



Savitribai Phule Pune University, Pune
(Formerly, University of Pune)

Under Graduate Degree Program in Seed Technology
(Faculty of Science & Technology)

Syllabi as per National Education Policy (2020) for
T.Y.B.Sc. Seed Technology (Semester-V and VI)
(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

To be implemented from
Academic Year 2026-2027

Framed by
BOARD OF STUDIES IN BOTANY
Savitribai Phule Pune University,
Ganeshkhind, Pune -07.


(Dr. Mahesh N. Chavande)
Chairman - BoS Botany

OBJECTIVES

- To promote the possibility of self-employment
- To bridge up the gap between knowledge based conventional education and market demands and to provide an alternative to those pursuing higher education.
- To enrich students' training and knowledge that would be useful in the seed industry so that the farmers will get quality seeds
- To introduce the concepts of experimental design in Seed Technology
- To inculcate sense of job responsibilities, while maintaining social and environment awareness
- To help students build-up a progressive and successful career in industries with a biotechnological perspective

According to NEP-2020 criteria, the under graduate degree in Botany (T.Y.B.Sc. Seed Technology) program at Savitribai Phule Pune University associated colleges, is structured to provide students with advanced field-related knowledge and essential fundamentals. Through a unique combination of required major core courses with in-depth exposure to multidisciplinary minor, elective, and vocational skill courses, among other courses, students will be trained and acquire the fundamental and advanced knowledge essential to the industries.

With the knowledge gained in the field of seed technology, this upgraded curriculum will develop educated, outcome-oriented candidates who are nurtured through discovery and learning, equipped with practice and skills to deal with practical problems, and competent with recent pedagogical trends in education, including E-learning, flipped class, hybrid learning, and experiential learning. These candidates will become responsible citizens, transforming the nation to lead the world in the future.

After successful completion of the Under Graduate (UG) Degree program, following POs, PSOs, COs, will be acquired by the students

PROGRAM OUTCOMES (POS)

- **PO1:** Attain thoughtful proficiency in the field of seed sciences.
- **PO2:** Acquire the ability to perform in multidisciplinary domains.
- **PO3:** Attain the ability to exercise intelligence of scientific knowledge for investigation and innovation and nourishment of the world.
- **PO4:** Learn value based ethical practices and principles committed to professional ethics.
- **PO5:** Incorporate 21st century skill oriented self-directed and life-long learning.
- **PO6:** Obtain ability to inculcate the knowledge of seed science in diverse contexts with global perspective.
- **PO7:** Attain maturity to harness the destiny and responds to one's calling.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- **PSO1:** Recall the diversity, classification, evolution and developmental changes among the plants with reference to lower and higher plant groups and create a knowledge base in understanding the basis of Seed Science and Technology.
- **PSO2:** Understand the advanced concepts of Seed Science and Technology and its implementation for the improvement of crop productivity.
- **PSO3:** Acquire and utilize the skills of post-harvest, flower design, fruit processing and dehydration techniques, organic farming and various plant processing technologies for developing the economy to the growing world.
- **PSO4:** Know about the importance of seeds and its relevance in modern agriculture.

- **PSO5:** Adapt methods of scientific research in plant improvement program and create entrepreneurship, employment to the society.
- **PSO6:** Enrich the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, and enhance communication skill.
- **PSO7:** Apply the fruitful knowledge of seed sciences and plant resources for the sustainable development, betterment of society and environment by recognizing the ethical values.
- **PSO8:** Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyze and interpret data and provide solutions. Exhibit organizational skills and the ability to manage time and resources.

1. **Title of the Course: B.Sc. Seed Technology (03 years) / B.Sc. with Honours in Seed Technology (04 years)** Syllabus revised as per National Education Policy (NEP) 2020 for the Colleges Affiliated to Savitribai Phule Pune University, Pune
2. **Faculty - Science and Technology**
3. **To be implemented** -For TYBSc (Semester V and Semester VI), from June 2026.
4. **Preamble:**

Vocational Seed Technology is a three year degree course approved by Savitribai Phule Pune University taught at undergraduate level since 1995 under the Vocationalisation of first degree education scheme sanctioned by UGC. The course "Seed Technology" was introduced in 1995 only at Pravara Rural Education Society's Padmashri Vikhe Patil College of Arts, Science and Commerce, Pravaranagar and has fetched employment to most of the students in reputed seed industries. The course is coordinated and conducted by the Department of Botany of the college.

Seed Technology is a science dealing with the methods of improving genetic and physical characteristics of seed. Study of seed technology is necessary for two reasons. Firstly, the introduction of hybrids and high yielding varieties of crop plants of immense importance has necessitated great care in the maintenance and preservation of seed. Secondly, if seed production is to evolve as a prime enterprise, instead of a byproduct as it has been characteristically handled down through the centuries. Development of seed enterprise is absolutely necessary in the context of modern agriculture. It is the quickest way of increasing agricultural production. Much of our success in increasing food production has been due to the development of seed enterprise over the past decade. Seed demand at present is strong and expected to continue expanding.

Indian economy depends on agriculture and about 60 % of Indian population depends on agriculture. For quality production the farmers need quality seeds or propagating materials. Unless the farmer gets seeds, which are genetically pure and possess other desired qualities namely, high germination percentage and vigour, high purity, sound health etc. they cannot obtain the expected yields.

Quality material is provided to the farmers by the seed industries established throughout the country. These industries are in continuous demand for the knowledgeable, trained, talented Seed Technologists. These industries provide career opportunities to the graduate and post graduate students in the following ways:

- Management of seed enterprise (Govt./Semi govt. undertakings and private seed companies)
- State and Central Seed Testing Laboratories
- Seed Certification Agencies
- Seed Law Enforcement Agencies
- Training/Extension Centers
- Research Institutes

The course focuses on training of students in plant breeding, tissue culture, seed health testing techniques, testing for purity of seeds, crop improvement, protection and storage techniques. Seed technology is of prime importance because

- Seed is a carrier of new technologies
- Seed is a basic tool for secured food supply
- Seed is the principal means to secure crop yields in less favorable production areas
- Seed is a medium for rapid rehabilitation of agriculture in cases of natural disaster

The proposed syllabus lays more stress on practical's as compared to theory. It concentrates on experimental practice and theoretical aspects. This approach justifies the term 'vocational'.

The teaching center will develop trained manpower for the industries and employments will be generated. Students can also become entrepreneurs. Trained and competent teachers with experience in industry would be ideal to teach the subject. Besides such teachers, persons from industry could contribute to the course.

Program Duration and Exit Options

The UG Program lasts for four years or eight semesters. Student may leave the program after the third year if, he/she would like to receive a three year undergraduate degree. If the student decides to withdraw after the first or second year, he/she will receive a UG Certificate or UG Diploma, depending on how many credits he/she is able to complete. Re-entering within three years to finish the degree program is allowed for students who leave with a UG certificate or UG diploma. A student must earn a minimum of 18 credits and a maximum of 26 credits each semester. It is recommended, nevertheless, that student should opt 22 credits per semester. This clause aims to give student the comfort of a flexible semester-based course load. However, Table 1 lists the minimum number of credits required to be earned in order to be awarded an Undergraduate Certificate/Undergraduate Diploma/Bachelor Degree/Bachelor's Degree with Honors in Botany.

Table1: Type of Awards and Stages of Exit

Sr. No.	Type of Award	Stage of Exit	Mandatory Credits
1.	Undergraduate Certificate in Seed Technology	After successful completion of First year Semesters	44
2.	Undergraduate Diploma in Seed Technology	After successful completion of Second year Semesters	88
3.	Bachelor of Science in Seed Technology	After successful completion of Third year Semesters	132
4.	Bachelor of Science in Seed Technology (Honours)	After successful completion of Fourth year Semesters	176

5. Eligibility Criteria -

The basic criteria for Under Graduate Degree (FYBSc Seed Technology) admission will be 10+2 criteria with Biology, Physics, Chemistry, as Principal subjects OR Crop Science, Animal Science, Dairy Science, MCVC, Crop Production OR Diploma courses related to Plant Sciences. Admissions will be given as per the selection procedure / policies adopted by the college keeping in accordance with the conditions laid down by the Savitribai Phule Pune University, Pune. Reservation and relaxation are as per the State Government rules. Students qualified in FYBSc Seed Technology as per the norms of SPPU will continue their education for SYBSc Seed Technology course.

6. **Fee Structure** – As per the norms of Savitribai Phule Pune University, Pune.
7. **Duration of the Course**
Certificate Course- 01 year (Completion of 02 Semesters)
Diploma Course- 02 years (Completion of 04 Semesters)
BSc Degree- 03 years (Completion of 06 Semesters)
BSc Degree with Honours- 04 years (Completion of 08 Semesters)
8. **No. of semesters** – Two semesters per year
9. **Medium of instructions and teaching:** English
10. **Course Implementation criteria for Theory, Practical, Field Project/Community Engagement Program:**
- Each semester comprises of 15 weeks (12 weeks Actual Teaching + 3 weeks for Continuous Internal Evaluation).
 - One Credit of the Theory** is equal to 15 clock hours (Teaching 1 hour per week for each credit, 12 hours Actual Teaching + 3 hours Continuous Internal Evaluation – Assignments, Tutorials, Practice, Problem solving sessions, Group discussion, Seminars and Unit Tests).
 - One Credit of Practical** is equal to 30 clock hours. (2 Contact hours per credit per week) One Credit = 30 clock hours (24 hours' Actual Table work + 6 hours for journal competition, and Continuous Internal Evaluation of each practical).
 - Practical for each course comprises of 02 Credits = 60 clock hours.** Therefore,
 - Minimum 12 laboratory sessions of 04 clock hours must be conducted in one semester.
 - In case of short practical, two practical should be conducted in one session.
 - Each practical of 04 clock hours in the laboratory should consist of: Table performance for concerned practical, careful observations, calculation, writing results and conclusion, and submission of practical in written form.
 - Pre-laboratory reading and post laboratory assignments should be given on each practical as a part of continuous internal evaluation.
 - Practical batch should comprise of 12 students.*
 - Field Project (FP): 02 credits** (60 hours including field study, labwork, presentations, assignments etc.).
 - Community Engagement Program (CEP): 02 Credits** (60 hours including community engagement activities, labwork, presentations, assignments etc.)
For field project and Community Engagement Program a batch of five (5) students should be considered.
11. **Examination Pattern (For each Semester):** The examinations will be conducted semester wise for both Theory, Practical and Field projects/Community Engagement Programs.
- Theory Paper of 02 Credits –**
Internal Exam (15 M) + University Theory Exam (35 M) = Total 50 M
Duration: For Internal exam = 40 Min. and For University Exam = 02 hours.
 - Practical Paper of 2 Credits –**
Internal Exam (15 M) + University Practical Exam (35 M) = Total 50 M
Duration: For Internal exam = 40 Min. and For University Exam = More than 04 hours.

- **Field Project: 02 credits**

Student field project should be evaluated for total 50 marks (15 marks for internal and 35 marks for external evaluation). During internal assessment following points should be considered

1. Appropriateness of the field project
2. Punctuality of the student
3. Field work
4. Field diary
5. Viva voce

The criteria for external evaluation should be

1. Originality and significance of the project, its relevance to the field, and potential impact.
2. Soundness of methodology, research design, and approach.
3. Quality, accuracy, and thoroughness of data collection, analysis, and interpretation.
4. Validity and significance of findings, conclusions, and recommendations.
5. Clarity, organization, and effectiveness of the project report and presentation.

- **Community Engagement Program (CEP): 02 Credits**

Student Community Engagement Program (CEP) shall be evaluated for total 50 marks (15 marks for internal and 35 marks for external evaluation). During internal assessment following points shall be considered

1. Effectiveness of program design and planning.
2. Student participation and engagement in program activities.
3. Effectiveness of student communication with community members.
4. Demonstration of seed technology knowledge and skills.
5. Maintenance of program records and documentation.

The criteria for external evaluation shall be

1. Clarity, organization, and effectiveness of the report and presentation.
2. Assessment of the program's impact on the local community.
3. Evaluation of student learning outcomes and skills development.
4. Assessment of the program's effectiveness in achieving its objectives.

12. Award of Class/Grade: The class / grade for the courses of each semester will be followed as per the norms and conditions laid down by SPPU, Pune.

13. ATKT Rules: As per the norms given by SPPU, Pune.

14. Important Note:

- a. There shall be at least a short tour/field visit/industrial visit (1-2 days) per year for all UG students.
- b. Tours are the part of curriculum and obligatory to each student, failing which they will not be considered eligible to appear for the practical examination. Under unavoidable circumstances, if the student fails to attend the tour, he/she have to produce justifiable evidence for not attending the tour. However, in lieu of tour the candidate will have to complete the work assigned by the Department.
- c. The documents to be produced by each student at the time of practical examination (at the end of each Semester) are:
 - Submission of practical records (Journals).
 - Submission of a Tour / Visit report duly signed by the concerned practical Incharge and Head of the Department.
 - Any submissions / assignments, etc. based on the practical course.

15. Question paper pattern for Theory (2 Credit courses)

A student will have to solve the question paper of 35 marks for external exam. The paper setter should set the paper on entire syllabus, including optional questions. As the course is of 2 Credits (30 clock hour lectures), paper setter should allot 1.16 marks per lecture and accordingly, questions should be set for 30 lectures, 35 marks on entire syllabus.

- **Note: All questions are compulsory.**
- **Time: 2 Hours**

Que. 1) Answer any five of the following in one sentence 05 Marks

- i.
- ii.
- iii.
- iv.
- v.
- vi.

Que. 2a) Write any one of the following 06 Marks

- i.
- ii.

Que. 2b) Write any one of the following 04 Marks

- i.
- ii.

Que. 3a) Solve any one of the following 06 Marks

- i.
- ii.

Que. 3b) Solve any one of the following 04 Marks

- i.
- ii.

Que. 4) Write notes on (Any four) 10 Marks

- a.
- b.
- c.
- d.
- e.
- f.

CREDIT FRAMEWORK FOR TYBSc SEED TECHNOLOGY, SEMESTER –V (Level 5.5 / 300)

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Vertical – 1 (V1)			
Major Core Courses – (4T + 2P) x 2C = 12C	ST 301 MJ -T	Plant Breeding and Testing for Cultivar Genuineness	2 C
	ST 302 MJ -T	Hybrid Seed Production-I	2 C
	ST 303 MJ -T	Seed Pathology	2 C
	ST 304 MJ -T	Seed Quality Control	2 C
	ST 305 MJ -P	Practical Based on ST 301 MJ-T & ST 302 MJ-T	2 C
	ST 306 MJ -P	Practical Based on ST 303 MJ-T & ST 304 MJ-T	2 C
Major Elective Courses – (1T + 1P) x 2C=4C (Any one from basket)	ST 310 MJ -T	Scientific Beekeeping and Agriculture	2 C
	ST 311 MJ -T	Bio-Pesticides	
	ST 312 MJ -T	Plant Nutrition	
	ST 313 MJ -P	Practical Based on ST 310 MJ-T	
	ST 314 MJ -P	Practical Based on ST 311 MJ-T	2 C
	ST 315 MJ -P	Practical Based on ST 312 MJ-T	
Vertical – 2 (V2)			
Minor Courses – (1T = 2C) (Any one from basket)	ST 341 MN - T	Plant Protection	2 C
	ST 342 MN - T	Landscape Gardening	
	ST 343 MN - T	Production Technology for Feed and Fodder	
Vertical – 3 (V3)			
GE / OE - (0C)	-----	-----	0 C
Vertical – 4 (V4)			
Vocational Skill Courses (VSC) – (1T/P= 2C) (Any one from basket)	ST 321 VSC- P	Seed Technology and Intellectual Property Rights (IPR)	2 C
	ST 322 VSC- P	Agricultural Crops Stress Physiology	
	ST 323 VSC- P	Plant Biotechnology	
SEC – (0C)	-----	-----	0 C
Vertical – 5 (V5)			
IKS - (0C)	-----	-----	0 C
AEC – (0C)	-----	-----	0 C
VEC – (0C)	-----	-----	0 C
Vertical – 6 (V6)			
FP / CEP – (2C)	ST 331 FP / ST 331 CEP	Field Project (FP) / Community Engagement Programme (CEP)	2 C
CC – (0C)	-----	-----	0 C
Total Credits (V1+V2+V3+V4+V5+V6)			22 C

CREDIT FRAMEWORK FOR TYBSc SEED TECHNOLOGY, SEMESTER-VI (Level 5.5/300)

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Vertical – 1 (VI)			
Major Core Courses – (4T + 2P) x 2C = 12C	ST 351 MJ-T	Seed Farm Management	2 C
	ST 352 MJ-T	Hybrid Seed Production-II	2 C
	ST 353 MJ-T	Seed Entomology	2 C
	ST 354 MJ-T	Seed Processing and Marketing	2 C
	ST 355 MJ-P	Practical Based on ST 351 MJ-T & ST 352-MJ T	2 C
	ST 356 MJ-P	Practical Based on ST 353 MJ-T and ST 354 MJ-T	2 C
Major Elective Courses – (1T + 1P) x 2C = 4C (Any one from basket)	ST 360 MJ-T	Millets and its Production	2 C
	ST 361 MJ-T	Agribusiness Management	
	ST 362 MJ-T	Bio-fertilizers	
	ST 363 MJ-P	Practical Based on ST 360 MJ-T	2 C
	ST 364 MJ-P	Practical Based on ST 361 MJ-T	
	ST 365 MJ-P	Practical Based on ST 362 MJ-T	
Vertical – 2 (V2)			
Minor Courses – (0C)	-----		0 C
Vertical – 3 (V3)			
GE / OE - (0C)	-----	-----	0 C
Vertical – 4 (V4)			
Vocational Skill Courses (VSC) – (1T/P= 2C) (Any one from basket)	ST 371 VSC-P	Pesticide and Formulation Technology	2 C
	ST 372 VSC-P	Fermentation Technology	
	ST 373 VSC-P	Food Safety and Standards	
SEC – (0C)	-----	-----	0 C
Vertical – 5 (V5)			
IKS - (0C)	-----	-----	0 C
AEC – (0C)	-----	-----	0 C
VEC – (0C)	-----	-----	0 C
Vertical – 6 (V6)			
OJT – (4C)	ST 381 OJT	On Job Training (OJT)	4 C
CC – (0C)	-----	-----	0 C
Total Credits (V1+V2+V3+V4+V5+V6)			22 C
Total Credits for TYBSC - Semester V (22 C) + Semester VI (22 C)			44 C

Exit Option: Award of Three Year UG Degree (B.Sc. Botany) in Major with 132 Credits OR Continue with Major and Minor.

