hydroponics A Practical Guide for the Soilless Grower,** Howard M. Resh, CRC Press, 2012
4. **Plant Production in Containers II** Carl E. Whitcomb, Lacebark Publications, 2003
5. **Introduction to Hydroponics,** M. S. Sodhi, Kalyani Publishers, New Delhi, 2017
6. **The Complete Guide to Growing Plants Hydroponically,** J. Benton Jones Jr., CRC Press, 2014
7. **Hydroponics for Beginners,** Tyler Baras, Quarry Books, 2018
8. **Hydroponics The future of food without soil** Compiled and Edited By Dr. Farooq A. Khan, Dr. Sajad A. Bhat, Dr. Imtiyaz Murtaza, , Dr. Shahid A. Padder, Dr. Saima M. Wani and Ms. Fauzia Shafi
9. **Hydroponics for Beginners, Nick Jones,** Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi - 110002 INDIA,

Institutional & Online References

1. Food and Agriculture Organization (FAO)
2. Manuals on soilless cultivation, greenhouse management, and sustainable agriculture.
3. Indian Council of Agricultural Research (ICAR)
4. Publications on protected cultivation, hydroponics, and nutrient management.
5. National Horticulture Board (NHB)
6. Guidelines on greenhouse structures and hydroponic farming in India.

1. हायड्रोपोनिक्स कृषी तंत्रज्ञान, लेखक (Author): संदीप भाऊसाहेब इठापे **प्रकाशक (Publisher):** चेतक बुक्स **वर्ष (Year):** 2019 **भाषा:** मराठी ,**तपशील:** हायड्रोपोनिक्सचे मूलभूत तत्त्वे, प्रणाली (NFT, DWC), पोषक द्रावण, आणि आधुनिक शेती पद्धती यावर आधारित मार्गदर्शक पुस्तक.

2. हायड्रोपोनिक्स (Soilless Gardening), लेखक (Author): बी. एल. जाना **प्रकाशक (Publisher):** Indian Books & Periodicals **वर्ष (Year):** 2019 **भाषा:** (मूळ इंग्रजी, पण मराठी विद्यार्थ्यांसाठी उपयुक्त संदर्भ) **तपशील:** मातीविरहित शेती, विविध प्रणाली, पोषक द्रावण, माध्यमे, आणि ग्रीनहाऊस व्यवस्थापन यांचा सविस्तर अभ्यास.

VSC-2: HORTICULTURE
COURSE CODE: BOT/VSC/T/301
EXAMINATION CODE: SEC03013015T
TOTAL CONTACT HOURS: 30 -CREDIT 02, MARKS 50 (CA=20, ESE 30)

Course Objectives

1. To introduce principles and scope of horticulture
2. To develop knowledge of fruit, vegetable and flower crops
3. To understand nursery management and plant propagation
4. To provide basic skills in post-harvest and crop management

Course Outcomes

After completion, students will be able to:

1. Understand horticultural crop production systems
2. Identify propagation methods and nursery techniques
3. Explain management of fruit, vegetable and ornamental crops
4. Apply basic knowledge in horticulture-based entrepreneurship

Module NO	Syllabus	Hours
I	**Fundamentals of Horticulture** a. Definition, scope and importance of horticulture b. Branches: Pomology, Olericulture, Floriculture, Landscape gardening c. Climatic and soil requirements for horticultural crops d. Plant propagation methods: i. Sexual (seed) ii. Asexual (cutting, layering, grafting, budding) e. Nursery management techniques	10

	f. Growth regulators in horticulture	
II	**Production Technology of Horticultural Crops** A. Fruit Crops a. Mango, Banana, Citrus, Guava b. Climate, soil, varieties, propagation and cultivation practices **B. Vegetable Crops** a. Tomato, Brinjal, Chilli, Onion Seasonal classification and production practices **C. Floriculture** • Rose, Marigold, Jasmine • Cultivation practices and economic importance	**10**
III	Post-Harvest Technology and Horticultural Practices a. Harvesting and maturity indices b. Post-harvest handling and storage c. Processing of fruits and vegetables d. Basics of landscaping and garden design e. Protected cultivation (polyhouse, greenhouse) f. Scope of horticulture in India and entrepreneurship opportunities	**10**

Suggested Reading

1. Rajaneesh Singh & B.K. Singh – *Textbook of Horticulture* – New India Publishing Agency
2. K.L. Chadha – *Handbook of Horticulture* – ICAR
3. S.N. Gupta – *Instant Horticulture* – Jain Brothers
4. P. Muthukumar & R. Selvakumar – *Glaustas Horticulture* – New Vishal
5. A.R. Karale et al. – *Essence of Horticulture* – Jain Brothers
6. N. Kumar – *Introduction to Spices, Plantation Crops* – Oxford
7. Thamburaj & Singh – *Vegetables, Tuber Crops & Spices* – ICAR
8. Ranjit Singh – *Fruits* – ICAR
9. Desh Raj – *Floriculture at a Glance* – Kalyani
10. George Acquaah – *Horticulture: Principles and Practices* – Pearson

REFERENCE BOOKS

1. K.L. Chadha – Handbook of Horticulture – ICAR
2. S.N. Gupta – Instant Horticulture – Jain Brothers
3. P. Muthukumar – Glaustas Horticulture – New Vishal
4. Rajaneesh Singh – Textbook of Horticulture – NIPA
5. N. Kumar – Introduction to Horticulture – Oxford
6. A.R. Karale – Essence of Horticulture – Jain
7. Desh Raj – Floriculture at a Glance – Kalyani
8. Ranjit Singh – Fruit Science – ICAR
9. Thamburaj – Vegetable Crops – ICAR
10. K.V. Peter – Basics of Horticulture – New India
11. K.V. Peter – Horticultural Science – Brillion
12. Jitendra Singh – Basic Horticulture – Kalyani
13. Udal Singh – Postharvest Technology – ICAR
14. Sunil Mehta – Fruit Science – Scientific
15. Vipesh Garg – Mission Horticulture
16. P.S. Gayakwad – Vision Horticulture
17. Satyanarayan Gupta – Question Bank Horticulture
18. Bharat Singh Hada – MCQs in Horticulture

VSC-3: PRACTICALS BASED ON VSC-1

COURSE CODE: BOT/VSC/P/326

EXAMINATION CODE: SEC03013265P

TOTAL CONTACT HOURS: 60 , CREDIT 02, MARKS 50 (CA=20, ESE 30)

Course Objectives (Practical)

1. To introduce students to the principles and importance of hydroponic cultivation systems.
2. To develop practical skills in preparation and maintenance of hydroponic nutrient solutions.
3. To train students in different hydroponic techniques such as wick, NFT, and deep-water culture systems.
4. To study the growth performance and nutrient requirements of plants under hydroponic conditions.
5. To familiarize students with monitoring environmental factors affecting hydroponic crop production.