SEMESTER-V

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Core Course (MJ)****Course Code – ST 301 MJ-T****Course Title: Plant Breeding and Testing for Cultivar Genuineness****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

1. Understand foundational principles of plant breeding
2. Apply classical and modern breeding methods
3. Use biotechnological and genomic tools in crop improvement
4. Evaluate and maintain cultivar purity and genuineness

Course Outcomes (CO's):

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

1. Explain the principles and methods of plant breeding
2. Apply breeding techniques to develop improved cultivars
3. Evaluate genetic purity and cultivar genuineness
4. Conduct field and laboratory tests for variety characterization
5. Analyze and interpret data related to varietal performance and authenticity
6. Demonstrate understanding of legal and regulatory frameworks
7. Design a complete workflow for cultivar identification and purity testing

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter-1: General Introduction to Plant Breeding 1.1 Introduction and definition 1.2 Objectives of Plant breeding 1.3 Branches of Plant Breeding 1.4 Landmarks in Plant Breeding 1.5 Eminent Indian Plant Breeders 1.6 Significant Achievements	2L
2.	Chapter-2: Topics Related to Plant Breeding 2.1 Activities in Plant Breeding-Creation of variation, Selection, Evaluation, Multiplication and Distribution 2.2 Mitosis and Meiosis 2.3 Pollination Control: Heterosis and inbreeding Depression, Self-Incompatibility, Male sterility and Apomixis	4L
3.	Chapter-3: General Breeding Methods 3.1 Introduction 3.2 Self Pollinated Species 3.3 Cross Pollinated Species 3.4 Asexually Propagated Species 3.5 Plant Breeding Methods	3L
4.	Chapter-4: Domestication and Plant Introduction 4.1 Introduction and definition 4.2 History of plant introduction 4.3 Objectives of plant introduction	2L

	4.4 Agencies for plant introduction 4.5 Procedure for plant introduction 4.6 Acclimatization 4.7 Merits and demerits 4.8 Achievements	
5.	Chapter-5: Selection Practices in Crop Improvement 5.1 Introduction 5.2 Definition, procedure, advantages, disadvantages and achievements of - Pure line Selection - Mass Selection - Clonal Selection	4L
	CREDIT-II	15L
6.	Chapter-6: Introduction and Hybridization 6.1 Definition 6.2 Objectives 6.3 Types of Hybridization 6.4 Procedure of Hybridization 6.5 Raising of F1 generation 6.6 Difficulties in hybridization	2L
7.	Chapter-7: Mutation 7.1 Introduction and Definition 7.2 Types of mutation 7.3 Mutagens 7.4 Achievements of mutation breeding 7.5 Limitations	2L
8.	Chapter-8: Heteroploidy (Polyploidy) 8.1 Introduction and definition 8.2 Types-Aneuploidy and Euploidy 8.3 Haploids and Monoploids 8.4 Auto polyploidy and its achievements 8.5 Allo polyploidy and its achievements	3L
9.	Chapter-9: Plant Biotechnology 9.1 Introduction and definition 9.2 Embryo culture 9.3 Meristem culture 9.4 Anther culture 9.5 Cell culture 9.6 Germplasm conservation 9.7 Somatic hybridization 9.8 Genetic engineering 9.9 Achievements	4L
10.	Chapter-10: Testing for Cultivar Genuineness 10.1 Introduction and definition of varietal purity 10.2 DUS Testing (Distinctness, Uniformity & Stability) 10.3 Morphological Characterization of Cultivars 10.4 Biochemical Tests for Varietal Identification - Isozyme analysis - Seed protein electrophoresis	4L

	10.5 DNA-Based Methods for Cultivar Identification • SSR, SNP fingerprints • Molecular passporting • DNA profiling 10.6 Seed Purity Testing • Grow-out tests (GOT) • Physical purity tests 10.7 Seed standards for different crops	
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References:

- A test book of Plant Breeding-B. D. Singh, Kalyani Publishers, Third Edition-2011
- Essentials of Plant Breeding-Phundan Singh, Kalyani Publishers, Third Edition-2008
- Cytogenetics, Evolution, Biostatistics and Plant Breeding-R. S. Shukla and P. S. Chandel, S. Chand and Company Ltd., 2007
- Manual on Mutation Breeding-Third Edition- Spencor Lopes, M. M; Forster, B. P. and Jankuloski L., Food and Agriculture Organization of the United Nations, International Atomic Energy Agency, Vienna, 2018
- Plant Breeding: Principles and Methods-B. D. Singh, Kalyani Publishers-2006

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Core Course (MJ)****Course Code – ST 302 MJ-T****Course Title: Hybrid Seed Production-I****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

1. To understand the concept and step of hybridization.
2. To understand the Heterosis and Inbreeding depression.
3. To understand the role of apomixis, male sterility and self-incompatibility.
4. To gain the knowledge regarding basic principles in hybrid seed production.
5. To learn hybrid seed production in cotton and maize.

Course Outcomes (CO's):

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

CO1: Acquainted with the concept and steps of hybridization.

CO2: Understand the basic concept of Heterosis and Inbreeding depression.

CO3: Understand role of apomixis, male sterility and self-incompatibility in hybrid seed production.

CO4: Gain the knowledge regarding basic principles in hybrid seed production.

CO5: Describe the commercial cultivation techniques and value addition processes of selected horticultural crops.

CO6: Learn hybrid seed production in cotton and maize.

Sr. No.	Topic Details	No. of Lectures
	CREDIT I	15L
1	Chapter-1: Introduction to Hybridization 1.1 Introduction and Definition 1.2 Objectives 1.3 Types of hybridization- Interspecific, Intraspecific, and Intergeneric. 1.3 Steps in hybrid seed production: Selection of parents, emasculation, bagging, pollination, tagging, and collection of hybrids. 1.4 Applications of hybridization.	4L
2	Chapter-2: Heterosis and inbreeding depression 2.1 Introduction, definition of Heterosis and Inbreeding depression 2.2 Effects of Inbreeding Depression. 2.3 Manifestations of Heterosis 2.2 Genetic basis of Heterosis and inbreeding depression 2.3 Commercial exploitation of Heterosis	4L
3	Chapter-3: Male sterility 3.1 Introduction, definition and its importance. 3.2 Types of male sterility - • GMS (Genetic Male Sterility) • CMS (Cytoplasmic Male Sterility) • CGMS (Cytoplasmic Genetic Male Sterility) 3.3 Application of male sterility.	4L
4	Chapter-4: Self- incompatibility	3L

	4.1 Introduction, definition and concept. 4.2 Types of self-incompatibility: Heteromorphic and Homomorphic 4.3 Utilization in production of hybrids	
	CREDIT II	15L
5	Chapter-5: Basic principles of hybrid seed production 5.1 Introduction, definition of variety and its type. 5.2 Selection of site for seed production. 5.3 Different techniques in Emasculation, pollination and precautions to be taken. 5.4 Use of male sterility and Gametocides. 5.5 Sowing, row spacing, fertilizer and irrigation. 5.6 Isolation, planting ratio and seed rate. 5.7 Rouging and pollen shedders. 5.8 Pollen viability. 5.9 Pollen storage. 5.10 Stigma receptivity.	6L
6	Chapter-6: Hybrid seed production 6.1 Introduction and concept of hybrid seed production. Hybrid seed production in - 6.2 Maize (Fodder Crop), 6.3 Cotton (Fiber Crop), 6.4 Soybean (Oil Seed Crop) with respect to following points - 6.4.1 Source of seed. 6.4.2 Selection of field (Land requirement). 6.4.3 Isolation distance. 6.4.4 Sowing. 6.4.5 Cultural practices (Fertigation, Irrigation, plant protection). 6.4.6 Rouging. 6.4.7 Harvesting and threshing.	6L
7.	Chapter-7: Somatic Hybridization 7.1 Introduction and definition 7.2 Types of somatic hybrids 7.3 Steps in somatic hybridization 7.4 Use of somatic hybridization 7.5 Limitations 7.6 Achievements	3L

References:

1. Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi.
2. Plant breeding-B.D Singh, Kalyani Publishers, New Delhi.
3. Essentials of Plant Breeding- Phundan Singh, 2008.
4. Experimental Seed Science and Technology -Umarani et. al. 2006., Agrobios, Jodhpur.
5. Plant Breeding: Principles and Methods- Phundan Singh, 2009. Kalyani Publishers, New Delhi.
6. Seed Technology- Agrawal, 2005. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Principles of crop production-Reddy, 2008. Kalyani Publishers, New Delhi.

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Core Course (MJ)****Course Code – ST 303 MJ-T****Course Title: Seed Pathology****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

1. To understand the concept Seed Pathology.
2. To understand the seed borne pathogens and seed infection biology.
3. To understand the transmission mechanism and seed health concept.
4. To gain the knowledge regarding seed treatments and IPM.

Course Outcomes:

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

CO1: Acquainted with the concept of seed pathology and seed borne pathogens

CO2: Understand the basic concept of seed infection biology and seed health.

CO3: Understand the need of seed treatment and IPM in seed production

Sr. No.	Topic Details	No. of Lectures
	CREDIT I	15L
1.	Chapter-1: Introduction to Seed Pathology 1.1 Definition and concept 1.2 Scope, importance, history, economic significance 1.3 Seed as a vehicle for pathogen dissemination 1.4 Seed anatomy and physiology relevant to infection 1.5 Seed maturation and dormancy	2L
2.	Chapter-2: Concepts of Seed borne Pathogens 2.1 Definitions, seed-transmitted, seed-contaminating pathogens 2.2 Pathogen reservoirs and epidemiology 2.3 Types of Seed borne Pathogens with examples – Fungi, bacteria, viruses, viroids, nematodes, phytoplasmas – Survival strategies 2.4 Seed–Pathogen Interactions – Infection courts – Mechanisms of entry, colonization, survival	3L
3.	Chapter-3: Seed Infection Biology 3.1 Infection Pathway-I: Floral Infection – Pollination-mediated infection – Inflorescence infection 3.2 Infection Pathways-II: Fruit/Pod Infection – Pericarp penetration – Saprophytic vs. parasitic phases 3.3 Infection Pathways-III: Seed Surface Contamination – Seed coat contamination vs. systemic infection	3L
4.	Chapter-4: Seed Transmission Mechanisms 4.1 Vertical vs. horizontal transmission	3L

	4.2 Mass infection dynamics 4.3 Pathogen survival in seed vs. soil 4.4 Longevity and dormancy of seed borne pathogens	
5.	Chapter-5: Seed Health Testing Techniques 1.1 Definition and importance of seed health and seed health testing 1.2 Overview of Seed Health Testing – International rules (ISTA, AOSA) – Sampling methods & handling 1.3 Visual Inspection, Blotter & Agar Plate Methods – Visual examination of dry seeds – Standard blotter test – Deep freeze blotter – Agar media isolation 1.4 Seedling Symptom Tests – Growing-on tests – Greenhouse & field evaluations 1.5 Serological Techniques – ELISA, immunostrips, immunofluorescence – Applications for viruses & bacteria	4L
	CREDIT-II	15L
6.	Chapter- 6: Molecular Diagnostics and Biochemical tests 6.1 PCR 6.2 DNA barcoding 6.3 Biochemical Tests-FAT, endotoxin detection, isozyme profiles	2L
7.	Chapter-7: Seed Health Certification & Standards 7.1 National and international seed certification systems 7.2 Phytosanitary regulations	1L
8.	Chapter-8: Major Seed borne Pathogens & Diseases 8.1 Seed borne Fungal Diseases- Smuts, bunts, blights 8.2 Mycotoxigenic Fungi & Seed Deterioration-Storage molds 8.3 Seed borne Bacterial Diseases- <i>Xanthomonas</i> , <i>Pseudomonas</i> 8.4 Seed borne Viral & Viroid Pathogens- TMV, CMV, TSWV, Potato spindle tuber viroid 8.5 Seed borne Nematodes- <i>Anguina</i> , <i>Ditylenchus</i> species	8L
9.	Chapter-9: Seed Treatment & Management Strategies 9.1 Physical Seed Treatments – Hot water, hot air, solarization – Radiation, steam treatments 9.2 Chemical Seed Treatments – Fungicides, bactericides, seed coatings – Systemic vs. contact chemicals 9.3 Biological & Eco-friendly Seed Treatments – Trichoderma, Bacillus, Pseudomonas – Botanicals, microbial consortia 9.4 Integrated Seed Health Management – Combining detection, certification, treatment – On-farm and commercial seed production practices	4L

References:

- Experiments in Microbiology, Plant Pathology and Biotechnology- K.R. Aneja, New Age International Publishers, 2007
- Plant Pathology, B. P. Pandey, S. Chand and Compant Pvt. Ltd., 2014
- Mycology and Plant Pathology, L. V. Gangawane, Veena Ganju, Susan Thomas, S. K. Agarwal, Common wealth Publishers, 2000
- Current Concepts in Crop Protection-Harendra Chaurasia, Agrotech Press, 2015
- Handbook of Plant defence-Shailendra Singh Gaurav, Wisdom Press, 2015

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Core Course (MJ)****Course Code – ST 304 MJ-T****Course Title: Seed Quality Control****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

1. To understand the concept Seed Quality Control.
2. To understand the genetic and physical purity parameters.
3. To understand the seed certification procedure.
4. To gain the knowledge regarding powers of seed inspector.

Course Outcomes:

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

C01: Acquainted with the concept of Seed quality Control and purity parameters

C02: Understand the basic concept of seed certification.