Course Outcomes (Practical)

After successful completion of the practical course, students will be able to:

1. Understand the basic principles and applications of hydroponic farming systems.
2. Prepare and manage nutrient solutions required for hydroponic crop cultivation.
3. Construct and operate simple hydroponic systems independently.
4. Analyze plant growth and identify nutrient deficiency symptoms under controlled conditions.
5. Apply hydroponic techniques for sustainable and soil-less cultivation practices.

No.	Title of the Experiment
	Introduction to Hydroponic Systems
1	Demonstration of Nutrient Film Technique (NFT) System
	Demonstration of Deep Water Culture (DWC) System
2	Study of Wick Hydroponic System
3	Comparative Analysis of Different Hydroponic Systems
4	Comparative Study of Hydroponic Growing Media
5	Preparation of Hydroponic Nutrient Solution
6	Measurement and Adjustment of pH in Nutrient Solution
7	Identification of Nutrient Deficiency Symptoms in Hydroponic Plants
8	Design and Construction of a Mini Greenhouse
9	Measurement of Light Intensity for Plant Growth
10	Installation and Maintenance of Hydroponic Setup
11	Analysis of Water Quality Parameters for Hydroponics
12	Seed Germination in Growing Media
13	Transplanting Techniques in Hydroponics

VSC-4: PRACTICALS BASED ON VSC-2

COURSE CODE: BOT/VSC/P/327

EXAMINATION CODE: SEC03013275P

TOTAL CONTACT HOURS: 60 , CREDIT 02, MARKS 50 (CA=20, ESE 30)

Practical Course Objectives

After completion of the practical course, students will be able to:

1. Understand the principles and practices of horticultural crop cultivation.
2. Develop skills in nursery management, propagation, and plant production techniques.
3. Identify important fruit, vegetable, ornamental, and medicinal plants used in horticulture.
4. Perform practical operations related to soil preparation, irrigation, pruning, and plant protection.
5. Acquire knowledge of post-harvest handling, preservation, and marketing of horticultural produce.

Practical Course Outcomes

After successful completion of the practical course, students will be able to:

1. Demonstrate various methods of plant propagation such as cutting, grafting, layering, and budding.
2. Prepare nursery beds, pot mixtures, compost, and maintain horticultural plants scientifically.
3. Identify major horticultural crops and diagnose common pests and diseases affecting them.
4. Apply modern horticultural techniques for cultivation, harvesting, and post-harvest management.
5. Develop entrepreneurial skills related to nursery raising, floriculture, kitchen gardening, and horticultural production.

No.	Title of the Experiment
1	Study of tools and implements used in horticulture
2	Identification of horticultural crops (fruits, vegetables, flowers)
3	Soil sampling and testing (pH, texture)
4	Preparation of nursery beds
5	Preparation and use of plant growth regulators
6	Visit to nursery and report writing
7	Planting methods and spacing
8	Training and pruning techniques
9	Seasonal classification of vegetables
10	Transplantation techniques
11	Field visit to vegetable farm
12	Flower arrangement techniques
13	Layout design of garden (practical drawing)
14	Visit to greenhouse/polyhouse
15	Preparation of project report

Course Name: Field Project
Course Code: SUB/CC/P/0226
COURSE CODE: BOT/OJT/P/327

EXAMINATION CODE: SJC03013265P

TOTAL CONTACT HOURS: 60 , CREDIT 02, MARKS 50 (CA=20, ESE 30)

Course Objectives

1. To develop field-based scientific observation skills among students for studying plant diversity and ecological systems.
2. To train students in systematic data collection, documentation, and interpretation of botanical field information.
3. To familiarize students with techniques of plant identification, herbarium preparation, and ecological sampling methods.
4. To enhance understanding of plant-environment interactions through real-time field exposure.
5. To build research aptitude, teamwork, and scientific reporting skills in students through independent or group field projects.

Course Outcomes

After completion of the Field Project, students will be able to:

1. Conduct systematic field surveys and record plant diversity using appropriate scientific methods.
2. Identify and classify plant species using floras, keys, and standard taxonomic tools.
3. Collect, preserve, and prepare herbarium specimens following standard botanical procedures.
4. Analyze ecological data and interpret plant-environment relationships in selected habitats.
5. Prepare a structured field report and present scientific findings effectively using oral and written communication skills.

Evaluation
1) The students shall submit project report of their Field Project at the end of the course individually or in group.
2) Students shall be assessed by the departments at departmental level on the basis of project reports and/or level and skill of engagement by each student. The departments shall submit marks to the Examination Centre. The evaluation structure will be as below:

No.	Parameters	Marks Distribution
1	Problem finding	05
2	Data collection	05
3	implementing solutions to actual 3 problems	20
4	Quality and effectiveness presentation	10
5	Field Project Report Submission	10
	Total	50

Report Format:
The Field Project Report must be:

- **Typed on A4 size, Times New Roman, font size 12, 1.5 spacing.**
- **Minimum 20 pages.**
- **Spiral bound**

Structure of the Project

1. Title Page (Report title, student name, roll no., program, guide name, submission month)
2. Certificate (Institute & Mentor)
3. Student's Declaration
4. Acknowledgement
5. Abstract (200–300 words)

Chapters:

1. Introduction (objectives, background, scope)
2. Literature Review
3. Materials and Methods

4. Results and Discussion: Field Work Observations & Analysis (with photos/diagrams if needed)
5. Conclusion & Recommendations
9. References (APA/MLA format) 1
0. Appendices (interviews, data, documents etc.)
    1) Introduction
    2) Review of Literature
    3) Materials and Methods
    4) Results and Discussion
       Table, graph, images etc
    5) References

The following are some suggested field project topics (not Compulsory). You can select any topic based on your interest.

Plant Pathology

1. Survey and Identification of Common Fungal Diseases in Crop Plants
2. Study of Leaf Spot Diseases in Local Garden Plants
3. Isolation and Identification of Soil-Borne Plant Pathogens
4. Assessment of Disease Incidence in Vegetable Crops
5. Study of Powdery Mildew Infection in Angiosperms
6. Role of Environmental Factors in Plant Disease Development
7. Comparative Study of Healthy and Diseased Plant Tissues
8. Survey of Post-Harvest Diseases in Fruits
9. Identification of Bacterial Plant Diseases in Field Crops
10. Study of Plant Disease Management Practices in Local Farms

Taxonomy of Angiosperms

1. Taxonomic Study of Common Angiosperms in Local Area
2. Morphological Characterization of Flowering Plants
3. Preparation of Herbarium of Angiospermic Plants
4. Study of Floral Diversity in Urban Gardens
5. Comparative Study of Monocot and Dicot Plants
6. Identification of Medicinal Angiosperms in Local Region
7. Study of Plant Classification Systems (Bentham & Hooker)
8. Documentation of Weed Flora in Agricultural Fields
9. Study of Endemic Angiospermic Species in Region
10. Taxonomic Study of Ornamental Plants

Cell Biology and Genetics

1. Study of Mitosis in Root Tip Cells
2. Observation of Meiosis in Flower Buds
3. Karyotype Analysis of Selected Plant Species
4. Study of Chromosomal Aberrations in Plants
5. DNA Extraction from Plant Materials
6. Study of Genetic Variation in Crop Plants

7. Observation of Cell Organelles Using Microscopy
8. Study of Mendelian Traits in Plants
9. Effect of Mutagens on Seed Germination
10. Study of Cell Division Stages in Onion Root Tips

Biotechnology

1. Plant Tissue Culture Techniques and Applications
2. Micropropagation of Medicinal Plants
3. Callus Culture Development in Plants
4. Study of GM Crops and Their Impact
5. Isolation of Plant DNA and Gel Electrophoresis
6. Production of Biofertilizers Using Microorganisms
7. Study of Plant Growth Regulators in Tissue Culture
8. Application of Biotechnology in Crop Improvement
9. Study of Fermentation Techniques in Biotechnology
10. In Vitro Propagation of Ornamental Plants

Algae

1. Study of Freshwater Algal Diversity
2. Identification of Algae from Local Water Bodies
3. Role of Algae in Aquatic Ecosystems
4. Study of Algal Blooms and Their Impact
5. Morphological Study of Green Algae
6. Collection and Preservation of Algal Samples
7. Economic Importance of Algae
8. Comparative Study of Blue-Green and Green Algae
9. Study of Algae as Biofertilizers
10. Seasonal Variation in Algal Population

Bryophytes

1. Study of Bryophyte Diversity in Moist Habitats
2. Morphological Study of Mosses and Liverworts
3. Life Cycle Study of Bryophytes
4. Ecological Role of Bryophytes
5. Collection and Identification of Bryophytes
6. Comparative Study of Liverworts and Mosses
7. Bryophytes as Pioneer Species

Economic Botany

1. Study of Medicinal Plants and Their Uses
2. Documentation of Ethnobotanical Knowledge in Local Area
3. Study of Crop Plants and Their Economic Importance
4. Survey of Timber-Yielding Plants
5. Study of Fiber-Producing Plants
6. Documentation of Spices and Condiments Plants
7. Role of Plants in Traditional Medicine
8. Study of Oil-Yielding Plants
9. Survey of Ornamental Plants in Nurseries
10. Economic Importance of Weeds

B. SC. III YEAR, SEMESTER – VI

DSC-19: GENETICS

COURSE CODE: BOT/DSC/T/350

EXAMINATION CODE: SAC03013506T

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Program Objectives (Theory)

1. To develop understanding of the fundamental principles and concepts of Genetics and heredity in living organisms.
2. To explain the structure, function, transmission, and expression of genes and chromosomes.
3. To acquaint students with Mendelian and non-Mendelian inheritance patterns and their applications in biology.
4. To provide knowledge about genetic variations, mutations, linkage, crossing over, and chromosomal abnormalities.
5. To develop analytical and problem-solving skills related to genetic mechanisms, human genetics, molecular genetics, and evolutionary genetics.

Practicals Course Outcomes (Genetics Practical)

After successful completion of the practical course, students will be able to:

1. Perform and interpret experiments related to Mendelian inheritance and genetic ratios.
2. Identify different stages of cell division and chromosomal behavior through microscopic observations.
3. Analyze genetic data using pedigree analysis, probability, and statistical methods.
4. Demonstrate laboratory skills in preparation, observation, and interpretation of genetic experiments and models.
5. Apply principles of genetics in fields such as plant breeding, biotechnology, medicine, and evolution studies.

Module No.		Hours
I	**1. Mendelism:** i. Introduction -G.J. Mendel ii. Mendelian principles –Law of Dominance , law of segregation, law of independent assortment, back cross and test cross **2. Interaction of genes:** i. Allelic interaction: incomplete dominance, co dominance, lethal genes ii. and blood group inheritance iii. Non allelic and non epistatic -comb shapes in fowls iv. Non allelic and epistatic: a. Complementary genes or duplicate recessive epistasis (9:7) b. Supplementary genes or recessive epistasis (9:3:4) c. Dominant epistatic genes or dominant epistasis (12:3:1) d. Duplicate genes or duplicate dominant epistasis (15:1)	11

II	**1. Sex determination:** i. Chromosomal theory of sex determination ii. Mechanism of sex determination in man (xx -xy), Drosophila (xx and xy), birds (zz-zw), grasshopper (xx-xo) and genic balance theory in Drosophila *iii.* Sex determination in plants – *Melandrium* **2. Sex linked inheritance: X, XY and Y linked inheritance:** i. Colourblindness and hemophilia in man ii. Holandric genes iii. White eye colour in Drosophila, iv. Gynandromorphs, **3. Linkage:** i. History & concepts ii. Complete linkage and complete linkage, Bridges experiments iii. Linkage maps based on two or three factors iv. Crossing over concept and significance	**10**
III	**1. Structure and function of gene:** i. Fine structure of gene (Seymour Benzer) ii. One gene one enzyme hypothesis iii. Genes and related diseases – phenylketonuria, and alkaptonuria iv. Detection of genetic diseases –amniocentesis, Genetic counseling **Quantitative inheritance** i. Multiple factor hypothesis ii. Character of multiple genes iii. Example of Quantitative inheritance; kernel colour in wheat, comb length in maize iv. Significance of Quantitative inheritance	**09**

Suggested Readings:

1. Genetics: A Molecular Approach, 3rd Edition by Peter j Russell, Pearson India, 2016.
2. Genetics , Gupta P K, , 5th Edition, Rastogi Publications. 2022.
3. Genetics, 9th Edition, Verma P.S. and Agarwal V.K, S.Chand and co. New Delhi.
4. Genetics, Principles and Analysis, Daniel L. Hartl , Elizabeth Jones, Jones and Bartlett Publishers1998.
5. Genetics Analysis and Principles, Robert J. Brooker, Mac Graw Hill Publishers, 2017
6. Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. Verma P.S and Agarwal V.K. (2006) S.Chand and Company, New Delhi.
7. Cytogenetics, Evolution & Biostatistics. Shukla R.S. & Chandel P.S.,S.Chand Publications.
8. Genetics. Sarin C 2004 (6^{th} Edition) TATA McGraw-Hill Publishing Company Ltd., New Delhi.
9. Genetics. Pawar C.B 2003 (First Edition). Vol. I and II. Himalaya Publishing House, Mumbai.
10. Genetics. Strickberger 2005. (3^{rd} Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.