C03: Understand the need of field inspection and seed certification tags

Sr. No.	Topic Details	No. of Lectures
	CREDIT I	15L
1.	Chapter-1: Introduction to Seed Quality Control 1.1 Definition & Importance of Seed Quality-components of quality 1.2 Characters of Good Quality Seed-physical, physiological 1.3 Factors Affecting Seed Quality-environmental & genetic 1.4 Classes & Standards of seed (breeder, foundation, certified)	3L
2.	Chapter-2: Genetic & Physical Purity 2.1 Genetic Purity & Maintenance (purpose & methods) 2.2 Deterioration Causes & Quality Loss 2.3 Physical Purity Concepts 2.4 Sampling Techniques for Quality Assessment 2.5 Seed Size, Shape & Uniformity Standards	4L
3.	Chapter-3: Seed Testing & Quality Assessment 3.1 Germination Testing Procedures (standards & scoring) 3.2 Viability & Vigor Tests 3.3 Physical Purity Analysis Methods 3.4 Health Tests for Seed-Borne Diseases 3.5 Biochemical & Molecular Tests (Grow-Out, electrophoresis, GMO detection)	4L
4.	Chapter-4: Seed Certification 4.1 Definition and concept of seed certification 4.2 Objectives of Seed certification 4.3 Foundation & Certified Seed Production Principles 4.4 Phases of seed certification 4.5 Seed Certification Procedure	4L
	CREDIT-II	15L
5.	Chapter-5: Legal & Policy Framework	4L

	5.1 Seed Act & Regulatory Framework (duties and power of seed inspector) 5.2 Procedure for seed law enforcement 5.3 Seed Control Orders & National Standards 5.4 Role of International Bodies (WTO, OECD) 5.5 Legal Issues in Seed Quality (offences & penalties) 5.6 Intellectual Property & Variety	
6.	Chapter-6: Field Inspection 6.1 Introduction and concept 6.2 Objectives and general principles of field inspection 6.3 Field inspection procedure	3L
7.	Chapter-7: Indian Regulatory System in Seed Quality Control 7.1 Introduction 7.2 Statutory Bodies & Agencies for Seed Quality Control in India • Central Seed Committee (CSC) • Central Seed Certification Board (CSCB) • State Seed Certification Agencies (SSCAs) • Central Seed Laboratory (CSL) • State Seed Testing Laboratories (SSTLs) • National Seed Board (NSB) • Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA) • National Seed Corporation (NSC) • State Seed Corporations (SSCs) • Directorate of Seed Quality Control • National Bureau of Plant Genetic Resources (NBPGR)	8L

References:

- Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi
- Experimental Seed Science and Technology-Umrani, Agribios 2006
- Seed Technology-Agarwal. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi
- Quality Seed Production in Cotton, Department of Seed Science and Technology, Centre for Plant Breeding and Genetics, TNAU, Coimbatore, 2003
- Quality Seed Production in Oil Seed Crops, Department of Seed Science and Technology, Centre for Plant Breeding and Genetics, TNAU, Coimbatore, 2003
- Quality Seed Production in Pulses, Department of Seed Science and Technology, Centre for Plant Breeding and Genetics, TNAU, Coimbatore, 2003
- Quality Seed Production in Rice and Millets, Department of Seed Science and Technology, Centre for Plant Breeding and Genetics, TNAU, Coimbatore, 2003

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Core Course (MJ)****Course Code – ST 305 MJ-P****Course Title: Practical Based on ST 301 MJ- T and ST 302 MJ-T****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives:**

2. Demonstrate hybrid seed production in cotton and maize.
3. Identify male sterile plants and confirm sterility using acetocarmine test.
4. Study pollen viability and seed extraction methods.
5. Calculate seed rate and NPK dose for hybrid crops.
6. Understand harvesting, plant protection, and farm machinery use.

Course Outcomes (COs):

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

CO1: Perform hybrid seed production techniques in field crops..

CO2: Identify and confirm male sterility using lab techniques.

CO3: Apply seed extraction and pollen viability methods.

CO4: Calculate agronomic inputs like seed rate and fertilizers.

CO5: Analyze hybrid seed production practices during field visits.

Sr. No.	Title of the Practical	Weightage
1.	Study of Different Stages of Mitosis in Onion Root-Tip Cells	1P
2.	Study of Different Stages of Meiosis in Plant Cells	1P
3.	Characterize and compare morphological traits of different cultivars of a given crop.	1P
4.	Study pollination techniques in self and cross pollinated crops	1P
5.	Demonstrate hybrid seed production technique in cotton.	1P
6.	Demonstrate hybrid seed production technique in maize.	1P
7.	Identification of genetic male sterile plants at bud initiation stage and study laboratory method for confirmation of sterility in maize by acetocarmine test under microscope.	1P
8.	Study percent pollen viability with suitable example.	1P
9.	Comparative Protein Profiling of Different Cultivars Using SDS-PAGE	1P
10.	Perform biochemical tests for varietal identification	1P
11.	Grow-Out Test (GOT): A Practical Study on Genetic Purity of Crop Seeds	1P
12.	Determination of Pure Seed Percentage by Physical Purity Analysis	1P
13.	Study the plant protection methods in hybrid seed production.	1P
14.	Study the calculation of NPK dose for hybrid seed production in any suitable crop.	1P
15.	Demonstration of different farm equipment's and machineries used in hybrid seed production. Visit to hybrid seed production plot and submission of report.	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Core Course (MJ)****Course Code – ST 306 MJ-P**

Course Title: Practical Based on ST 303 MJ- T and ST 304 MJ- T
[No. of Credits: 2 C] [No. of Lectures: 60 L]

Course Objectives:

1. To understand the concept Seed Pathology and Seed Quality Control
2. To understand the seed borne pathogens, transmission mechanism.
3. To gain the knowledge regarding seed health and quality concept.
4. To understand the seed certification procedure.

Course Outcomes:

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

C01: Acquainted with the concept of seed pathology and seed quality

C02: Understand the basic concept of seed infection biology and seed health.

C03: Understand the need of seed health and quality concept in seed production

C04: Understand the need of field inspection and seed certification tags

Sr. No.	Title of the Practical	Weightage
1.	Demonstration and handling of binocular and research microscope	1P
2.	Measurement of pathogens by the use of an ocular micrometer	1P
3.	Visual Examination & Seed Inspection	1P
4.	Detect seed borne fungi using standard blotter method (ISTA Protocol)	1P
5.	Detection of Seed borne Bacteria by serial dilution agar plate technique	2P
6.	Study nematodes associated with seeds	1P
7.	Study seed treatment (Slurry) method	1P
8.	Study eco-friendly approaches-Seed coating with <i>Trichoderma</i> , <i>Bacillus</i> , <i>Pseudomonas</i>	1P
9.	Study and demonstrate the procedures of seed sampling as per Seed Act and ISTA rules.	1P
10.	Practical exposure to Indian Minimum Seed Certification Standards (IMSCS).	1P
11.	Determine moisture content of different seed samples as per ISTA/Seed Testing Rules.	1P
12.	Determine the viability of seeds using the Tetrazolium (TZ) test	1P
13.	Study the procedure of field inspection for seed certification	1P
14.	Study tag colors, tag sizes, and mandatory information as per Seed Certification Standards.	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Elective Course (MJ)****Course Code – ST 310 MJ-T****Course Title: Scientific Beekeeping and Agriculture****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

- Understand the importance of beekeeping in agriculture and its role in enhancing crop productivity and sustainability.
- Acquire knowledge of the biology, behavior, and species of honeybees such as *Apis cerana indica* and *Apis mellifera*.
- Learn the principles of scientific colony management and apiary practices.
- Develop understanding of pollination biology and bee flora in relation to agricultural crops.
- Gain knowledge about bee products (honey, wax, propolis, etc.) and their economic importance.
- Understand major diseases and pests of honeybees and their management.
- Explore the role of beekeeping in sustainable agriculture and rural entrepreneurship, including initiatives by National Bee Board.

Course Outcomes (CO's)

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

- CO1: Knowledge (Remember & Understand)
- CO2: Comprehension (Understand & Explain)
- CO3: Application (Apply Knowledge)
- CO4: Analysis (Analyze & Diagnose)
- CO5: Evaluation (Assess & Recommend)
- CO6: Skill & Employability (Create / Practical Insight)

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter-1. Introduction to Beekeeping 1.1 History and importance of beekeeping in agriculture 1.2 Scope of apiculture in India 1.3 Species of honeybees in India: 1.3.1 <i>Apis cerana indica</i> 1.3.2 <i>Apis mellifera</i> 1.3.3 <i>Apis dorsata</i> 1.3.4 <i>Apis florea</i> 1.4 Role of bees in pollination and ecosystem services	4L
2.	Chapter-2. Biology of Honeybees 2.1 External morphology of honeybees 2.2 Castes and their functions (queen, worker, drone) 2.3 Life cycle of honeybees 2.4 Social behavior and communication (dance language)	4L

	2.5 Colony organization and division of labor	
3.	Chapter-3. Bee Flora and Pollination 3.1 Concept of bee flora 3.2 Major nectar and pollen plants in India 3.3 Role of bees in increasing yield and quality of crops	3L
4.	Chapter-4. Beekeeping Equipment and Apiary Establishment 4.1 Types of hives (traditional and modern) 4.2 Parts of a beehive (brood chamber, super, frames) 4.3 Beekeeping equipment: smoker, hive tool, bee veil 4.4 Site selection and layout of apiary 4.5 Seasonal management basics	4L
	CREDIT-II	15L
5.	Chapter-5. Colony Management 5.1 Methods of colony multiplication (splitting, queen rearing basics) 5.2 Feeding and management during dearth periods 5.3 Swarming: causes and control 5.4 Migration of bee colonies 5.5 Seasonal management (summer, winter, monsoon)	4L
6.	Chapter-6. Bee Products and Their Uses 6.1 Honey: composition, properties, and extraction 6.2 Other products: beeswax, royal jelly, propolis, bee venom 6.3 Processing, storage, and quality control of honey 6.4 Economic importance and value-added products	4L
7.	Chapter-7. Diseases and Pests of Honeybees 7.1 Common diseases: bacterial, viral, fungal 7.2 Important pests: wax moth, mites, ants 7.3 Symptoms, prevention, and control measures 7.4 Safe use of chemicals and biological control	4L
8.	Chapter-8. Beekeeping and Sustainable Agriculture 8.1 Integration of beekeeping with farming systems 8.2 Role in crop pollination and yield enhancement 8.3 Organic farming and beekeeping 8.4 Government schemes and support in India (e.g., National Bee Board initiatives) 8.5 Scope for entrepreneurship and rural development	3L

References:

- Textbook of Beekeeping (Apiculture)– D. P. Abrol, Publisher: Scientific Publishers (India), Jodhpur
- Beekeeping in India, – M. G. Nair. Publisher: ICAR / Indian Council of Agricultural Research, New Delhi
- The Hive and the Honey Bee (Indian Adaptation/Reference Use) – Joe M. Graham. Publisher: Dadant & Sons (International, but widely used in India)
- Honey Bees and Their Management – S. S. Mishra. Publisher: APH Publishing Corporation, New Delhi
- Beekeeping: A Practical Guide for Rural Development– R. K. Gupta. Publisher: Agrotech Publishing Academy, Udaipur

- Apiculture (Fundamentals and Practices), J. S. Brar & G. S. Gatoria. Publisher: Kalyani Publishers, Ludhiana
- Pollination in Crop Production, – D. P. Abrol. Publisher: Scientific Publishers
- Handbook of Beekeeping – E. V. Nair. Publisher: ICAR / Regional agricultural institutes
- Beekeeping and Pollination Management– A. K. Singh. Publisher: New India Publishing Agency

★ Institutional / Government Sources

- Indian Council of Agricultural Research (ICAR) manuals and bulletins
- Khadi and Village Industries Commission (KVIC) training manuals on beekeeping
- National Bee Board publications and training guides

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Elective Course (MJ)****Course Code – ST 311 MJ-T****Course Title: Bio-Pesticides****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

- Understand types and roles of biopesticides
- Learn production, formulation, and application methods
- Evaluate their effectiveness and environmental impact
- Gain practical exposure to preparation and use

Course Outcomes (CO's):

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

- CO1: Classify different types of biopesticides and explain their roles in sustainable agriculture.
- CO2: Describe the methods of production, formulation, and application of various biopesticides.
- CO3: Assess the effectiveness of biopesticides in pest management and evaluate their environmental impact.
- CO4: Demonstrate practical skills in the preparation and application of biopesticides for field use.
- CO5: Analyze the advantages and limitations of biopesticides compared to chemical pesticides.

Sr. No.	Topic Details	No. of Lectures
	Credit-I	
1	Chapter 1: Introduction to Biopesticides 1.1 Definition and classification: ○ Botanical biopesticides ○ Microbial biopesticides ○ Biochemical biopesticides 1.2 Limitations of chemical pesticides 1.3 Role in sustainable agriculture and IPM	04
2	Chapter 2: Botanical Biopesticides 2.1 Important plants: ○ Neem (<i>Azadirachta indica</i>) ○ Pyrethrum (<i>Chrysanthemum cinerariifolium</i>) ○ Tobacco (<i>Nicotiana tabacum</i>) 2.2 Active compounds (azadirachtin, pyrethrins, nicotine) 2.3 Mode of action: repellent, antifeedant, insect growth regulator	04
3	Chapter 3: Microbial Biopesticides 3.1 Bacterial agents: <i>Bacillus thuringiensis</i> (Bt) 3.2 Fungal agents: <i>Trichoderma</i> spp., <i>Beauveria bassiana</i>	04

	3.3 Viral biopesticides: NPV (Nuclear Polyhedrosis Virus)	
	3.4 Mode of action and target pests	
4	Chapter-4: Insects and Nematodes as Biocontrol Agent 4.1 Important Insect Biocontrol Agents (30 min) 4.1.1 Predators: ○ Ladybird beetles (e.g., aphid control) ○ Lacewings 4.1.2 Parasitoids: ○ <i>Trichogramma</i> spp. (egg parasitoids) ○ <i>Braconid</i> and <i>Ichneumonid</i> wasps 4.2 Introduction to Entomopathogenic Nematodes (EPNs) ○ Mode of Action ○ Important Genera and Applications (20 min) ○ <i>Steinernema</i> spp. ○ <i>Heterorhabditis</i> spp. ○ Target pests (soil insects, grubs, borers)	03
	Credit-II	
5	Chapter 5: Production and Formulation (5 Hours) 5.1 Mass production techniques 5.2 Fermentation basics 5.3 Formulation types: ○ Wettable powders ○ Granules ○ Liquid formulations 5.4 Shelf life and storage	04
6	Chapter 6: Application and Field Use (4 Hours) 6.1 Methods: ○ Foliar spray ○ Seed treatment ○ Soil application 6.2 Dose, timing, and environmental factors 6.3 Compatibility with fertilizers and other inputs	04
7	Chapter 7: Environmental Impact & Safety (2 Hours) 7.1 Biodegradability 7.2 Non-target effects (pollinators, natural enemies) 7.3 Human safety and residue issues	03
8	Chapter 8: Regulations and Commercial Aspects (1.5 Hours) 8.1 Registration process in India 8.2 Quality standards 8.3 Market scope and challenges	02
9.	Chapter 9: Recent Advances & Future Trends (1.5 Hours) 9.1 Nano-biopesticides 9.2 Integrated Pest Management (IPM) strategies 9.3 Climate-resilient pest control	02

References:

- Biopesticides in Sustainable Agriculture: Progress and Potential – N. K. Dubey – Scientific Publishers (India)

- Basic and Applied Aspects of Biopesticides – Rakesh Arora & S. Arora – Springer India
- Advances in Plant Biopesticides – Dwijendra Singh – Springer India
- Biopesticides: Innovations and Practices – Opendar Koul – Springer / Scientific Publishers
- New and Future Developments in Biopesticide Research – Opendar Koul – Springer India
- Microbial Biopesticides – S. Sahayaraj – New India Publishing Agency
- Biological Control of Crop Pests in India – T. N. Ananthakrishnan – Oxford & IBH Publishing
- Principles of Insect Pest Management – G. S. Dhaliwal & R. Arora
- Biopesticides: A Biotechnological Approach- S.R. Joshi
- Biopesticides for sustainable agriculture- Nutan Kaushik,
- Indian Insect Predators in Biological Control- K. Sahayaraj
- Botanicals as Ecofriendly Pesticides- Pramod P. Mahulikar & Kshama M. Chavan,
- Biofertilizers, Biopesticides & Bioinsecticides- Prof. S. N. Pandey,
- Bio-Pesticide & IPM, Pesticide Remediation in Soils & Water- G K Ghosh,
- Biofertilizer & Biopesticides- Rajaram Choyal
- Biofertilizers & Biopesticides- Dr. Shalini Suri

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Elective Course (MJ)****Course Code – ST 312 MJ-T****Course Title: Plant Nutrition****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

- To understand the basic concepts of plant nutrition and essential nutrients
- To study the sources, functions, and roles of macro- and micronutrients in plant growth
- To analyze the mechanisms of nutrient uptake, transport, and translocation in plants
- To evaluate the causes and symptoms of nutrient deficiencies and toxicities
- To examine fertilizer types, nutrient management strategies, and sustainable practices

Course Outcomes (COs)

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

- CO1: Explain the principles of plant nutrition and classify essential nutrients based on their functions and availability.
- CO2: Describe the sources, uptake, mobility, and roles of macro- and micronutrients in plant metabolism.
- CO3: Analyze the visual and physiological symptoms of nutrient deficiencies and toxicities in crops.
- CO4: Discuss the types of fertilizers, biofertilizers, and soil amendments, including their advantages and limitations.
- CO5: Evaluate different nutrient management strategies, including integrated nutrient management, for sustainable crop production.
- CO6: Interpret soil test data and theoretical concepts to make informed nutrient management decisions.