DSC-20: PLANT DISEASE MANAGEMENT
COURSE CODE: BOT/DSC/T/351

EXAMINATION CODE: SAC03013516T

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30

Course Objectives

1. To introduce students to the fundamentals of microbiology, including the definition, scope, classification, and importance of microorganisms in various fields.
2. To develop practical understanding of microbial techniques such as microscopy, micrometry, staining, sterilization, and preparation of culture media.
3. To provide knowledge of industrial applications of microorganisms and various plant disease management practices including preventive and control measures.
4. To create awareness about modern techniques in plant pathology, safe use of pesticides, environmental impacts, and the role of biological control and plant quarantine.

Course Outcomes

1. Students will be able to explain the basic concepts of microbiology and classify microorganisms with their significance.
2. Students will acquire skills in handling microscopes, staining techniques, sterilization methods, and preparation of different culture media.
3. Students will be able to apply knowledge of disease management practices, including chemical, biological, and cultural control methods.
4. Students will understand recent advances in plant pathology such as GMOs, PCR, and integrated pest management, along with awareness of environmental safety and pesticide handling.

I	**Microbiology** Defination,scope ,importance and classification of Microorganisms **Microbial techniques:** 1. Microscopy – simple, compound and electron microscope 2. Micrometry – Principle, ocular and stage micrometer working and uses 3. Common stains used in pathology, with special reference to cotton blue and Gram's Stain 4. Sterilization of glass wares and different culture media(PDA,MRB,CZA,NA) **Industrial application of microorganisms** - organic acids (Citric acid or glutamic acid), alcohol(ethanol), antibiotics (penicillin) milk products, and biopesticide	**10**
II	**Disease management**: **Preventive methods:** field sanitation, use of clean planting material, crop rotation, trap crops, time of sowing, planting distance and tillage **Control methods –** a. Seed treatment: concept, objective, traditional and modern methods of seed treatment (02) b. Soil sterilization: concept, objectives and methods c. Fungicides: Definition, classification and general accounts of application and uses (06) i. Sulphur fungicides – Inorganic – Wettablesulphur, Organic – Ziram ii. Copperoxychloride iii. Mercuric chloride – Agrosan – GN iv. Heterocyclic nitrogenous compounds – Iprodine v. Benzene compounds – Dexon vi. Antibiotics – Streptomycin and Aureofungin vii. Systemic – Benomyl and propiconazole	**10**
III	d. Pesticides:Nicotin,Neem and pyrethrum e. Rhodenticides – Zinc phosphoid f. Nematicides- Nemagon, Propoxar g. Weedicides- 2,4-D	**10**

	h. Biological control with special reference to *Trichoderma&Rhizobium* i. Plant quarantine: definition, importance & principle **Control measures and environment:** pollution due to chemicals, residual effects, toxicity, safe measures, colour code, antidote, symptoms of poisoning, precautions in using pesticides **Pesticide application equipment's:** principle and working –pneumatic air pump, knapsack sprayer, mist blower and duster, types of nozzles **Plant disease clinic:** Concept, objective and need **Recent techniques in plant pathology:** Genetically modified organisms (GMO's), B.T.Cotton, Pheromones,PCR protocol	

Suggested Reading

1. Prescott's Microbiology – Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton; McGraw-Hill Education.
2. Microbiology – Michael J. Pelczar Jr., E.C.S. Chan; Tata McGraw-Hill.
3. An Introduction to Plant Pathology – George N. Agrios; Academic Press.
4. Plant Pathology – R.S. Mehrotra, A. Aggarwal; Tata McGraw-Hill.
5. Introductory Mycology – C.J. Alexopoulos; Wiley India.
6. Plant Diseases – R.S. Singh; Oxford & IBH Publishing.
7. Microbial Biotechnology – Alexander N. Glazer, Hiroshi Nikaido; Cambridge University Press.
8. Agricultural Microbiology – G. Rangaswami, D.J. Bagyaraj; PHI Learning.
9. Principles of Plant Pathology – J.G. Manners; Cambridge University Press.
10. Plant Pathology and Plant Pathogens – John F. Brown; Springer.

DSC-21: BASED ON DSC_19 (Genetics)
COURSE CODE: BOT/DSC/P/376

EXAMINATION CODE: SAC0301376P

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Practical Program Objectives– Genetics Practical

1. To develop practical skills in handling genetic materials, laboratory instruments, and experimental procedures used in Genetics.
2. To enable students to understand the principles of heredity, Mendelian genetics, and chromosomal behavior through experiments and observations.
3. To train students in cytological techniques such as preparation and study of chromosomes, cell division, and genetic abnormalities.
4. To provide hands-on experience in solving genetic problems, pedigree analysis, and interpretation of inheritance patterns.
5. To encourage scientific thinking, data analysis, report writing, and interpretation of experimental results in Genetics.

Practical Course Outcomes – Genetics Practical

After successful completion of the practical course, students will be able to:

1. Perform basic genetic experiments and use laboratory techniques related to Genetics efficiently and safely.
2. Analyze Mendelian and non-Mendelian inheritance patterns using practical observations and genetic crosses.
3. Prepare and identify stages of mitosis and meiosis and explain chromosomal behavior during cell division.
4. Solve genetic problems, construct pedigrees, and interpret inheritance of genetic traits and disorders.
5. Record, analyze, and present experimental data scientifically with proper interpretation and conclusions.

Module No.	Practicals
1	Quizzes on various related aspects
2	Study of Mendelian inheritance using seed/coin or bead models
3	Monohybrid cross problems and verification of Mendel's laws
4	Dihybrid cross problems and calculation of phenotypic ratios
	Study of incomplete dominance and codominance (e.g., flower color or ABO blood group model)
5	Sex-linked inheritance problems (e.g., colour blindness, haemophilia)

DSC-22: Plant Biotechnology, BASED ON DSC_20
COURSE CODE: BOT/DSC/P/377

EXAMINATION CODE: SAC03013776P

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Practical Program Objectives of Plant Biotechnology (B.Sc. III Year)

1. To develop practical skills in basic plant biotechnology techniques such as aseptic handling, media preparation, and plant tissue culture.
2. To provide hands-on training in the use of laboratory instruments and biotechnological tools used in plant science research.
3. To enable students to understand and perform methods related to micropropagation, callus culture, and organ culture.
4. To acquaint students with molecular and biochemical techniques used in plant biotechnology and genetic improvement.
5. To enhance scientific thinking, laboratory safety awareness, data recording, and interpretation skills in biotechnology experiments.

Practical Course Outcomes of Plant Biotechnology

After successful completion of the practical course, students will be able to:

1. Prepare culture media and maintain aseptic conditions for plant tissue culture experiments.
2. Perform basic plant biotechnology techniques such as callus induction, micropropagation, and organ culture.
3. Handle and operate common biotechnology laboratory instruments safely and effectively.
4. Analyze and interpret experimental observations related to plant biotechnology applications.
5. Apply practical knowledge of plant biotechnology in agriculture, plant improvement, conservation, and research activities.

1	Study of fungicides as per theory syllabus
2	Preparation of Bordeaux mixture, burgundy mixture and Bordeaux paste
3	Study of insecticides with respect to active ingredient, colour code, formulation, mode of action, antidote and uses
4	Study of *Trichoderma* culture
5	Study of plant protection equipments –pneumatic air pump, knapsack sprayer, mist blower cum duster
6	Principle and working of autoclave, laminar air flow, Tilak air sampler
7	Use of aerobiological techniques to study fungal spora (gravity slide method, Tilak air sampler)
8	Calibration of microscope and measurement of fungal spores
9	Sketching of fungal spore by camera Lucida technique
10	Detection of organic acids from healthy and infected leaves by circular paper chromatography
11	Detection of Amino acids from healthy and infected leaves by circular paper chromatography

12	Study of pathogens in fruits from local market
13	Study of fungi from locally available seed samples
14	Preparation of sterile media - nutrient agar, potato dextrose agar
15	Preparation of stains and mounting media - cotton blue, lacto phenol

DSC-23: Indian Knowledge System BASED ON DSC_20
COURSE CODE: BOT/DSC/T/352

AYURVED FOR PLANTS

EXAMINATION CODE: SAC03013526T

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Course Objectives:

1. To introduce students to the rich heritage of the Indian Knowledge System (IKS) specifically related to plant sciences and agriculture.
2. To explore the scientific foundations of ancient Indian botanical texts, such as *Vrikshayurveda* and *Krishi-Parashara*.
3. To bridge the gap between traditional Indian botanical wisdom and modern scientific botany.
4. To understand traditional conservation strategies and the ethnobotanical heritage of indigenous communities, particularly in Maharashtra.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Identify and appreciate the foundational texts and concepts of ancient Indian plant sciences.
- Correlate traditional agricultural and plant protection practices (e.g., seed treatment, soil management) with modern botanical principles.
- Analyze the significance of traditional conservation methods, such as Sacred Groves (*Devrais*), in modern biodiversity conservation.
- Recognize the medicinal and economic value of plants as described in Ayurveda and local ethnobotanical practices.

Module	Syllabus	Hours
Unit - I	**Introduction to IKS and Ancient Plant Sciences** • Definition of IKS, scope, and sources (*Vedas, Puranas, Samhitas*) with specific reference to natural and biological sciences. • **Ancient Indian Conservation:** ***In-situ***-Concept and ecological significance of Sacred Groves (*Devrais* in Maharashtra). ***Ex-situ-*** Traditional layouts of *Panchavati*, *Nakshatra Vana*, and *Navagraha Vana* and their role in modern urban forestry. • **Krishi-Shastra (Agriculture):** Introduction to *Krishi-Parashara*; Traditional meteorological beliefs for monsoon prediction; Ancient water management and mixed cropping systems; *Bijaposhana* (Seed preservation and treatment). • **Vrikshayurveda (Science of Plant Life):** Ancient botanical nomenclature; Diseases of Plants and their treatment mentioned in Vrikshayurved.	10
Unit-II	**Medicinal Plants, Aromatics, and AYUSH** Introduction to the basic principles of plant-based healing in Ayurveda, Siddha, and Unani (AYUSH). **Local Medicinal Flora:** Botanical identification, traditional IKS uses, and modern pharmacological correlations of: • *Azadirachta indica* (Neem) • *Ocimum tenuiflorum* (Tulsi) • *Withania somnifera* (Ashwagandha) • *Justicia adhatoda* (Adulsa) • *Aegle marmelos* (Bael) • *Terminalia bellirica (Beheda)*	10

	• Terminalia chebula (Hirda) • Phyllanthus emblica (Amla) **Aromatic Plants:** Economic, cultural, and therapeutic uses of Sandalwood, Lemon grass, and Mint.	
Unit-III	**Ethnobotany & Global Conservation Strategies:** • Concept and scope of ethnobotany within the Indian Knowledge System. • Role of indigenous communities in the preservation of traditional crops, food plants, and forest resources. • Knowledge of wild edible plants used during scarcities, with special reference to the flora of the Marathwada region. • Conservation of Plant Wealth: Major threats to Indian flora (Habitat loss, over-exploitation). Overview of conservation strategies: *In-situ* Conservation (Wild Life Sanctuaries, National Parks, Biospherec Reserves,) and *Ex-situ* Conservation (Botanical gardens, seed banks).	**10**

Suggested Readings

1. Kochhar, S.L. – *Economic Botany in the Tropics* (Macmillan Publishers India).
2. Pandey, B.P. – *Economic Botany* (S. Chand & Company).
3. Wickens, G.E. – *Economic Botany: Principles and Practices* (Springer).
4. Jain, S.K. – *Manual of Ethnobotany* (Scientific Publishers, India).
5. Sadhale, N. (Tr.): Surapala's Vrikshayurveda (The Science of Plant Life by Surapala). Asian Agri-History Foundation.
6. Sadhale, N. (Tr.): Krishi-Parashara (Agriculture by Parashara). Asian Agri-History Foundation.
7. Jain, S.K.: Manual of Ethnobotany. Scientific Publishers, India.
8. Naik, V.N.: Flora of Marathwada. Amrut Prakashan, Aurangabad.
9. Govt. of India: The Ayurvedic Pharmacopoeia of India. Ministry of AYUSH.
10. Sivaramakrishnan, K. (Ed.): Indian Knowledge Systems (Vol I & II).
11. Gadgil, M. & Vartak, V. D.: Sacred Groves of India.

DSE-01- DIVERSITY OF ANGIOSPERMS
COURSE CODE: BOT/DSE/T/350

EXAMINATION CODE: SBC03013506T

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Course Objectives

1. To develop understanding of plant identification methods using keys, herbaria, and botanical gardens.
2. To explain the origin and evolution of angiosperms with reference to major theories and fossil groups.
3. To familiarize students with principles of binomial nomenclature and the Shenzhen Code (2018).
4. To introduce modern trends in taxonomy including cytotaxonomy, chemotaxonomy, molecular systematics, and APG IV classification with study of selected plant families.

Course Outcomes

1. Students will be able to identify plants using taxonomic tools like keys, herbarium techniques, and botanical garden resources.
2. Students will understand evolutionary relationships and origin theories of angiosperms.
3. Students will apply rules of binomial nomenclature according to the Shenzhen Code (2018) correctly.
4. Students will classify plants using APG IV system and describe diagnostic features of important families such as Lythraceae, Rutaceae, Asteraceae, Cucurbitaceae, and Liliaceae.