Sr. No.	Topic Details	No. of Lectures
	Credit-I	
1.	Chapter-1: Introduction to Plant Nutrition 1.1 Definition and importance of plant nutrition 1.2 Essential nutrients for plants • Macro (N, P, K, Ca, Mg, S) • Micro (Fe, Mn, Zn, Cu, Mo, B, Cl, Ni) 1.3 Criteria for essentiality 1.4 Functions of nutrients in plant growth	4L
2.	Chapter-2: Soil and Nutrient Availability 2.1 Soil as a medium for nutrients 2.2 Soil properties affecting nutrient availability (pH, texture, organic matter) 2.3 Forms of nutrients in soil (available, unavailable, organic, inorganic) 2.4 Role of soil microorganisms in nutrient cycling	4L

3.	Chapter-3: Macronutrients 3.1 Nitrogen • Functions and deficiency symptoms • Sources: organic and inorganic • Uptake and mobility in plants 3.2 Phosphorus • Functions and deficiency symptoms • Sources and availability 3.3 Potassium • Functions, deficiency, and toxicity symptoms • Sources and role in plant stress resistance 3.4 Secondary Nutrients (Ca, Mg, S) • Functions and deficiency symptoms • Sources and management	7L
	Credit-II	
4.	Chapter- 4: Micronutrients 4.1 Iron, Manganese, Zinc, Copper, Boron, Molybdenum, Chlorine, Nickel 4.2 Functions and deficiency/toxicity symptoms 4.3 Foliar and soil application methods	4L
5.	Chapter- 5: Nutrient Uptake and Transport 5.1 Mechanism of nutrient uptake (diffusion, mass flow, root interception) 5.2 Active vs passive uptake 5.3 Translocation within plant (xylem and phloem) 5.4 Factors affecting nutrient absorption	3L
6.	Chapter- 6: Fertilizers and Soil Amendments 6.1 Types of fertilizers: organic and inorganic 6.2 Common chemical fertilizers (urea, SSP, DAP, MOP) 6.3 Biofertilizers: Rhizobium, Azotobacter, Azospirillum, Mycorrhiza 6.4 Slow-release fertilizers and nano-fertilizers 6.5 Fertilizer management practices	4L
7.	Chapter- 7: Nutrient Deficiency and Toxicity 7.1 Visual symptoms of macro and micronutrient deficiencies 7.2 Toxicity effects of excessive nutrients 7.3 Simple remedies and corrective measures	2L
8.	Chapter-8: Integrated Nutrient Management 8.1 Concept and importance of INM 8.2 Combining chemical, organic, and biofertilizers for sustainable production	2L

References:

- Soil Fertility and Nutrient Management – *A. S. Jadeja, et al.* — New India Publishing Agency / NPH India (2022)
- Manures, Fertilizers and Soil Fertility Management– *A. Rathinasamy* — Scientific Publishers (2024)
- Textbook on Plant Nutrition and Advanced Soil Fertility– *P. Kavitha, et al.* — NPH India (2023)
- Soil Fertility and Plant Nutrient Management– *Rajendra Prasad & Yashbir Singh Shivay* — New India Publishing Agency (2021)
- Fundamental Aspects of Soil Fertility, Fertilizers and Plant Nutrient Management – *K. K. Patel, et al.* — NPH India (2024)
- Soil Fertility and Plant Nutrition– *Susanta Kumar Pal* — CBS Publishers & Distributors (2025)
- Soil Fertility, Fertilizer and Integrated Nutrient Management– *Shivanand Tolanur* — Vedams Books

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Elective Course (MJ)****Course Code – ST 313 MJ-P****Course Title: Practical based on ST 310 MJ-T: Scientific Beekeeping and Agriculture****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

- Understand the importance and scope of beekeeping in agriculture and rural economy.
- Identify different species of honeybees and understand their biology and behavior.
- Gain knowledge of bee flora and pollination ecology.
- Develop skills in handling beekeeping equipment and apiary establishment.
- Learn colony management practices and seasonal handling.
- Understand bee products, their extraction, processing, and economic value.
- Identify diseases and pests and apply appropriate control measures.
- Appreciate the role of beekeeping in sustainable agriculture and entrepreneurship.

Course Outcomes (COs)

After successful completion, students will be able to:

- **CO1:** Describe the importance of apiculture and identify major bee species.
- **CO2:** Explain morphology, life cycle, and social organization of honeybees.
- **CO3:** Recognize important bee flora and evaluate pollination benefits.
- **CO4:** Demonstrate the use of beekeeping tools and establish an apiary.
- **CO5:** Perform basic colony management practices including feeding and splitting.
- **CO6:** Extract and process honey and other bee products.
- **CO7:** Diagnose common diseases and pests and suggest control measures.
- **CO8:** Apply beekeeping knowledge for sustainable farming and income generation.

Sr. No.	Title of the Practical	Weightage
1.	Study of <i>Apis cerana indica</i> , <i>Apis mellifera</i> , <i>Apis dorsata</i> , and <i>Apis florea</i> using charts/specimens w.r.t head, thorax, abdomen, wings, and legs.	2P
2.	Study of Honeybee Castes- queen, worker, and drone based on structure and function	1P
3.	Study of Life Cycle of Honeybee	1P
4.	Study of Social Behavior and Communication -Understanding waggle dance and division of labour (video/demo-based).	1P
5.	Collection and identification of at least 5 nectar and pollen yielding plants from local area.	1P
6.	Study of Beekeeping Equipment	1P
7.	Study of Beehive Structure	1P

8.	Demonstration of frame handling, brood observation, and general colony care.	1P
9.	Preparation of sugar syrup and discussion on seasonal care (summer, winter, monsoon).	1P
10.	Demonstration of honey extraction and basic processing methods	1P
11.	Study of honey, beeswax, propolis, royal jelly, and bee venom.	1P
12.	Identification of common diseases and pests (wax moth, mites, ants) and their control measures.	1P
13.	Preparation of apiary layout plan and writing proposal for getting financial support through government schemes	1P
14.	Apiary visit and report	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Elective Course (MJ)****Course Code – ST 314 MJ-P****Course Title: Practical Based on ST 311 MJ-T: Bio-Pesticides****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

- To identify different types of biopesticides used in agriculture
- To develop skills in preparation, formulation, and application of biopesticides
- To examine the effectiveness of biopesticides through observation and field practices
- To gain hands-on experience in the use of biopesticides for pest management

Course Outcomes

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

- **CO1:** Identify and differentiate various types of biopesticides used in laboratory and field conditions.
- **CO2:** Perform basic techniques for preparation, formulation, and handling of biopesticides.
- **CO3:** Evaluate the effectiveness of biopesticides through practical observation and simple experiments.
- **CO4:** Demonstrate proper methods of application of biopesticides such as seed treatment, soil application, and foliar spray.

Sr. No.	Title of the Practical	Weightage
1.	Study of Common Botanical biopesticides Plants (<i>Azadirachta indica</i> , <i>Nicotiana tabacum</i> , <i>Chrysanthemum cinerariifolium</i>)	1P
2.	Study of Different Types of Biopesticides Formulation (powder, liquid, granules)	1P
3.	Study of Fungal Biocontrol Agents (<i>Trichoderma</i> spp.,)	1P
4.	Demonstration of Viral Biopesticides (NPV) and Their Symptoms on Insects	1P
5.	Identification of Beneficial Insects (Predators and Parasitoids)	1P
6.	Study Mass Rearing Techniques of Biocontrol Agent- <i>Trichogramma</i> spp.	2P
7.	Study of Entomopathogenic Nematodes (EPNs) Under Microscope	1P
8.	Study Seed Treatment with Biopesticides	1P
9.	Study Soil Application Techniques of Biopesticides	1P
10.	Field Visit to Observe Biopesticides Application / IPM Practices	2P
11.	Comparative Study of Chemical Vs. Biopesticides Effects (Case Study)	3P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Major Elective Course (MJ)****Course Code – ST 315 MJ-P****Course Title: Practical based on ST 312 MJ-T: Plant Nutrition****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

- To understand the role of essential macro- and micronutrients in plant growth
- To develop skills in identifying nutrient deficiencies and toxicities in crops
- To gain practical knowledge of fertilizer types, application methods, and nutrient management
- To observe and analyze the effect of nutrients on plant growth and development
- To promote sustainable crop production through integrated nutrient management

Course Outcomes (COs) –

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

- CO1: Identify and describe the functions of essential macro- and micronutrients in plants.
- CO2: Recognize nutrient deficiency and toxicity symptoms in crops through field and laboratory observations.
- CO3: Perform soil tests and interpret results to determine nutrient availability.
- CO4: Demonstrate proper application techniques of fertilizers (soil, foliar, and organic amendments).
- CO5: Evaluate plant growth responses to different nutrient management practices.
- CO6: Integrate chemical, organic, and biofertilizers use for sustainable crop nutrition.

Sr. No.	Title of the Practical	Weightage
1.	Study of macro- and micronutrients required for plant growth	1P
2.	Study of Deficiency Symptoms of Macronutrients (N, P, K)	1P
3.	Study of Secondary Nutrient (Ca, Mg, S) Deficiency Symptoms	1P
4.	Determination of soil texture by using feel method or Bouyoucos hydrometer method.	1P
5.	Measurement of Soil pH and Electrical Conductivity (EC)	1P
6.	Determination of Organic Carbon in Soil by Walkley–Black method or rapid titration method	1P
7.	Estimation of Available Nitrogen, Phosphorus, and Potassium in Soil {Kjeldahl method (N), Olsen method (P), Flame photometry (K)}	1P
8.	Study of Micronutrient (Fe, Mn, Zn, Cu, B) Deficiency Symptoms	1P
9.	Demonstrate preparation and foliar application of micronutrients	1P

10.	Demonstration of Nutrient Uptake Mechanisms using simple water culture experiments	1P
11.	Study of common chemical Fertilizers: Urea, DAP, SSP, MOP.	1P
12.	Demonstrate N, P, K content analysis (qualitative tests).	1P
13.	Demonstrate seed treatment and soil application techniques using <i>Rhizobium</i> , <i>Azotobacter</i> , <i>Azospirillum</i> cultures	1P
14.	Study effect of Fertilizer Application on Plant Growth (Pot Experiment)	1P
15.	Demonstration of Integrated Nutrient Management (INM)	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Minor Course (MN)****Course Code – ST 341 MN-T****Course Title: Plant Protection****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

The course is designed to:

1. Provide fundamental knowledge of plant protection, including insect pests, diseases, and weeds affecting crops.
2. Develop understanding of the biology, life cycles, and damage symptoms of major pests and pathogens.
3. Introduce principles and methods of pest, disease, and weed management.
4. Familiarize students with pesticides, their classification, application methods, and safe handling practices.
5. Promote awareness of sustainable approaches, including Integrated Pest Management (IPM) and biological control.
6. Enhance skills in identification and diagnosis of plant protection problems in field conditions.

Course Outcomes (CO's)

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

CO1: Explain the basic concepts and importance of plant protection in agriculture and food security.

CO2: Identify major insect pests, describe their life cycles, and recognize symptoms of damage on crops.

CO3: Differentiate various plant diseases, their causal agents, and typical symptoms.

CO4: Recognize common weeds and explain their impact on crop production.

CO5: Apply appropriate management strategies (cultural, biological, mechanical, and chemical) for pests, diseases, and weeds.

CO6: Demonstrate safe and judicious use of pesticides, including proper application techniques and precautions.

CO7: Understand and apply the principles of Integrated Pest Management (IPM) for sustainable agriculture.

CO8: Analyze basic plant protection problems and suggest practical, eco-friendly solutions.

Sr. No.	Topic Details	No. of Lectures
	Credit-I	
1.	Chapter-I: Introduction to Plant Protection 1.1 Definition and scope of Plant Protection 1.2 Importance in agriculture and food security 1.3 History and development of plant protection 1.4 Overview of plant health problems: pests, diseases, and weeds 1.5 Economic impact of crop losses	3L
2.	Chapter-2: Basics of Entomology (Insect Pests)	6L

	2.1 Introduction to insect morphology and classification 2.2 Identification of major insect orders 2.3 Types of insect pests (chewing, sucking, boring, etc.) 2.4 Major crop pests (cereals, pulses, vegetables, fruits) and Life cycles and metamorphosis 2.5 Nature and symptoms of insect damage	
3.	Chapter-3: Basics of Plant Pathology (Diseases) 3.1 Definition and types of plant diseases 3.2 Causes: fungi, bacteria, viruses, nematodes 3.3 Symptoms of plant diseases 3.4 Important crop diseases and their causal organisms 3.5 Methods of disease transmission	6L
	Credit-II	15L
4.	Chapter-4: Weed Science 4.1 Definition and classification of weeds 4.2 Crop-weed competition 4.3 Harmful and beneficial effects of weeds 4.4 Common weeds in major crops 4.5 Principles of weed management	4L
5.	Chapter-5: Pest and Disease Management Strategies 5.1 Cultural control methods 5.2 Mechanical and physical methods 5.3 Biological control (predators, parasitoids, pathogens) 5.4 Chemical control (pesticides, fungicides, herbicides) 5.5 Integrated Pest Management (IPM): principles and importance	5L
6.	Chapter-6: Pesticides and Their Safe Use 6.1 Classification and formulation of pesticides 6.2 Methods of application (spraying, dusting, seed treatment) 6.3 Toxicity and hazards 6.4 Safe handling, storage, and disposal 6.5 Environmental impact of pesticides	3L
7.	Chapter-7: Plant Quarantine and Biosecurity 7.1 Concept of plant quarantine 7.2 National and international regulations 7.3 Role in preventing pest and disease spread	2L
8.	Chapter-8: Recent Trends in Plant Protection 8.1 Biopesticides and botanicals 8.2 Organic plant protection 8.3 Use of biotechnology in pest management	1L

References:

- "Biointensive Integrated Pest Management in Horticultural Ecosystems"-P. Parvatha Reddy, Springer India, 2014
- "Advances in Plant Biopesticides"- Dwijendra Singh, Springer India, 2014
- "Textbook of Agricultural Entomology", Hem Singh Pruthi, ICAR / Govt. of India, 1963

- “Insect Pathology: Current Principles and Methods”, K. L. Srivastava, Today & Tomorrow’s Printers & Publishers, 2025
- “The Indian Journal of Entomology”, Entomological Society of India
- “Plant Pathology in India”-S. S. Chahal, R. K. Khetarpal, T. S. Thind, Scientific Publishers, India, 2010 / 2019 edition
- “Integrated Plant Pathology”-S. M. Reddy & H. N. Gour, Scientific Publishers, 2009
- “Compendium of Phytopathogenic Microbes in Agro-Ecology”- Natarajan Amaresan, Krishna Kumar, Springer
- “Fungal Diversity, Ecology and Control Management”- Vijay Rani Rajpal & Ishwar Singh, Springer

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Minor Course (MN)****Course Code – ST 342 MN-T****Course Title: Landscape Gardening****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

- To introduce students to principles and elements of landscape gardening.
- To develop understanding of garden types and design concepts.
- To impart knowledge of ornamental plants and their uses.
- To familiarize students with planning, execution, and maintenance of landscapes.
- To promote sustainable and eco-friendly landscaping practices.

Course Outcomes

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

1. Understand basic concepts and scope of landscape gardening.
2. Identify and select suitable ornamental plants for different landscapes.
3. Design small-scale gardens using scientific principles.
4. Apply landscaping techniques in residential and institutional settings.
5. Maintain gardens using sustainable practices.

Sr. No.	Topic Details	No. of Lectures
	Credit-I	
1.	Chapter-1: Introduction to Landscape Gardening 1.1 Definition, scope, and importance of landscape gardening 1.2 History of gardening in India 1.3 Role of landscaping in urban and rural environments 1.4 Landscape gardening as a profession and entrepreneurship opportunities	4L
2.	Chapter-2: Principles and Elements of Landscape Design 2.1 Principles: Unity, balance, proportion, rhythm, emphasis, contrast 2.2 Elements: Line, form, texture, color, space 2.3 Concepts of focal point and vistas 2.4 Landscape composition and visual aesthetics	6L
3.	Chapter-3: Types of Gardens 3.1 Formal gardens (e.g., Mughal gardens) 3.2 Informal gardens 3.3 Kitchen gardens 3.4 Terrace/roof gardens 3.5 Mughal, Japanese, and English garden styles 3.6 Public vs private gardens	5L
	Credit-II	
4.	Chapter-4: Ornamental Plants in Landscaping 4.1 Classification of ornamental plants: • Trees • Shrubs	5L

	• Climbers and creepers • Annuals and perennials 4.2 Lawns and ground covers 4.3 Selection criteria for ornamental plants 4.4 Seasonal flowering plants 4.5 Native vs exotic plants	
5.	Chapter-5: Garden Components and Features 5.1 Structural components: • Paths, lawns, hedges, edges • Fencing, walls, pergolas, arches 5.2 Water features: • Fountains, ponds 5.3 Garden accessories: • Lighting, statues, benches	4L
6.	Chapter-6: Garden Planning and Layout 6.1 Site analysis (soil, climate, topography) 6.2 Preparation of layout plan 6.3 Zoning and space utilization 6.4 Basic tools and materials used in landscaping	4L
7.	Chapter-7: Maintenance and Sustainable Landscaping 7.1 Irrigation methods 7.2 Pruning, mowing, fertilization 7.3 Pest and disease management 7.4 Eco-friendly landscaping: • Xeriscaping • Waste recycling • Water conservation	2L

References

1. Bose, T.K., Maiti, R.G., Dhua, R.S. & Das, P. – *Floriculture and Landscaping*
2. Randhawa, G.S. & Mukhopadhyay, A. – *Floriculture in India*
3. Chada, K.L. – *Handbook of Horticulture*
4. Laurie, A. & Ries, V.H. – *Floriculture: Fundamentals and Practices*
5. Kumar, N. – *Introduction to Horticulture*
6. Singh, A.K. – *Flower Crops: Cultivation and Management*
7. ICAR – *Handbook of Horticulture (Latest Edition)*

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]**Course Category - Minor Course (MN)****Course Code – ST 343 MN-T****Course Title: Production Technology for Feed and Fodder****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

- To introduce the importance of feed and fodder in livestock production.
- To impart knowledge of different fodder crops and their management.
- To understand conservation techniques like hay and silage making.
- To develop skills in planning year-round fodder production.
- To promote sustainable and efficient fodder production systems.

Course Outcomes

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

1. Understand the role of feed and fodder in livestock nutrition.
2. Identify major fodder crops and their cultivation practices.
3. Plan fodder production systems for different agro-climatic regions.
4. Apply fodder conservation techniques effectively.
5. Manage fodder resources sustainably for livestock farming.

Sr. No.	Topic Details	No. of Lectures
	Credit-I	
1.	Chapter-1: Introduction to Feed and Fodder 1.1 Importance of feed and fodder in livestock production 1.2 Classification of feeds: • Roughages (green and dry fodder) • Concentrates 1.3 Nutritional components of feed: • Carbohydrates, proteins, fats, vitamins, minerals 1.4 Role of fodder in dairy, poultry, and livestock sectors	4L
2.	Chapter- 2: Fodder Crops and Their Classification 2.1 Classification based on season: Kharif, Rabi, Summer fodders 2.2 Classification based on type: Cereals (e.g., maize, sorghum) Legumes (e.g., berseem, lucerne) Grasses (e.g., napier grass, guinea grass) 2.3 Annual vs perennial fodder crops 2.4 Fodder trees and shrubs	5L
3.	Chapter- 3: Cultivation Practices of Major Fodder Crops 3.1 Land preparation and sowing methods 3.2 Seed rate and spacing 3.3 Nutrient management (organic and inorganic fertilizers) 3.4 Irrigation management 3.5 Weed control	6L

	3.6 Harvesting stages and yield 3.7 Package of practices for: • Cereal fodders • Leguminous fodders	
	Credit-II	
4.	Chapter- 4: Grassland and Pasture Management 4.1 Types of grasslands and pastures 4.2 Establishment of pastures 4.3 Grazing management: • Rotational grazing • Controlled grazing 4.4 Improvement of degraded pastures 4.5 Role of legumes in pasture improvement	5L
5.	Chapter- 5: Fodder Conservation Techniques 5.1 Importance of fodder conservation 5.2 Hay making: • Methods and precautions 5.3 Silage making: • Principles and preparation 5.4 Storage and preservation techniques 5.5 Urea treatment of straw	5L
6.	Chapter- 6: Fodder Production Systems 6.1 Cropping systems for year-round fodder supply 6.2 Mixed and intercropping systems 6.3 Integrated farming systems 6.4 Hydroponic fodder production (basic concept)	3L
7.	Chapter- 7: Sustainable and Innovative Practices 7.1 Fodder banks and community fodder systems 7.2 Use of agricultural by-products 7.3 Climate-resilient fodder production 7.4 Organic fodder production	2L

References

1. Singh, C. & Singh, P. – *Modern Techniques of Raising Field Crops*
2. ICAR – *Handbook of Agriculture*
3. Reddy, D.V. – *Principles of Animal Nutrition and Feed Technology*
4. Panda, P.C. – *Animal Nutrition*
5. Rai, S.N. & Mudgal, V.D. – *Feeds and Fodder in India*
6. Pathak, N.N. – *Animal Nutrition*
7. Kalyani Publishers – *Fodder Production and Grassland Management*

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]
Course Category – Vocational Skill Course (VSC)
Course Code – ST 321 VSC-P

Course Title: Seed Technology and Intellectual Property Rights (IPR)
[No. of Credits: 2 C] [No. of Lectures: 60 L]

Course Objectives

- To provide practical exposure to different forms of Intellectual Property Rights.
- To develop skills in patent search, copyright registration, and trademark analysis.
- To familiarize students with IPR databases and legal procedures.
- To encourage innovation and protection of intellectual creations.

Course Outcomes

After completing the practical course, students will be able to:

1. Identify different types of intellectual property.
2. Conduct basic patent and trademark searches.
3. Understand procedures for filing IPR applications.
4. Analyze real-world IPR cases.
5. Apply IPR concepts in research and innovation.

Sr. No.	Title of the Practical	Weightage
1.	To study the basics of Intellectual Property Rights- Patent, Trademark, Copyright, GI	1P
2.	To study the structure of a patent document	1P
3.	To study basic patent search techniques- Keyword search and prior art	1P
4.	To study online patent search tools-Using WIPO and Google Patents	1P
5.	To study simple patent drafting- Writing title and abstract of an idea	1P
6.	To study trademark search procedures	1P
7.	To study copyright and its registration process	1P
8.	To study Geographical Indications (GI)- Darjeeling Tea, Alphonso Mango	1P
9.	To study industrial design registration	1P
10.	To study the role of IPR in business- Startups and product protection	1P
11.	To study case analysis in IPR	1P
12.	To study filing procedures of IPR Patent and trademark steps (demo)	1P
13.	To study IPR institutions through field/virtual visit	1P
14.	To study and present a mini project on IPR-Report writing and presentation	2P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]
Course Category – Vocational Skill Course (VSC)
Course Code – ST 322 VSC-P

Course Title: Agricultural Crops Stress Physiology

[No. of Credits: 2 C]

[No. of Lectures: 60 L]

Course Objectives

- To introduce students to different types of plant stresses and their impact on crops.
- To develop practical skills in assessing physiological responses under stress conditions.
- To understand key biochemical and physiological indicators of stress tolerance.
- To train students in basic laboratory techniques related to plant stress analysis.
- To create awareness about crop adaptation and management under stress environments.

Course Outcomes

After completing the course, students will be able to:

- Identify different abiotic and biotic stresses affecting crops.
- Perform basic experiments to evaluate plant responses to stress.
- Measure physiological parameters such as RWC, chlorophyll, and membrane stability.
- Interpret biochemical indicators like proline and enzyme activity.
- Analyze stress tolerance and suggest suitable management practices.

Sr. No.	Title of the Practical	Weightage
1.	To study the concept and types of plant stress-Abiotic and Biotic	1P
2.	To study seed germination under stress conditions-Salinity	1P
3.	To study the effect of drought stress on plant growth	1P
4.	To study the effect of salinity stress on plants	1P
5.	To study the effect of temperature stress	1P
6.	To study relative water content (RWC) in leaves-Normal and Stress conditions	1P
7.	To study membrane stability index (MSI)- Electrolyte leakage method	1P
8.	To study chlorophyll content under stress	1P
9.	To study proline accumulation in stressed plants	1P
10.	To study antioxidant enzyme activity (basic demonstration)	1P
11.	To study stomatal behavior under stress	1P
12.	To study osmotic adjustment in plants	1P
13.	To study stress tolerance indices-Calculation and interpretation	1P
14.	To study field symptoms and adaptation strategies	2P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]
Course Category – Vocational Skill Course (VSC)

Course Code – ST 323 VSC-P

Course Title: Plant Biotechnology

[No. of Credits: 2 C]

[No. of Lectures: 60 L]

Course Objectives

- To provide hands-on knowledge of advanced plant biotechnology techniques.
- To develop skills in plant tissue culture and molecular biology.
- To understand principles of genetic engineering in plants.
- To familiarize students with modern tools used in crop improvement.

Course Outcomes

After completion, students will be able to:

- Perform basic plant tissue culture techniques.
- Isolate and analyze plant DNA.
- Understand molecular tools like PCR and electrophoresis.
- Explain genetic transformation methods.
- Apply biotechnology concepts in crop improvement.

Sr. No.	Title of the Practical	Weightage
1.	To study laboratory safety and basic equipment in plant biotechnology	1P
2.	To study preparation of culture media (MS)	1P
3.	To study sterilization techniques in tissue culture	1P
4.	To study aseptic techniques for inoculation	1P
5.	To study callus induction from plant explants	1P
6.	To study organogenesis in plant tissue culture	1P
7.	To study somatic embryogenesis	1P
8.	To study micro propagation technique in Banana	2P
9.	To study DNA isolation from plant tissues	1P
10.	To study agarose gel electrophoresis of DNA	1P
11.	To study Polymerase Chain Reaction (PCR)- Amplification of DNA (demonstration)	1P
12.	To study genetic transformation methods	1P
13.	To study cryopreservation and germplasm conservation	1P
14.	To study applications of plant biotechnology	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - V]
Course Category – Field Project (FP)/Community Engagement
Program (CEP)

Course Code – ST 331 FP/ ST 331 CEP

[No. of Credits: 2 C]

[No. of Lectures: 60 L]

Guidelines for Field Projects in Seed Technology

Introduction

Field projects in Seed Technology are designed to provide students with practical knowledge and hands-on experience in seed production, processing, testing, storage, certification, and quality management. These projects help students apply theoretical concepts to real agricultural and industrial conditions.

Course Objectives of Field Project

1. To develop practical skills in seed technology operations.
2. To understand field-level seed production practices.
3. To gain experience in seed quality assessment and certification procedures.
4. To improve observation, data collection, and analytical skills.
5. To encourage problem-solving and research-based learning.
6. To familiarize students with modern technologies used in the seed industry.
7. To promote teamwork, communication, and report-writing skills.

Course Outcomes

After completion of the field project, students will be able to:

1. Apply seed technology concepts in real field conditions.
2. Conduct seed testing and quality evaluation independently.
3. Understand industrial and agricultural seed practices.
4. Analyze field problems and suggest suitable solutions.
5. Prepare technical reports and presentations effectively.
6. Develop confidence for careers in seed industries, research, and agriculture sectors.

Areas for Field Projects

Students may conduct projects in the following areas:

1. Seed Production
2. Seed Processing
3. Seed Testing and Quality Control
4. Seed Storage
5. Seed Certification
6. Seed Marketing and Entrepreneurship
7. Biotechnological Applications
8. Organic Farming
9. Breeding experiments

10. Biological Control

Guidelines for Conducting Field Project**1. Selection of Topic**

- Select a relevant and practical topic related to seed technology.
- The project should address real agricultural or industrial problems.

2. Project Planning

- Define objectives clearly.
- Prepare work schedule and methodology.
- Identify required materials, equipment, and study area.

3. Field Work

- Visit farms, seed industries, laboratories, or research centers regularly.
- Record observations systematically.
- Follow safety and ethical practices during field activities.

4. Data Collection

- Collect accurate field and laboratory data.
- Use tables, charts, and photographs wherever necessary.

5. Analysis and Interpretation

- Analyze collected data scientifically.
- Compare results with standard recommendations or previous studies.

6. Report Preparation

The final project report should contain:

1. Title page
2. Certificate
3. Acknowledgement
4. Introduction
5. Objectives
6. Materials and Methods
7. Observations and Results
8. Discussion
9. Conclusion
10. Suggestions/Recommendations
11. References
12. Photographs/Appendices

Suggested Field Project Topics

Sr. No.	Project Topic
1	Study of seed germination percentage in different crops
2	Effect of storage conditions on seed viability
3	Comparative study of seed treatment methods
4	Hybrid seed production techniques in maize
5	Seed quality assessment of locally available seeds
6	Study of seed-borne diseases in crop plants
7	Moisture content analysis during seed storage

Sr. No.	Project Topic
8	Survey of seed marketing systems in local areas
9	Performance evaluation of improved crop varieties
10	Organic seed production practices
11	Study of seed certification procedures
12	Role of biofertilizers in seed treatment
13	Comparative study of manual and mechanical seed grading
14	Farmer awareness regarding certified seeds
15	Study of post-harvest seed processing methods

Evaluation Criteria

Criteria	Marks (%)
Topic Selection and Planning	10
Field Work and Practical Skills	30
Data Collection and Analysis	20
Project Report	25
Presentation/Viva	15

Student Responsibilities for Field Project in Seed Technology

1. Complete project and maintain punctuality.
2. Follow discipline, safety rules, and professional ethics at the workplace or field site.
3. Wear proper laboratory coat, gloves, masks, or safety equipment whenever required.
4. Maintain a daily work diary/logbook of all activities and observations.
5. Perform assigned tasks sincerely under the guidance of supervisors.
6. Handle laboratory instruments, seeds, chemicals, and equipment carefully.
7. Collect and record field and laboratory data accurately.
8. Follow proper procedures during seed production, processing, testing, and storage activities.
9. Maintain cleanliness and hygiene in laboratories, seed processing units, and field areas.
10. Respect the rules, regulations, and confidentiality of the organization or institution.
11. Communicate effectively with supervisors, staff members, farmers, and team members.
12. Participate actively in field visits, demonstrations, surveys, and practical activities.
13. Submit reports, assignments, and project work within the specified time.
14. Analyze observations and prepare conclusions scientifically.
15. Avoid misuse or wastage of seeds, chemicals, laboratory materials, and resources.

16. Report any problems, accidents, or equipment damage immediately to the supervisor.
17. Develop teamwork, leadership, and problem-solving skills during the project/training period.
18. Prepare and deliver presentations or viva reports confidently at the end of the project/training.
19. Follow ethical agricultural and environmental practices during field work.
20. Maintain positive behavior and represent the institution professionally during training/project activities.

Guidelines for Community Engagement Program in the Field of Seed Technology

Introduction

Community Engagement Programs in Seed Technology are organized to connect educational institutions, students, farmers, seed industries, and rural communities for the promotion of quality seed production, awareness, and sustainable agricultural practices. These programs help students gain practical exposure while contributing to community development.

Objectives of Community Engagement Program

1. To create awareness among farmers about quality seeds and modern seed technologies.
2. To promote the use of certified and high-quality seeds for better crop production.
3. To provide practical exposure to students through community interaction and field activities.
4. To transfer scientific knowledge and improved agricultural practices to rural communities.
5. To encourage sustainable agriculture and seed conservation practices.
6. To develop communication, leadership, and teamwork skills among students.
7. To strengthen collaboration between educational institutions, farmers, and seed industries.