Module No.	Syllabus	Hours
Unit-I	a. Plant identification: Preparation and use of keys, b. Origin of angiosperms: place and time of origin, probable ancestors: Pteridospermales- Angiosperms, Bennettitalean, Caytonialean and Gnetales-Angiosperms theory. Hutchinson's principles of angiosperms origin. c. Binomial nomenclature: Principles and rules, Shenzhen code 2018, Citation of Authority d. Modern trends in taxonomy: Cytotaxonomy, Chemotaxonomy, and Molecular systematics and Phylogeny e. Biosystematics and its categories.	10
Unit-II	a. Taxonomy: APG IV system of classification of plants b. Study of diversity of families as per APG IV system: 1. Nymphaeaceae 2. Lauraceae 3. Commelinaceae 4. Musaceae 5. Zingiberaceae	10

Unit-III	**Study of diversity of families as per APG IV system:** 1. Fabaceae 2. Rosaceae 3. Cucurbitaceae 4. Myrtaceae 5. Malvaceae 6. Lamiaceae 7. Asteraceae	10

Suggested Reading

1. Plant Systematics – Michael G. Simpson
   A comprehensive and modern textbook covering principles of plant taxonomy, phylogeny, and APG classification.
2. Plant Taxonomy – V. N. Naik
   Useful for Indian students; includes practical aspects, nomenclature, and plant identification.
3. An Introduction to Plant Taxonomy – C. Jeffrey
   Covers classical and modern approaches to taxonomy and classification.
4. Taxonomy of Angiosperms – P. C. Vashishta
   Detailed description of angiosperm families and traditional classification systems.
5. Plant Systematics: A Phylogenetic Approach – Walter S. Judd
   Focuses on molecular systematics and APG-based phylogeny.
6. Introduction to Angiosperms – B. P. Pandey
   Covers origin, evolution, and classification of angiosperms in a simple manner.
7. Botany for Degree Students: Angiosperms – B. P. Pandey
   Standard undergraduate textbook with clear explanations of plant families.
8. Plant Taxonomy and Biosystematics – Clive A. Stace
   Important reference for cytotaxonomy, chemotaxonomy, and biosystematics.
9. International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code 2018) – International Botanical Congress
   Official rules for plant naming and nomenclature.
10. Flora of British India – J. D. Hooker
    Classic reference for plant identification and taxonomy in the Indian region.

DSE-01-PLANT BREEDING
COURSE CODE: BOT/DSE/T/350

EXAMINATION CODE: SBC03013516T

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Course Objectives:

1. To introduce the principles and methods of Plant Breeding.
2. To understand genetic variation and inheritance in crops.
3. To develop skills in crop improvement techniques (Selection, Hybridization, etc.).
4. To familiarize students with modern tools in breeding.
5. To address challenges like yield improvement, disease resistance, and climate adaptability.

Course Outcomes:

After completing the course, students will be able to:

1. Explain basic concepts and methods used in plant breeding.
2. Apply breeding techniques to develop improved crop varieties.
3. Analyze genetic variability and select superior plants.
4. Integrate conventional and modern breeding approaches.
5. Solve practical agricultural problems related to crop improvement.

Module No.	Syllabus	Hours
Unit-I	Introduction & History: Aims and objectives of plant breeding. Patterns of Evolution in Crop Plants: Centre of Origin, Agro-biodiversity and its significance. Domestication: Plant introduction and acclimatization processes. Genetic basis of breeding: Self and Cross pollinated crops including mating systems and response to selection.	10
Unit-II	Hybridization: History, procedure, and specific applications in: Self-pollinated crops (e.g., Brinjal, Chilly, Tomato). Cross-pollinated plants (e.g., Onion, Gourds, Melons, Pumpkins). Specific programs for Chilly and Cotton.	10
Unit-III	Selection Methods: Mass selection and pure-line selection with examples. Modern Techniques: Marker-assisted selection and diploid technique (DH). Speed breeding, CRISPR technique, and the use of IoT and AI. Experimental Designs: Biometrical techniques including RBD, Latin square design, and variance assessment.	10

Suggested Reading

Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.

Chahal GS and Gossal, SS. 2002. Principles and Procedures of Plant Breeding Biotechnological and Conventional approaches. Narosa Publishing House.

Chopra VL. 2004. Plant Breeding. Oxford & IBH.

George A. 2012. Principles of Plant Genetics and Breeding. John Wiley & Sons.

Gupta SK. 2005. Practical Plant Breeding. Agribios.

Jain HK and Kharakwal MC. 2004. Plant Breeding and–Mendelian to Molecular Approach, Narosa Publications, New Delhi

Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ. House. Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.

Sharma JP. 2010. Principles of Vegetable Breeding. Kalyani Publ, New Delhi.

Simmonds NW.1990. Principles of Crop Improvement. English Language Book Society.

Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.

Singh S and Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS.

DSE-01- DIVERSITY OF ANGIOSPERMS COURSE CODE: BOT/DSE/T/350 EXAMINATION CODE: SBC03013766P TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)	
	I. Study of following families with suitable examples available in your area
1	Nymphaeaceae
2	Lauraceae
3	Commelinaceae
4	Musaceae
5	Zingiberaceae
6	Rosaceae
7	Fabaceae
8	Cucurbitaceae
9	Myrtaceae
10	Malvaceae
11	Lamiaceae
12	Asteraceae
	II. Identification of plants up to species level by using flora (Flora of Bombay Presidency/Flora of Marathwada/ Flora of Maharashtra/ keys)

DSE-01- PLANT BREEDING
COURSE CODE: BOT/DSE/T/350

EXAMINATION CODE: SBC03013766P

TOTAL CONTACT HOURS: 30, CREDIT 02,MARKS 50 (CA=20, ESE 30)

Practical Program Objectives

1. To develop practical skills in plant breeding techniques such as emasculation, hybridization, and controlled pollination in crop plants.
2. To train students in identifying floral structures and breeding behavior of self-pollinated and cross-pollinated crops.
3. To provide hands-on experience in selection methods, maintenance of breeding records, and handling of breeding materials.
4. To enable students to understand the application of genetic principles, heterosis, mutation, and polyploidy in crop improvement programs.
5. To enhance analytical and observational skills for evaluating plant variability, breeding performance, and crop improvement strategies.

Practical Course Outcomes

After successful completion of the practical course, students will be able to:

1. Perform emasculation, artificial hybridization, and pollination techniques in important crop plants.
2. Distinguish between self-pollinated, cross-pollinated, and vegetatively propagated crops based on floral biology and breeding methods.
3. Apply different plant breeding methods such as mass selection, pedigree selection, and hybrid breeding for crop improvement.
4. Analyze breeding data and evaluate genetic variation, heritability, and breeding performance in crop plants.
5. Demonstrate competency in maintaining practical records, interpreting breeding experiments, and understanding the role of plant breeding in sustainable agriculture and food security.