Course Outcomes

After completion of the Community Engagement Program, students will be able to:

1. Communicate scientific seed technology concepts effectively to farmers and communities.
2. Understand real agricultural problems related to seed production and quality.
3. Apply practical knowledge in field situations.
4. Develop leadership, teamwork, and social responsibility.
5. Promote awareness about quality seeds and sustainable agricultural practices.
6. Contribute to rural development and agricultural productivity improvement.

Major Areas of Community Engagement

1. Farmer Awareness Programs

- Importance of certified seeds
- Seed treatment methods
- Improved crop varieties and hybrids
- Government schemes related to seeds and agriculture

- Seed Production Demonstrations
- Field preparation and sowing methods
- Isolation distance and rouging
- Hybrid seed production techniques
- Seed Quality and Testing Awareness
- Germination testing methods
- Seed storage techniques
- Identification of healthy and diseased seeds
- Sustainable and Organic Seed Practices
 - Organic seed production
 - Biofertilizers and biopesticides
 - Indigenous seed conservation

2. Training and Workshops

- Hands-on training for farmers and self-help groups
- Demonstration of seed processing equipment
- Entrepreneurship opportunities in seed business

3. Surveys and Data Collection

- Farmer seed usage survey
- Crop performance studies
- Problems faced by farmers in seed availability and storage

Guidelines for Conducting the Program

1. Planning and Preparation

- Identify community needs and target groups.
- Select suitable topics related to seed technology.
- Prepare training materials, charts, posters, and demonstrations.
- Coordinate with local agriculture officers, seed companies, or farmer groups.

2. Selection of Location

Programs may be conducted at:

- Villages and rural communities
- Farmer training centers
- Agricultural schools and colleges
- Seed farms and demonstration plots

Role of Students

1. Participate actively in awareness campaigns and field demonstrations.
2. Interact respectfully with farmers and community members.
3. Conduct surveys and collect field information accurately.
4. Assist in demonstrations of seed treatment and testing methods.
5. Prepare educational materials and presentations.
6. Maintain records, photographs, and reports of activities.
7. Promote scientific and environmentally friendly farming practices.

Role of Faculty/Program Coordinator

1. Guide students during planning and execution of activities.
2. Arrange expert lectures and technical support.
3. Coordinate with government departments and local organizations.
4. Monitor student participation and program effectiveness.

- Evaluate reports and provide feedback.

Suggested Community Engagement Activities

Sr. No.	Activity
1	Awareness campaign on certified seeds
2	Demonstration of seed germination testing
3	Farmer training on seed treatment methods
4	Seed storage management awareness program
5	Village survey on seed usage practices
6	Demonstration of hybrid seed production
7	Organic seed production awareness
8	Exhibition on improved crop varieties
9	Distribution of educational pamphlets/posters
10	Workshop on entrepreneurship in seed business
11	Awareness on seed-borne diseases and control
12	Demonstration of seed grading and cleaning
13	Community seed bank awareness program
14	Farmer interaction with seed experts
15	Field visit to seed production farms

Documentation and Report Preparation

The final report should include:

- Title of program
- Objectives
- Date and location
- Details of participants
- Activities conducted
- Photographs and survey data
- Observations and outcomes
- Problems identified in the community
- Suggestions and recommendations
- Conclusion

Evaluation Criteria

Criteria	Marks (%)
Participation and Discipline	20
Communication and Teamwork	20
Field Activities and Practical Work	30
Report Preparation	20

Criteria	Marks (%)
Presentation/Viva	10

Organizations that may support community engagement activities include:

- Indian Council of Agricultural Research
- Krishi Vigyan Kendra
- National Seeds Corporation
- State Department of Agriculture

SEMESTER-VI

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Core Course (MJ)****Course Code – ST 351 MJ-T****Course Title: Seed Farm Management****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

- To understand the concept of Farm management.
- To understand the Farm budget.
- To understand the role of farm machinery
- To gain the knowledge regarding Farm Business
- To learn the concept of Farm economics

Course Outcomes:

- Students will be acquainted with the concept of Farm management.
- They will understand the basic concept Farm budgeting
- Students will understand role of farm machinery
- They'll gain the knowledge regarding Farm Business
- They'll learn Farm economics

Sr. No.	Topic Details	No. of Lectures
	Credit-I	15L
1	Chapter-1: Introduction to Seed Farm Management 1.1.Principles of seed farm management 1.2. Importance of quality seed in agriculture. 1.3.Role of seed farm management in crop productivity	3L
2	Chapter-2: Seed Farm Planning and Organization 2.1.Selection of site for seed farm 2.2. Layout and infrastructure of a seed farm. 2.3. Buildings, roads, irrigation, and fencing.	4L
3	Chapter-3: Farm Equipment and Machinery 3.1.Machinery selection and their management 3.2. Role of machinery in saving labor, time and cost. 3.3.Farm Machinery: 3.3.1.Tractors: Different Power sources 3.3.2. Tillage Equipment: Moldboard plows, disc plows, cultivators for soil preparation. 3.3.3. Seed drills, planters for precise seed placement. 3.3.4. Pumps, sprinklers, drip systems for water management. 3.3.5. Sprayers for fertilizers and pesticides. 3.3.6. Harvester and Threshers.	4L
4	Chapter-4: Farm Management 4.1. Introduction and Definition 4.2. Objectives and scope of Farm management	4L

	4.3. Complete farm management and Partial farm management 4.4. Farm management vs Agricultural economics 4.5. Use of farm management in actual farming	
	Credit-II	15L
5	Chapter-5: Farm Business 5.1. Introduction 5.2. Factors involved in the selection of a business (Locality limitations, Capital limitations, Income limitations and personal inclination) 5.3. Comparison of general and specialized farming	3L
6	Chapter-6: Integrated farming System 6.1. Concept of Integrated Farming 6.2. Components of Farming 6.3. Rice Based Integrated Farming System 6.4. Advantages of Integrated Farming	3L
7	Chapter-7: Farm management 7.1. Concept, scope and basic principles. 7.2. Production cost and capital investment. 7.3. Planning and management of crops 7.4. Building and machinery Important crops of India.	3L
8	Chapter-8: Budget and Record Keeping 8.1. Farm budgeting, procedure and its uses 8.2. Farm records and their use. 8.3. Management of Land Labour and Capital Farm Surveys.	3L
9	Chapter-9: Farm economics 9.1. Economics of seed production 9.2. Cost of cultivation and profitability 9.3. Record keeping and documentation in seed farms 9.4. Challenges and future prospects in seed farm management	3L

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- Reddy, S.R. Principles of Agronomy Kalyani Publishers, Ludhiana, India.
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T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Core Course (MJ)****Course Code – ST 352 MJ-T****Course Title: Hybrid Seed Production-II****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

- To understand the principles and importance of vegetable seed production
- To study floral biology and pollination behavior of vegetable crops
- To learn techniques of quality seed production and maintenance
- To gain knowledge on harvesting, processing, testing, and storage of seeds

Course Outcomes

After completion, students will be able to:

- Explain seed production principles and seed quality parameters
- Identify suitable methods for seed production in major vegetables
- Demonstrate seed extraction, processing, and storage techniques
- Understand seed certification standards and quality testing

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter I: Introduction to Vegetable Seed Production (Hybrid) 1.1 Concept and objectives of vegetable seed production 1.2 History and development of vegetable seed production 1.3 Present status and importance in India 1.4 Major vegetable seed industries in India	5L
2.	Chapter 2: Classification of Vegetable Crops 2.1 Classification based on botanical families 2.2 Classification based on growing season (Rabi, Kharif, Zaid) 2.3 Classification based on life cycle (annual, biennial, perennial) 2.4 Classification based on plant parts used for consumption 2.5 Classification based on method of cultivation (direct-seeded and transplanted crops)	3L
3.	Chapter 3: Vegetable Farming Systems 3.1 Introduction to vegetable farming 3.2 Types of vegetable farming: a) Kitchen garden b) Market garden c) Truck garden 3.3 Processing of vegetables: a) Primary processing b) Secondary processing c) Value-added products	4L
4.	Chapter 4: Vegetable Nursery Management 4.1 Introduction and importance of nursery management 4.2 Types of nursery beds: a) Raised beds b) Flat beds c) Hi-tech nurseries and soilless media (pro-trays, cocopeat)	3L

	4.3 Transplanting techniques of seedlings 4.4 Precautions for raising healthy seedlings	
	CREDIT-II	
5.	Chapter 5: Hybridization Techniques in Vegetable Crops 5.1 Introduction and objectives of hybridization 5.2 Role of male sterility and self-incompatibility in hybrid seed production 5.3 Steps in hybridization: a) Selection of parents b) Emasculation c) Pollination d) Bagging and tagging e) Seed collection 5.4 Breeding methods for hybrid development: a) Simple cross b) Backcross c) Test cross 5.5 True Potato Seed (TPS) production technique 5.6 Advantages of hybridization in vegetable crops	4L
6.	Chapter 6: Breeding Methods in Vegetable Crops 6.1 Introduction to plant breeding in vegetables 6.2 Selection methods: a) Pure line selection b) Pedigree method c) Bulk method	3L
7.	Chapter 7: Population Improvement 7.1 Introduction and objectives of population improvement 7.2 Methods of population improvement: a) Mass selection b) Progeny selection 7.3 Applications and achievements in vegetable crops	3L
8.	Chapter 8: Seed Production Techniques in Vegetables 8.1 General principles of seed production 8.2 Seed production techniques in selected crops: • Brinjal • Tomato • Bitter gourd • Onion 8.3 Seed production practices with reference to: a) Land requirement and climate b) Isolation distance c) Nursery management d) Cultural practices e) Rouging f) Plant protection measures g) Harvesting and maturity h) Seed extraction methods i) Seed drying j) Seed storage	5L

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1. Hazra, P. and Som, M.G. – *Vegetable Seed Production and Hybrid Technology*, Kalyani Publishers
2. Thompson, J.R. – *An Introduction to Seed Technology*, Scientific Publishers
3. Agarwal, R.L. – *Seed Technology*, Oxford & IBH Publishing
4. Bose, T.K. and Som, M.G. – *Vegetable Crops in India*, Naya Prokash
5. ICAR e-Course: *Seed Science and Technology & Vegetable Science*

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Core Course (MJ)****Course Code – ST 353 MJ-T****Course Title: Seed Entomology****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

1. To understand the concept Seed Entomology.
2. To understand the collection and preservation techniques in insect.
3. To study important orders of insect pest with examples
4. To gain the knowledge regarding protection of seeds during storage.

Course Outcomes:

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

CO1: Acquaint with the concept of Seed Entomology and insect pest

CO2: Understand the basic concept of pest identification and protection of field crops.

CO3: Gain the knowledge regarding protection of seeds during storage.

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter-1: Introduction to Seed Entomology 1.1 Definition, scope, importance in agriculture & seed systems. 1.2 Economic importance of insects 1.2.1 Beneficial insects-Commercially valuable products, Insect pollinators, Entomophagus insects (Predators), Weed Killers, Soil Builders, Scavengers, Human food, Educational and Scientific value, Medicinal value, Source of dyes and aesthetic importance 1.2.2 Harmful Insects- Plant pest and vectors of diseases, Household/Human and animal pest	2L
2.	Chapter-2: Collection and Preservation of Insects 2.1 Where to look for insects 2.2 Catching insects 2.3 Baiting insects 2.4 Killing insects 2.5 Preservation-Dry and Liquid, Embalming insects	3L
3.	Chapter-3: Insect Life Cycles & Development 3.1 Hemimetabolous vs. holometabolous development. 3.2 Important orders of insect pest 3.2.1 Orthoptera 3.2.2 Hemiptera 3.2.3 Lepidoptera 3.2.4 Coleoptera 3.2.5 Diptera 3.2.6 Thysanoptera 3.2.7 Isoptera 3.2.8 Hymenoptera	10L

	3.2.9 Blattodea 3.2.10 Siphonaptera	
	CREDIT-II	15L
4.	Chapter-4: Seed Crop pests-I (W.r.t Morphology, Life history, Host plants, Damage and symptoms, Control measures) 4.1 Introduction 4.2 Pests of cereals and millets- <i>Chilo partellus</i> (Maize stem borer), <i>Macrosiphum miscanthi</i> (Wheat aphid) 4.3 Pests of Sugarcane- <i>Saccharicoccus sacchari</i> (Mealy Bug), <i>Holotrichia serrata</i> (White grub) 4.4 Pests of Pulses- <i>Helicoverpa armigera</i> (Army worm), <i>Chromatomyia horticola</i> (Pea leaf miner)	5L
5.	Chapter-5: Seed Crop pests-II (W.r.t Morphology, Life history, Host plants, Damage and symptoms, Control measures) 5.1 Pests of oil seeds- <i>Aphis craccivora</i> (Groundnut aphid), <i>Amsacta moorei</i> (Red hairy caterpillar) 5.2 Pests of Vegetables- <i>Leucinodes orbonalis</i> (Brinjal fruit borer), <i>Thrips tabaci</i> (Onion thrips), 5.3 Pest of Fibre Crops- <i>Dysdercus koenigii</i> (Red Cotton Bug), <i>Bemisia tabaci</i> (Cotton white fly) 5.4 Pest of fruits- <i>Bactocera rufomaculata</i> (Mango Stem Borer), <i>Bactrocera dorsalis</i> (Oriental fruit fly)	6L
6.	Chapter-6: Seed Storage entomology 6.1 Introduction and Definition 6.2 Insects in Stored Seeds- <i>Sitophilus spp.</i> , <i>Tribolium spp.</i> Bruchids 6.3 Factors affecting seed storage 6.4 Control of seed damage during storage 6.4.1 Storage structures 6.4.2 Seed Treatment 6.4.3 Air conditioning 6.4.4 Dehumidification 6.4.5 Sanitation 6.4.6 Fumigation	4L

References:

- A text book of Applied Entomology, Vol. II-K. P. Srivastava and G. S. Dhaliwal, Kalyani Publishers, 2014
- A TEXT BOOK OF Entomology-Manju Yadav, Sonali Publication, New Delhi-2013
- Encyclopedia of Entomology (Vol.1-3)-Nitish Shekhar, Sonali Publications, New Delhi, 2012
- Pest Management in Vegetables (I-II)- I. M. Khan, AGrotech Press, New Delhi, 2015
- Indian Insect Predators in Biological Control-K. Sahayaraj-Daya Publishing House, Delhi, 2004
- Integrated Production and Pest Management- K. R. Nair, Gene Tech Books, New Delhi, 2007

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Core Course (MJ)****Course Code – ST 354 MJ-T****Course Title: Seed Processing and Marketing****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives:**

- To understand the concept of Seed Processing.
- To understand the Seed Marketing.
- To understand the role of Seed conditioning and Seed drying
- To gain the knowledge regarding Seed marketing structure
- To learn the concept of seed cleaning

Course Outcomes:

- Students will be acquainted with the concept of Seed Processing.
- They will understand the basic concept Seed marketing
- Students will understand role of Seed Conditioning and Seed drying
- They'll gain the knowledge regarding basic principles in Seed marketing structure
- They'll learn seed cleaning
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Sr. No.	Topic Details	No. of Lectures
	Credit-I	15L
1	Chapter-1: Seed Processing 1.1. Introduction 1.2. Definition 1.3. Scope and objectives	3L
2	Chapter-2: Management of Seed Processing 2.1 Layout of seed processing plant 2.2 Basic flow pattern in seed processing plant 2.2.1 Receiving the seed in seed processing unit 2.2.2 Conditioning 2.2.2 Seed drying 2.2.3 Seed cleaning 2.2.4 Separation and grading 2.2.5 Seed treatment 2.2.6 Bagging, Packaging and Storage 2.2.7 Seed Marketing 2.3 Assembly line of processing and storage: Elevating and conveying equipment's. 2.4 Maintenance and management of the plant	4L

3	Chapter-3: Seed Conditioning and Seed drying 3.1. Definition:Seed Conditioning 3.2. Functions of 3.2.1 Scalper 3.2.2 Debearder 3.2.3 Scarifier 3.2.4 Huller 3.3.Definition: Seed drying 3.4. Methods of seed drying 3.4.1 Physical 3.4.2 Mechanical drying. 3.5. Advantages of seed drying	4L
4	Chapter-4: Seed processing machines 4.1. Seed cleaning: Air screen cleaner cum grader, Working principle and uses. 4.2. Separation and grading :Specific gravity separator, aspirators and Destoner machine 4.3. Magnetic separators and Spiral separators. 4.4. Seed treating equipment's 4.5. Bag sieving and Labeling machine Working principle and uses.	4L
	Credit-II	15L
5	Chapter-5: Seed Storage 5.1. Bagging and its methods 5.2. Methods of seed storage 5.3. Storage containers 5.4. Factors affecting storability of seeds 5.5. Changes during seed storage 5.6. Basic requirements of seed storage	4L
6	Chapter-6: Seed Marketing 6.1. Introduction, Major components of seed marketing 6.2. Role of different seed organizations in seed marketing 6.3. Role of information technology and telecommunication in marketing of seed.	4L
7	Chapter-7: Seed Marketing Structure 7.1. Importance and promotion of quality seed. 7.2. Formal and informal seed supply system 7.3. Seed marketing structure 7.4. Direct marketing and Contract marketing 7.5. Role of seed federation in seed trade	4L
8	Chapter-8: National Seed policy and seed marketing 8.1. Salient features of National seed policies. 8.2. Role of different agencies in efficient seed marketing 8.3. Responsibilities of seed companies and dealers under Seed Act.	3L

References:

1. Ponnuswamy , A.S. 2001 , Quality Seed Production in Hybrids Rice In Recent

2. Techniques and Participatory Approaches on Quality Seed Production ICAR Winter School Training Manual , Dept . of Seed Science and Technology , Tamil Nadu Agricultural University , Coimbatore 641 003, India .
3. R. Umarani , R.Jerlin , N. Natrajan , P.Masilamani and A.S. Ponnuswamy , Experimental Seed Science and Technology Dept . of Seed Science and Technology , Tamil Nadu Agricultural University , Coimbatore 641 003, India
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5. L.M. Jeswani , B. Baldev . Pulse Production Technology . Publication and Information Division, Indian Council of Agricultural Research Krishi Anusandhan Bhavan , Pusa New Delhi .
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7. Desai. B.B., P.M Kotecha and D.K. Salunkha. 1997. Seeds Hand Book - Biology Production, Processing and Storage. Marcel Dekker. New York.