1	Selfing and crossing techniques.
2	Selection methods in segregating populations and evaluation of breeding material
3	Floral biology in self and cross pollinated species. (Chilly and Cotton)
4	Artificial Emasculation in Chilli and Cotton
5	Demonstration of Hybridization technique in Chilli and Cotton
6	Floral Biology of Onion
7	Maintenance of Experimental records.
8	Visit to seed production plots of Chilli and other crops

MINOR - 8: SEED INDUSTRY AND MARKETING
COURSE CODE: BOT/MN/T/350
EXAMINATION CODE: SCC03013506T
TOTAL CONTACT HOURS: 30, CREDIT 02, MARKS 50 (CA=20, ESE 30)

Course Objectives

The course is designed to:

1. Provide knowledge about seed production, supply systems, and distribution channels.
2. Explain principles of seed marketing, pricing, and demand forecasting.
3. Develop skills in seed industry management and entrepreneurship.
4. Familiarize students with government policies, quality control, and regulatory frameworks in the seed sector.
5. Enhance understanding of marketing strategies, sales promotion, and market intelligence in the seed business.

Course Outcomes (COs)

After completion of the course, students will be able to:

1. Explain the organization and functioning of the seed industry
2. Analyze seed supply systems and marketing channels for efficient distribution.
3. Apply concepts of marketing mix, pricing, and demand forecasting in seed business.
4. Evaluate constraints and challenges in seed production and marketing sectors.

Module No	Syllabus	Hours
Unit -I	a. Introduction to seed industry – genesis, growth and structure of seed industry – mission and objectives – present status of Indian and global seed industry – role of seed industry in Indian agriculture; government initiatives – seed hubs, seed villages and community seed production system. b. Seed industry – organization set up and functions – public, private, MNC's, seed corporations; structure of small, medium and large seed industries, components of seed industry – public private partnership – custom seed production – risk management – human resource – infrastructure – processing unit – storage go down.	10
Unit -II	a. Seed production and distribution systems in state and central government; seed supply chain systems – seed production and distribution – planning, organization and coordination, staffing, assembling of resources; cost of seed production – overhead charges. b. Marketing – definition – importance – role of marketing; type of markets – domestic and global market – problems and perspectives; marketing policies – seed marketing schemes – marketing channels, responsibilities of dealers – marketing mix.	10
Unit -III	a. Seed demand forecasting – purpose – methods and techniques; indenting and seed dispatch procedures and forms – seed store records – maintenance – missing link in seed supply chain; market intelligence – SWOT analysis; seed cost analysis; seed pricing – policy – components of seed pricing – factors – local market rate (LMR) – fixation of procurement and sale price of seed.	10

Suggested readings: -

1. Acharya SS and Agarwal NL. 2004. *Agricultural Marketing in India.* 4th Ed. Oxford and IBH.
2. Broadway AC and Broadway A. 2003. *A Text Book of Agri-business Management.*
3. Kalyani Singh AK and Pandey S. 2005. *Rural Marketing.* New Age Publications.
4. Kugbei S. 2008. *Seed Economics.* Scientific Publishers, Jodhpur, Rajasthan.
5. Sharma P. 2008. *Marketing of Seeds*, Green-Tech Book Publishers, New Delhi.
6. Singh G and Asokan SR. 1991. *Seed Industry in India: A Management Perspective* Oxford &
7. IBH Publishing Co Pvt. Ltd., New Delhi.
8. Singh S. 2004. *Rural Marketing – Focus on agricultural Inputs.* Vikas Publishing House.

MINOR - 8:ETHNOBOTANY
COURSE CODE: BOT/MN/T/351
EXAMINATION CODE: SCC03013516T
TOTAL CONTACT HOURS: 30, CREDIT 02, MARKS 50 (CA=20, ESE 30)

Course Objectives

1. To introduce students to the concept, scope, and significance of ethnobotany.
2. To understand traditional knowledge systems related to plants.
3. To study medicinal, economic, and cultural uses of plants.
4. To promote conservation of indigenous plant knowledge and biodiversity.
5. To introduce scientific and cultural dimensions of ethnobotany

Course Outcomes

After completion of this course, students will be able to:

1. Understand human-plant relationships.
2. Identify and document ethnobotanical uses of plants.
3. Apply field methods for ethnobotanical studies.
4. Appreciate traditional knowledge and conservation strategies.
5. Evaluate conservation strategies and indigenous knowledge systems
6. Relate ethnobotany with modern pharmacology and rural development

Module No	Syllabus	Hours
Unit-I	**Introduction to Ethnobotany** a) Definition, concept, scope, and significance of ethnobotany b) History and development of ethnobotany (global and Indian context) c) Contribution of major ethnobotanists d) Interdisciplinary nature (Botany, Anthropology, Pharmacology) e) Methods in ethnobotanical research: field survey, questionnaire, herbarium f) Field work, data collection, herbarium techniques g) Ethical issues and Intellectual Property Rights (IPR)	10
Unit-II	**Ethnobotanical Resources and Uses** a) Plants used in traditional medicine (Ayurveda, folk medicine) b) Plants used in traditional medicine (Ayurveda, folk medicine) c) Ethnobotany of food plants, beverages, spices, and fibers d) Sacred plants and religious significance (cultural uses) e) Ethnobotany of tribal communities of India f) Case studies from Maharashtra / Vidarbha / Marathwada region g) Role of ethnobotany in drug discovery and pharmacology	10
Unit-III	**Applied Ethnobotany and Conservation** a) Role of ethnobotany in biodiversity conservation, indigenous knowledge systems b) Sustainable utilization of plant resources c) Threats to traditional knowledge d) Documentation and preservation of indigenous knowledge e) Modern approaches: Ethnopharmacology, bioprospecting f) Role of ethnobotany in rural development g) Field survey techniques h) Herbarium preparation and documentation	10

Suggested reading

1. Jain S.K. – *Ethnobotany in India* – Deep Publications
2. Jain S.K. – *Manual of Ethnobotany* – Scientific Publishers
3. Jain S.K. & Mudgal V. – *A Handbook of Ethnobotany* – Bishen Singh Mahendra Pal Singh
4. Jain S.K. – *Dictionary of Indian Folk Medicine* – Deep Publications
5. Trivedi P.C. – *Ethnobotany* – Pointer Publishers
6. Trivedi P.C. – *Medicinal Plants: Ethnobotanical Approach* – Aavishkar
7. Maheshwari J.K. – *Ethnobotany and Medicinal Plants of India* – Scientific Publishers
8. Joshi S.G. – *Medicinal Plants* – Oxford & IBH
9. Kirtikar K.R. & Basu B.D. – *Indian Medicinal Plants* – Lalit Mohan Basu
10. Nadkarni K.M. – *Indian Materia Medica* – Popular Prakashan
11. Chopra R.N. et al. – *Glossary of Indian Medicinal Plants* – CSIR
12. Sharma P.P. – *Ethnobotany* – Rastogi Publications
13. Singh J.S. & Singh S.P. – *Forests of Himalaya* – Gyanodaya
14. Pushpangadan P. – *Ethnobiology in India* – Scientific Publishers
15. Sinha R.K. – *Ethnobotany: The Renaissance of Traditional Herbal Medicine* – INA Shree
16. Pal D.C. & Jain S.K. – *Tribal Medicine* – Naya Prokash
17. Kaushik P. – *Ethnobotany* – Pointer
18. Yadav S.R. – *Medicinal Plants of Maharashtra* – Shivaji University
19. Bhandari M.M. – *Flora of Indian Desert* – MPS Repros
20. Rao R.R. – *Ethnobotany of India* – Botanical Survey of India
21. Kumar A. – *Ethnobotany and Biodiversity Conservation* – Daya Publishing
22. Sharma O.P. – *Plant Taxonomy and Ethnobotany* – McGraw Hill
23. Katewa S.S. – *Ethnobotany of Rajasthan* – Scientific Publishers
24. Sikarwar R.L.S. – *Ethnobotany of Central India* – APH Publishing
25. Singh V. – *Ethnobotany of Rajasthan* – Scientific Publishers
26. Verma S.K. – *Ethnobotany in India* – Deep Publications