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Core Course (MJ)****Course Code – ST 355 MJ-P**

Course Title: Practical Based on ST 351 MJ- T and ST 352 MJ- T
[No. of Credits: 2 C] [No. of Lectures: 60 L]

Course Objectives

The course is designed to:

1. To introduce the basic concepts and importance of vegetable seed production.
2. To impart knowledge on classification, nursery management, and vegetable farming systems.
3. To develop understanding of hybridization and breeding methods in vegetable crops.
4. To provide knowledge on seed extraction, processing, storage, and quality maintenance.
5. To understand the concept of Farm management.
6. To understand the Farm Tillage implements.
7. To understand the role of farm machinery
8. To gain the knowledge regarding Farm machinery
9. To learn the concept of record keeping

Course Outcomes

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

1. Explain the fundamentals and significance of vegetable seed production.
2. Classify vegetable crops based on different criteria and understand their cultivation systems.
3. Demonstrate nursery raising, transplanting, and basic crop management practices.
4. Apply hybridization and breeding techniques in vegetable crops.
5. Students will be acquainted with the concept of Farm management.
6. They will understand the basic concept Farm implements
7. Students will understand role of farm machinery
8. They'll gain the knowledge regarding Farm machinery
9. They'll learn Farm record keeping

Sr. No.	Title of the Practical	Weightage
Practical Based on ST 351-T		
1.	To study Layout and infrastructure of a seed farm	1P
2.	Study of Primary and secondary Tillage Implements: Mould board Plough, Disc Plough, Harrows and Cultivators	1P
3.	Study of Seed-Cum-Fertilizer Drill	1P
4.	Study of Harvesting and Threshing Machinery	1P
5.	Study of Power Tiller- Important Parts and Attachments	1P
6.	Study of Inter-Culturing Tools and Implements	1P
7.	To study farm record keeping	1P
Practical Based on ST 352-T		

8.	To study identification and morphology of seeds of major vegetable crops (Tomato, brinjal, chilli, cucurbits, onion, etc.)	1P
9.	To study nursery bed preparation and raising of vegetable seedlings (Raised bed, flat bed, and pro-tray nursery)	1P
10.	To perform transplanting techniques and handling of vegetable seedlings	1P
11.	To study floral biology and perform emasculation and artificial pollination in vegetable crops (Tomato, Cucurbits)	1P
12.	To study hybridization techniques including bagging and tagging (Tomato, Cucurbits)	1P
13.	To study seed extraction methods in vegetable crops (Wet method in tomato; dry method in cucurbits)	1P
14.	To study seed processing, drying, storage, and basic viability testing	1P
15.	Visit to seed industry/ research institute/breeding station/show rooms-Machinery	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Core Course (MJ)****Course Code – ST 356 MJ-P****Course Title: Practical Based on ST 353 MJ- T and ST 354 MJ- T****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

After completing this course, students will be able:

1. To learn different methods of collection and preservation of insect pests.
2. To understand morphological characteristics and identification of major insect pests.
3. To study the life cycle and host range of important crop pests.
4. To recognize damage symptoms caused by insect pests in different crops.
5. To acquire knowledge of basic pest management and control measures.
6. To develop skills in handling, observing, and documenting insect specimens.
7. To understand the layout of Seed Processing.
8. To understand the methods of Seed Drying.
9. To understand the role of air screen cleaner cum grader machine
10. To gain the knowledge regarding seed packaging materials
11. To learn the concept of seed treatment

Course Outcomes

At the end of the course, students will be able:

1. Collect, preserve, and maintain insect specimens using dry, liquid, and embalming methods.
2. Identify major insect pests of cereals, pulses, oilseeds, sugarcane, fiber crops, vegetables, fruits, and stored grains.
3. Describe morphology and life history of important insect pests.
4. Diagnose pest damage and symptoms in various crops.
5. Suggest suitable control measures for different insect pests.
6. Apply practical knowledge for pest monitoring and basic pest management in field conditions.
7. Students will be acquainted with the layout of Seed Processing.
8. They will understand the methods of Seed Drying.
9. Students will understand role of air screen cleaner cum grader machine
10. They'll gain the knowledge regarding seed packaging materials
11. They'll learn seed treatment

Sr. No.	Title of the Practical	Weightage
	Practical Based on ST 353 MJ-T	
1.	Collection and Preservation of insect pest by using Dry method	1P
2.	Liquid and Embalming Methods in Insect Pest Collection and Preservation	1P
3.	Study of any one pest of cereals and millets w.r.t. W.r.t Morphology, Life history, Host plants, Damage and symptoms, Control measures	1P

4.	Study of any one pest of pulse and oil seed crop w.r.t. W.r.t Morphology, Life history, Host plants, Damage and symptoms, Control measures	1P
5.	Study of any one pest of fiber and vegetable crop w.r.t. W.r.t Morphology, Life history, Host plants, Damage and symptoms, Control measures	1P
6.	Study of any four pest of storage grain w.r.t. Morphology, Life history, Host plants, Damage and symptoms, Control measures	1P
Practicals Based on ST 354 MJ T		
7.	To study Layout and infrastructure of Seed Processing plant	1P
8.	To Study methods of drying (Natural and Artificial)	1P
9.	Study of air screen cleaner cum grader machine	1P
10.	Study of different types of elevator and conveyors.	1P
11.	Study of specific gravity separator.	1P
12.	Study of seed treatment equipment's and application of various chemicals	1P
13.	Study of seed packaging materials.	1P
14.	To study Bag sieving and Labeling machine	1P
15.	One day visit with seed marketing executive/ Seed processing and Storage complex	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Elective Course (MJ)****Course Code – ST 360 MJ-T****Course Title: Millets and its Production****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

1. To introduce students to the importance and diversity of millets.
2. To impart knowledge on classification, botany, and production practices of millets.
3. To develop understanding of improved varieties and cropping systems.
4. To familiarize students with nutrient management and plant protection.
5. To provide knowledge on harvesting, processing, and utilization of millets.

Course Outcomes

After completion, students will be able to:

1. Explain the importance and scope of millets in agriculture and nutrition.
2. Classify millets and describe their botanical characteristics.
3. Apply improved production technologies for major millets.
4. Understand nutrient, water, and weed management practices.
5. Identify major pests and diseases and suggest control measures.
6. Describe harvesting, processing, and value addition of millets.

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter 1: Introduction to Millets 1.1 Definition and concept of millets 1.2 History and origin of millets 1.3 Importance of millets in nutrition and climate resilience 1.4 Scope and status of millet production in India	3L
2.	Chapter 2: Classification and Botany of Millets 2.1 Classification of millets: • Major millets (sorghum, pearl millet) • Minor millets (finger millet, foxtail, little, kodo, barnyard, proso) 2.2 Botanical description and morphology	3L
3.	Chapter 3: Agro-climatic Requirements 3.1 Climate and soil requirements 3.2 Cropping seasons and distribution 3.3 Land preparation and sowing methods 3.4 Seed rate, spacing, and time of sowing	4L
4.	Chapter 4: Improved Varieties and Cropping Systems 4.1 High-yielding and hybrid varieties of major millets 4.2 Cropping systems and intercropping in millets 4.3 Millets in dryland farming systems 4.4 Role of millets in sustainable agriculture	5L
	CREDIT-II	
5.	Chapter 5: Nutrient and Water Management	3L

	5.1 Nutrient requirements and fertilizer application 5.2 Integrated nutrient management (INM) 5.3 Water management and drought tolerance	
6.	Chapter 6: Weed, Pest, and Disease Management 6.1 Major weeds and their control 6.2 Important insect pests of millets and management 6.3 Major diseases and their control measures 6.4 Integrated pest management (IPM)	4L
7.	Chapter 7: Harvesting and Post-Harvest Management 7.1 Maturity indices and harvesting methods 7.2 Threshing, drying, and storage 7.3 Post-harvest losses and management	3L
8.	Chapter 8: Processing and Utilization of Millets 8.1 Processing techniques (dehulling, milling) 8.2 Nutritional value of millets 8.3 Value-added products (flour, bakery products, ready-to-eat foods) 8.4 Role of millets in food security and health	5L

References:

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3. Rachie, K.O. and Majmudar, J.V. – *Pearl Millet*, Penn State University Press
4. ICAR – *Handbook of Agriculture*, ICAR Publications
5. Yadav, O.P. et al. – *Millets for Food and Nutritional Security*, ICAR
6. FAO – *Small Millets in Global Agriculture*
7. ICAR e-Course: *Dryland Agriculture & Millets Production*

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Elective Course (MJ)****Course Code – ST 361 MJ-T****Course Title: Agribusiness Management****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

- To introduce students to the fundamentals of agribusiness and its role in agriculture.
- To develop understanding of farm management and agribusiness operations.
- To familiarize students with marketing, finance, and entrepreneurship in agriculture.
- To build skills for decision-making in agricultural enterprises.

Course Outcomes

After completing the course, students will be able to:

- Understand the structure and functioning of agribusiness systems.
- Apply farm management principles for decision-making.
- Analyze agricultural marketing systems and price behavior.
- Identify financial sources and manage risks in agriculture.
- Develop basic business plans for agribusiness ventures.
- Understand supply chain and value addition in agriculture.

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter-1: Introduction to Agribusiness 1.1 Concept, scope, and importance of agribusiness 1.2 Components of agribusiness system (input, production, processing, marketing) 1.3 Agribusiness in India: structure and status 1.4 Role of agribusiness in rural development 1.5 Emerging trends in agribusiness	5L
2.	Chapter-2: Farm Management Principles 2.1 Meaning, objectives, and scope of farm management 2.2 Factors of production (land, labor, capital, management) 2.3 Types of farming systems 2.4 Cost concepts and farm income measures 2.5 Farm planning and budgeting 2.6 Decision-making in farm management	6L
3.	Chapter-3: Agricultural Marketing 3.1 Concepts and functions of agricultural marketing 3.2 Marketing channels and intermediaries 3.3 Price determination and market structure 3.4 Regulated markets and e-NAM 3.5 Storage, grading, and standardization 3.6 Problems and reforms in agricultural marketing in India	4L

	CREDIT-II	
4.	Chapter-4: Agribusiness Finance and Risk Management 4.1 Importance of finance in agribusiness 4.2 Sources of agricultural finance (institutional and non-institutional) 4.3 Credit planning and repayment 4.4 Risk and uncertainty in agriculture 4.5 Crop insurance and risk management strategies	5L
5.	Chapter-5: Agripreneurship and Enterprise Development 5.1 Concept of agripreneurship 5.2 Characteristics of successful agripreneurs 5.3 Business plan preparation 5.4 Government schemes for agribusiness development (e.g., PMFME, Agri-startups)	5L
6.	Chapter-6: Supply Chain and Value Addition 6.1 Concept of supply chain management in agriculture 6.2 Value chain and value addition 6.3 Post-harvest management and processing 6.4 Role of cooperatives and Farmer Producer Organizations (FPOs)	5L

References

1. Reddy, S.S. & Ram, P.R. – *Agricultural Finance and Management* – Oxford & IBH
2. Subba Reddy, S. et al. – *Agricultural Economics* – Oxford & IBH
3. Acharya, S.S. & Agarwal, N.L. – *Agricultural Marketing in India* – Oxford & IBH
4. Kahlon, A.S. & Tyagi, D.S. – *Agricultural Marketing and Price Policies* – Allied Publishers
5. Pandey, U.K. – *Agricultural Economics* – CBS Publishers
6. Singh, R.K.P. – *Farm Management* – Scientific Publishers
7. Government of India – *Economic Survey (Agriculture Chapter)*
8. NABARD Publications – *Agriculture and Rural Development Reports*
9. FAO – *Agribusiness Handbook Series*
10. ICAR – *Handbook of Agriculture*

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Elective Course (MJ)****Course Code – ST 362 MJ-T****Course Title: Bio-fertilizers****[No. of Credits: 2 C]****[No. of Lectures: 30 L]****Course Objectives**

- To introduce the concept and importance of biofertilizers in sustainable agriculture
- To understand different types of biofertilizers and their functions
- To develop basic knowledge of production, application, and quality control
- To promote eco-friendly nutrient management practices

Course Outcomes

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

- Understand the concept and importance of biofertilizers
- Identify different types and their functions
- Gain knowledge of production and application methods
- Evaluate quality and standards of biofertilizers
- Apply biofertilizers in sustainable agriculture practices

Sr. No.	Topic Details	No. of Lectures
	CREDIT-I	15L
1.	Chapter-1: Introduction to Biofertilizers 1.1 Definition, concept, and scope of biofertilizers 1.2 History and development of biofertilizer technology 1.3 Role of biofertilizers in sustainable agriculture 1.4 Advantages and limitations of biofertilizers 1.5 Comparison with chemical fertilizers	4L
2.	Chapter-2: Types of Biofertilizers 2.1 Nitrogen-fixing biofertilizers: Rhizobium, Azotobacter, Azospirillum 2.2 Cyanobacteria (BGA) and Azolla-Anabaena association 2.3 Phosphate solubilizing microorganisms (PSB) 2.4 Potassium solubilizing bacteria (KSB) 2.5 Mycorrhiza (VAM/AM fungi) 2.6 Zinc and other micronutrient solubilizers	5L
3.	Chapter-3: Mass Production of Biofertilizers 3.1 Isolation and selection of efficient strains 3.2 Culture media and growth conditions 3.3 Mass multiplication techniques 3.4 Carrier materials and inoculant preparation 3.5 Packaging, storage, and shelf life	6L
	CREDIT-II	
4.	Chapter-4: Application and Field Use 4.1 Methods of application (seed treatment, soil application, root dipping) 4.2 Crop-specific recommendations	5L

	4.3 Integrated Nutrient Management (INM) 4.4 Compatibility with fertilizers and pesticides 4.5 Factors affecting efficiency in field conditions	
5.	Chapter-5: Quality Control and Standards (3 Hours) 5.1 Quality parameters of biofertilizers 5.2 BIS standards and specifications 5.3 Methods for testing microbial count and contamination 5.4 Shelf life and labeling requirements	5L
6.	Chapter-6: Recent Advances and Future Prospects (3 Hours) 6.1 Liquid biofertilizers and consortia 6.2 Biofertilizers in organic farming 6.3 Role in climate-resilient agriculture 6.4 Government policies and promotion in India	5L

References

- Subba Rao, N.S. – *Biofertilizers in Agriculture and Forestry* – Oxford & IBH
- Kannaiyan, S. – *Biofertilizers* – Scientific Publishers
- Vessey, J.K. – *Plant Growth Promoting Rhizobacteria as Biofertilizers*
- Dubey, R.C. – *A Textbook of Biotechnology* – S. Chand
- ICAR – *Handbook of Agriculture*
- Mahdi, S.S. et al. – *Biofertilizers: A Sustainable Approach*
- Government of India – *Fertilizer Control Order (FCO) Guidelines*
- FAO – *Biofertilizer Manuals and Guidelines*
- Bhattacharyya, P.N. & Jha, D.K. – *Plant Growth-Promoting Rhizobacteria (PGPR)*
- NCERT/UGC e-resources on soil microbiology

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Elective Course (MJ)****Course Code – ST 363 MJ-P****Course Title: Practical Based on ST 360 MJ- T: Millets and its Production****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

1. To provide knowledge about the importance, nutritional value, and economic significance of millets.
2. To understand the origin, classification, and different types of millets cultivated in India and worldwide.
3. To study soil, climate, seed selection, and agronomic practices required for millet cultivation.
4. To develop skills in sustainable millet production, nutrient management, irrigation, and weed control.
5. To encourage entrepreneurship opportunities in millet cultivation and millet-based food industries.