Text Books

1. Pandey B.P. – *Botany for Degree Students* – S. Chand
2. Sharma O.P. – *Economic Botany* – McGraw Hill
3. Verma V. – *Economic Botany* – Ane Books
4. Singh V. & Jain D.K. – *Taxonomy of Angiosperms* – Rastogi
5. Bhojwani S.S. – *Plant Biotechnology* – S. Chand
6. Kochhar S.L. – *Economic Botany* – Cambridge University Press
7. Sambamurty A.V.S.S. – *Economic Botany* – New Age
8. Taiz L. & Zeiger E. – *Plant Physiology* – Sinauer

COURSE NAME: ON JOB TRAINING (OJT)

COURSE CODE: BOT/OJT/P/376 (TRAINING COURSE)

EXAMINATION CODE-SJC03013766T

CREDITS: 2, CONTACT HOURS: 30 ; MARKS: 50 (CIA-20 SEE-30)

Course Objectives

The main objectives of OJT/Internship are:

- To provide practical exposure to real work environments.
- To enhance technical, analytical, and problem-solving skills.
- To develop professional ethics, teamwork, and communication skills.
- To promote industry-academia interaction.
- To encourage entrepreneurship and innovation.
- To familiarize students with workplace culture and expectations.

Learning Outcomes

After completing the OJT/Internship, students will be able to:

Knowledge Outcomes

- Understand industry processes, tools, and technologies.
- Apply theoretical concepts in practical situations.

Skill Outcomes

- Develop technical and vocational skills relevant to their discipline.
- Improve communication, presentation, and interpersonal skills.
- Demonstrate problem-solving and critical thinking abilities.

Attitude/Behavioral Outcomes

- Exhibit professional ethics and responsibility.
- Adapt to workplace discipline and teamwork.
- Show initiative, creativity, and leadership qualities.

Sr. No	Particulars of OJT details	
1	**Guidelines for On Job Training (OJT) / Internship under NEP 2020** 1. Introduction The National Education Policy 2020 emphasizes **experiential learning, skill development, and employability**. OJT/Internships are essential components that bridge the gap between **theoretical knowledge and real-world application,** enabling students to gain hands-on experience in their chosen fields.	
2	**Types of OJT / Internship** 1. Industry Internship • Conducted in industries, companies, or manufacturing units. • Focus: **technical skills and industrial exposure**. 2. Research Internship • Conducted in universities, research institutes, or laboratories. • Focus: **research methodology, data analysis, and scientific writing**. 3. Field-Based Internship • Involves fieldwork (e.g., agriculture, biodiversity surveys, NGOs). Focus: **data collection, environmental studies, social outreach**. 4. Entrepreneurship / Start-up Internship • Work with start-ups or develop own business ideas. • Focus: **innovation, business planning, and management**. 5. Community Engagement Internship • Work with NGOs, rural development programs, or social sectors. • Focus: **social responsibility and community development.** 6. Virtual / Online Internship • Conducted remotely through digital platforms.	

	• Focus: **flexibility and digital skill enhancement.**	
3	5. OJT / Internship Structure Duration • Typically **4 to 8 weeks** (or as per university guidelines). • Can be extended depending on course requirements. Credits (as per NEP 2020) • 2–6 academic credits depending on duration and workload. Phases *1. Pre-Internship Phase* • Orientation program • Selection of organization • Approval from institution • Setting objectives and work plan *2. Internship Phase* • Actual training/work • Daily logbook maintenance • Weekly progress reporting *3. Post-Internship Phase* • Report submission • Presentation/Viva voce Evaluation and feedback	
5	6. OJT Implementation Mechanism 1. Institutional Responsibilities • Establish an **Internship/OJT Cell**. • Develop **MoUs with industries, NGOs, and research institutes**. • Provide **guidelines, formats, and evaluation criteria**. • Assign **faculty mentors/supervisors**. 2. Role of Faculty Mentor • Guide students in selecting internships. • Monitor progress through regular communication. • Evaluate reports and presentations. 3. Role of Industry/Organization Supervisor • Assign tasks/projects to students. • Provide training and supervision. • Evaluate student performance. 4. Student Responsibilities • Follow organizational rules and discipline. • Maintain **daily logbook/diary**. • Complete assigned tasks sincerely. • Submit **internship report on time**.	
4	7. Assessment and Evaluation Evaluation Components • **Attendance and discipline** – 10% • **Performance at workplace** – 30% • **Internship report** – 30% • **Presentation/Viva voce** – 20% • **Logbook/Diary** – 10%	
5	Assessment Methods • Continuous evaluation by supervisor • Final evaluation by faculty panel • Internal + external assessment (if applicable)	
6	8. Documentation Requirements Students must submit: • Internship **joining letter** • **Completion certificate**	

	• **Daily logbook** • **Internship report (project-based)** • **Supervisor evaluation form** • **Presentation (PPT/poster)**	
7	9. Expected Benefits For Students • Improved employability • Industry readiness • Confidence and professional skills For Institutions • Strong industry linkage • Better placement opportunities For Industry • Access to young talent Opportunity to train future workforce	
8	10. General Guidelines • Internship must be **relevant to the student's discipline**. • Minimum **attendance (75–80%) is mandatory**. • Ethical conduct and confidentiality must be maintained. • Plagiarism in reports is strictly prohibited. • Safety and legal norms must be followed.	

STRUCTURE / PATTERN OF 30 MARKS THEORY COURSE

- The SEE of the theory course shall have two parts (10 + 20 = 30 Marks).
- **Part A** shall consist of 5 questions having 2 marks each (multiple choice questions / fill in the blanks / answer in sentence) as compulsory questions, and it should cover the entire course curriculum (10 Marks).
- **Part B** shall consist of 6 questions (5 marks for each question) (02 questions from each of 03 units / covering the entire syllabus), and students shall have to attempt any 04 questions out of 06 (20 Marks).
- Wherever possible, 20 to 30% weightage can be given to problems/numerical, wherein the use of a non-programmable scientific calculator may be allowed.
- The number of sub-questions (with the allotment of marks) in a question may be decided by the examiner.