Course Outcomes – Millets and Its Production

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

1. Explain the importance, nutritional benefits, and economic value of millets.
2. Identify different millet crops and describe their characteristics and cultivation requirements.
3. Apply suitable agronomic practices for effective millet production.
4. Demonstrate knowledge of soil preparation, seed treatment, irrigation, fertilizer application, and weed management in millet farming.
5. Develop basic entrepreneurial and research skills related to millet production and millet-based products.

Sr. No.	Title of the Practical	Weightage
1.	To study classification of millets	1P
2.	To study morphological characteristics of selected millets	1P
3.	To study land preparation and sowing methods	1P
4.	To perform seed rate calculation and spacing for millets	1P
5.	To study fertilizer application and nutrient management practices	1P
6.	To study water management practices in millets	1P
7.	To study weed identification and control methods	1P
8.	To identify major insect pests of millets	1P
9.	To identify major diseases of millets	1P
10.	To study harvesting and threshing methods	1P
11.	To study post-harvest handling and storage of millets	1P
12.	To study processing methods (dehulling/milling)	1P
13.	To prepare value-added millet products	2P
14.	Visit to Millet Research Centre/Processing Unit/Millet Product Manufacturing Unit	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Elective Course (MJ)****Course Code – ST 364 MJ-P****Course Title: Practical Based on ST 361 MJ- T: Agribusiness Management****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

1. To understand the structure, components, and functioning of the agribusiness system including input supply, production, processing, and marketing.
2. To develop practical knowledge of farm management practices such as cost calculation, farm planning, budgeting, and income analysis.
3. To familiarize students with agricultural marketing systems, grading, standardization, price spread analysis, and regulated markets/APMC functioning.
4. To enhance understanding of agricultural finance, crop insurance, and institutional support systems available to farmers and agribusiness enterprises.
5. To develop entrepreneurial and managerial skills through preparation of case studies and business plans for agribusiness enterprises.

Course Outcomes

1. After completion of the course, students will be able to:
2. Identify and classify different agribusiness enterprises and explain the functioning of various components of the agribusiness system.
3. Analyze farm resources, calculate cost of cultivation, estimate farm income measures, and prepare farm plans and partial budgets.
4. Evaluate agricultural marketing channels, analyze price spread, and understand grading, standardization, and APMC operations.
5. Assess sources of agricultural finance and explain the application of crop insurance schemes in farming situations.
6. Prepare and present a feasible business plan for small-scale agribusiness enterprises such as dairy, nursery, or food processing units.

Sr. No.	Title of the Practical	Weightage
1.	To study different components of agribusiness system (input, production, processing, marketing)	1P
2.	To identify various agribusiness enterprises in the local area and classify them	1P
3.	To study the structure and functioning of an agribusiness firm (case study method)	1P
4.	To study factors of production in a farm (land, labor, capital, management)	1P
5.	To calculate cost of cultivation of a selected crop	1P
6.	To estimate different farm income measures (gross income, net income, family labor income)	1P
7.	To prepare a simple farm plan for a small farm	1P
8.	To perform partial budgeting for farm decision-making	1P
9.	To study marketing channels for major agricultural commodities	1P

10.	To analyze price spread of a selected commodity	1P
11.	To visit a regulated market / APMC and study its functioning	1P
12.	To study grading and standardization practices of agricultural produce	1P
13.	To identify sources of agricultural finance in the locality (banks, cooperatives, SHGs)	1P
14.	To study crop insurance schemes and calculate premium/claims (case example)	1P
15.	To prepare a simple business plan for an agribusiness enterprise (e.g., nursery, dairy, food processing unit)	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category - Major Elective Course (MJ)****Course Code – ST 365 MJ-P****Course Title: Practical Based on ST 362 MJ- T: Bio-fertilizers****[No. of Credits: 2 C]****[No. of Lectures: 60 L]****Course Objectives**

1. To provide practical knowledge on isolation, identification, and characterization of important biofertilizer microorganisms.
2. To develop laboratory skills in microbial techniques such as media preparation, staining, culturing, and viable cell count estimation.
3. To understand the role and effectiveness of different biofertilizers in improving soil fertility and crop productivity.
4. To familiarize students with methods of mass multiplication, carrier preparation, packaging, and quality aspects of biofertilizer products.
5. To impart hands-on training on application methods of biofertilizers including seed treatment, root dipping, and soil application techniques.

Course Outcomes

1. Isolate and identify important biofertilizer microorganisms such as *Rhizobium*, *Azotobacter*, PSB, and cyanobacteria from soil and plant samples.
2. Prepare selective culture media, perform Gram staining, and evaluate colony morphology and microbial characteristics.
3. Assess nodulation efficiency and estimate viable microbial population using serial dilution techniques.
4. Demonstrate mass multiplication, carrier-based inoculant preparation, packaging, and storage practices of biofertilizers.
5. Apply appropriate biofertilizer inoculation methods for different crops and understand their practical significance in sustainable agriculture.

Sr. No.	Title of the Practical	Weightage
1.	To isolate <i>Rhizobium</i> from root nodules of leguminous plants	1P
2.	To isolate <i>Azotobacter</i> from soil samples using selective media	1P
3.	To isolate phosphate solubilizing bacteria (PSB) from soil	1P
4.	To observe and identify cyanobacteria (BGA) from water/soil samples	1P
5.	To study colony morphology of different biofertilizer microorganisms	1P
6.	To perform Gram staining of biofertilizer microbes	1P
7.	To study nodulation in legume roots and effectiveness of nodules	1P
8.	To prepare culture media for biofertilizer organisms (e.g., YEMA, Ashby's medium)	1P
9.	To study mass multiplication techniques of biofertilizers (demonstration)	1P
10.	To prepare carrier-based biofertilizer inoculant	1P
11.	To demonstrate seed treatment with biofertilizers	1P
12.	To demonstrate root dipping method for transplanting crops	1P

13.	To demonstrate soil application method of biofertilizers	1P
14.	To estimate viable cell count of biofertilizer using serial dilution method	1P
15.	To study packaging, labeling, and shelf-life of biofertilizer products (market samples)	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]
Course Category – Vocational Skill Course (VSC)
Course Code – ST 371 VSC-P

Course Title: Pesticide and Formulation Technology

[No. of Credits: 2 C]

[No. of Lectures: 60 L]

Course Objectives

- To provide basic knowledge of different types and formulations of pesticides.
- To develop skills in identification and handling of pesticide formulations.
- To familiarize students with simple formulation techniques and physico-chemical properties.
- To train students in calibration and safe application of pesticides.
- To create awareness about safe handling, storage, and environmental aspects of pesticide use.

Course Outcomes

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

- Classify and identify pesticides and their formulations used in agriculture.
- Demonstrate basic preparation methods of common pesticide formulations (dust, WP, EC).
- Evaluate physico-chemical properties such as pH, wettability, suspensibility, and emulsion stability.
- Calibrate and operate spraying equipment for accurate pesticide application.
- Calculate correct dosage and prepare spray solutions for field use.
- Follow safe handling, storage, and disposal practices for pesticides.
- Understand the role of formulation components like carriers, solvents, and surfactants.

Sr. No.	Title of the Practical	Weightage
1.	To study classification of pesticides based on target organisms and chemical nature	1P
2.	To identify and study different pesticide formulations available in the market (EC, WP, SC, GR, etc.)	1P
3.	To study labels and specifications of commercial pesticide products	1P
4.	To prepare a simple dust formulation of a pesticide (demonstration)	1P
5.	To prepare a wettable powder (WP) formulation (demonstration)	1P
6.	To prepare an emulsifiable concentrate (EC) formulation (demonstration)	1P
7.	To study properties of carriers, solvents, surfactants, and adjuvants used in formulations	1P
8.	To determine pH of pesticide formulations	1P
9.	To determine emulsion stability of EC formulation	1P
10.	To study wettability and suspensibility of wettable powder (WP)	1P
11.	To determine particle size of dust or granular formulations (sieve analysis)	1P

12.	To calibrate a knapsack sprayer for pesticide application	1P
13.	To study different spraying and dusting equipment	1P
14.	To calculate dosage and prepare spray solution for field application	1P
15.	To study safe handling, storage, and use of pesticides (PPE and safety measures)	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]
Course Category – Vocational Skill Course (VSC)
Course Code – ST 372 VSC-P

Course Title: Fermentation Technology

[No. of Credits: 2 C]

[No. of Lectures: 60 L]

Course Objectives

1. To understand the basic principles and importance of fermentation technology.
2. To develop laboratory skills related to microbial cultivation and fermentation processes.
3. To study sterilization, media preparation, and aseptic techniques used in fermentation industries.
4. To understand the role of microorganisms in industrial fermentation products.
5. To perform small-scale fermentation experiments and analyze fermentation parameters.
6. To develop awareness about industrial applications of fermentation technology in food, pharmaceutical, and biotechnology sectors.

Course Outcomes

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

1. Demonstrate proper laboratory safety and aseptic techniques in fermentation experiments.
2. Prepare culture media and perform sterilization procedures effectively.
3. Identify and cultivate microorganisms used in fermentation industries.
4. Perform batch fermentation and monitor factors affecting fermentation.
5. Analyze fermentation products such as alcohol, organic acids, and enzymes.
6. Understand industrial applications of fermentation technology in various sectors.

Sr. No.	Title of the Practical	Weightage
1.	Introduction to fermentation laboratory instruments and safety procedures	1P
2.	Preparation and sterilization of culture media	1P
3.	Study of aseptic techniques and microbial handling	1P
4.	Isolation and cultivation of yeast from natural sources	1P
5.	Microscopic observation and identification of fermentation microorganisms	1P
6.	Preparation of inoculum for fermentation process	1P
7.	Alcoholic fermentation using yeast	1P
8.	Estimation of alcohol produced during fermentation	1P
9.	Production of curd/yogurt by lactic acid fermentation	1P
10.	Production of vinegar by acetic acid fermentation	1P
11.	Study of factors affecting fermentation (pH, temperature, substrate concentration)	1P
12.	Enzyme production by microbial fermentation	1P
13.	Measurement of microbial growth during fermentation	1P

14.	Downstream processing: filtration and centrifugation techniques	1P
15.	Visit report/mini project on industrial fermentation process	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]
Course Category – Vocational Skill Course (VSC)
Course Code – ST 373 VSC-P

Course Title: Food Safety and Standards

[No. of Credits: 2 C]

[No. of Lectures: 60 L]

Course Objectives

- To develop understanding of basic concepts of food safety, hygiene, and sanitation.
- To familiarize students with different types and sources of food contamination.
- To introduce methods for assessing food quality and detecting adulteration.
- To create awareness about food safety regulations and standards in India, especially those prescribed by Food Safety and Standards Authority of India.
- To promote safe food handling practices and public health protection.

Course Outcomes

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

1. Understand food safety principles and identify potential hazards in food.
2. Explain sources and types of food contamination and their impact on health.
3. Perform basic tests for food quality evaluation and adulteration detection.
4. Apply safe food handling and hygiene practices in daily life and food-related activities.
5. Interpret food labels and standards as per Food Safety and Standards Authority of India guidelines.
6. Demonstrate awareness of food safety regulations and their role in consumer protection.

Sr. No.	Title of the Practical	Weightage
1.	To study personal hygiene and sanitation practices in food handling	1P
2.	To assess cleanliness and sanitation of food preparation areas (kitchen/lab audit)	1P
3.	To study sources and types of food contamination (physical, chemical, biological)	1P
4.	To evaluate sensory qualities of food (appearance, taste, texture, aroma)	1P
5.	To determine moisture content in food samples (basic method)	1P
6.	To determine ash content of food sample (demonstration)	1P
7.	To estimate acidity (pH) of different food samples	1P
8.	To detect common adulterants in milk (water, starch, detergent)	1P
9.	To detect adulterants in spices (turmeric, chili powder, pepper)	1P
10.	To detect adulteration in edible oils	1P
11.	To detect adulterants in sugar and jaggery	1P
12.	To study microbial load in food using simple plate count method (demonstration)	1P
13.	To study spoilage of food under different storage conditions	1P
14.	To study labeling requirements of packaged food products as per Food Safety and Standards Authority of India	1P
15.	To conduct a survey of food safety practices in local food outlets/vendors	1P

T. Y. B. Sc. SEED TECHNOLOGY [Semester - VI]**Course Category – On Job Training (OJT)****Course Code – ST 381 OJT****[No. of Credits: 4 C]****[No. of Lectures: 120 L]**

Guidelines for On-Job Training (OJT) in the Field of Seed Technology**Introduction**

On-Job Training (OJT) in Seed Technology provides students with practical exposure to seed production, processing, testing, storage, certification, and marketing activities carried out in seed industries, research organizations, and agricultural farms. The training helps students develop technical skills, professional ethics, and industry experience.

Course Objectives of On-Job Training

1. To provide practical exposure to seed technology operations and industrial practices.
2. To develop technical skills in seed production, processing, testing, and storage.
3. To understand quality control and seed certification procedures.
4. To bridge the gap between theoretical knowledge and practical applications.
5. To develop communication, teamwork, and professional skills.
6. To familiarize students with modern equipment and technologies used in seed industries.
7. To create awareness about entrepreneurship and employment opportunities in seed technology.

Course Outcomes of OJT

After completion of training, students will be able to:

1. Perform basic seed technology operations independently.
2. Understand industrial practices in seed production and processing.
3. Apply seed testing and quality control techniques.
4. Maintain professional ethics and workplace discipline.
5. Improve practical, communication, and problem-solving skills.
6. Gain confidence for employment or entrepreneurship in the seed sector.

Duration of Training

- The duration of OJT may range from **4 to 8 weeks** depending on institutional guidelines.
- Students should complete the required training hours regularly.

Place of Training

Students may undergo training at:

- Seed processing industries
- Seed certification agencies
- Agricultural universities and research stations
- Seed testing laboratories

- Government agriculture departments
- Private seed companies
- Seed farms and production units

Major Areas Covered During Training

1. Seed Production
2. Seed Processing
3. Seed Testing
4. Seed Storage
5. Seed Certification
6. Marketing and Distribution
7. Seed Quality Control
8. Seed Treatment
9. Seed Germination and vigour studies
10. Research and Development in Seed Technology
11. Biotechnological Applications in Seed Technology

Student Responsibilities

1. Maintain discipline and punctuality during training.
2. Follow laboratory and field safety rules.
3. Wear appropriate protective clothing when required.
4. Maintain a daily record/work diary of activities performed.
5. Interact professionally with supervisors and staff members.
6. Complete assignments, observations, and reports on time.
7. Protect confidential information of the organization.

Role of Industry Supervisor

- Guide students during practical activities.
- Assign relevant tasks and responsibilities.
- Monitor attendance and performance.
- Provide technical support and feedback.
- Evaluate student performance at the end of training.

Training Report Guidelines

The final OJT report should include:

1. Cover page
2. Certificate from organization
3. Acknowledgement
4. Objectives of training
5. Introduction to organization
6. Daily work record/log book
7. Activities performed
8. Skills learned
9. Problems observed and solutions
10. Photographs (if permitted)
11. Conclusion
12. Suggestions and references

Evaluation Criteria

Criteria	Marks (%)
Attendance and Discipline	20
Practical Performance	30
Daily Record/Log Book	20
Final Report	20
Viva/Presentation	10
