

**Rayat Shikshan Sanstha's**

**Yashwantrao Chavan Institute of Science,  
Satara  
(Autonomous)**

**Syllabus under Autonomy  
For**

**B. Sc. I Botany (Seed Technology)**

**Academic Year 2020 – 2021**

Rayat Shikshan Sanstha's  
**Yashavantrao Chavan Institute of Science, Satara**  
**Syllabus for Bachelor of Science**  
**B. Sc. (Part – I) Botany (Seed Technology)**

**1. TITLE: Seed Technology**

**2. YEAR OF IMPLEMENTATION: 2020-2021**

**3. PREAMBLE:**

The B. Sc. Botany (Seed Technology) course under autonomy will be effective from the academic year 2020. In that focus, 3 year B.Sc. vocational course prepared for the students. It is offered among as two theory and one practical course at B.Sc. I, at B. Sc. II and B.Sc. III it has two theory and two practical courses. The emphasis is to provide students the reliable and professional knowledge of seed production, quality control and maintenance. The course will provide opportunity of career in seed industries.

**4. GENERAL OBJECTIVES OF THE COURSE:**

1. To introduce the concept of new concepts in seed technology
2. To enrich student straining and knowledge that would be useful in seed industries so that the farmers will get quality seeds.
3. To develop skill in practical work, experiments and laboratory materials in seed technology.
4. To help students build up a progressive and successful career in seed industry.
5. To inculcate the sense of job responsibilities and to promote the possibilities of self-employment

**5. DURATION: 01 year**

**6. PATTERN: CBCS Semester**

**7. MEDIUM OF INSTRUCTION: English**

**8. STRUCTURE OF COURSE:**

**1] FIRST SEMESTER  
(NO. OF COURSES –02)**

Sr. No.	Subject Title	Theory					Practical	
		Course No. & Code	Title of Course	No. of lectures per week	Credits		No. of lectures Per week	Credits
1.	Seed Technology	Course – I: BBST 101	Seed Development and Morphology	5	4	Practical Course – I : BBSP103	4	2
		Course – II: BBST102	Plant Breeding					

**2]SECOND SEMESTER  
(NO. OF COURSES – 02)**

Sr. No.	Subject Title	Theory					Practical	
		Course No. & Code	Title of Course	No. of lectures per week	Credits		No. of lectures Per week	Credits
1.	Seed Technology	Course-III: BBST 201	Seed Physiology	5	4	Practical Course –II : BBSP 203	4	2
		Course – IV: BBST 202	Seed Production					

2] Structure and titles of Courses of B. Sc. Course

**B. Sc. I Semester - I**

BBST 101 Course - I: Seed Development and

Morphology BBST 102 Course - II: Plant Breeding

BBSP 103 Botany Practical - I: Practicals based on Theory Course I and II

**B. Sc. I Semester - II**

BBST 201 Course - III: Seed

Physiology BBST 202 Course - IV:

Seed Production

BBSP 203 Botany Practical - II: Practicals based on Theory Course III and IV

**3] OTHER FEATURES:**

**A] LIBRARY:**

Reference books, Textbooks, Journal, Periodicals available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

**B] SPECIFIC EQUIPMENTS:**

a] Computer, LCD projector, visualizer, smart board

b] Laboratory Equipment's:

1. Microscope with digital camera
2. Stereo microscope
3. Digital weighing balance
4. Microtome
5. Autoclave
6. Hot Air Oven
7. Incubator
8. Refrigerator
9. Seed separator
10. Seed Triers

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**Yashwantrao Chavan Institute of Science, Satara (Autonomous)**  
**Syllabus introduced from June 2020**  
**Bachelor of Science (B.Sc.) Part - I: Botany (Seed Technology)**  
**Semester: I**

**Theory Course I (BBST 101) Seed Development and Morphology**

**Learning Objectives:**

1. Student should be able to understand the concept of seed technology.
2. Student should be able to identify seeds identification based on morphological characters.
3. Student should get knowledge about reproduction in plants, seed structure and development.

**Total Lectures 36**

**Unit I Introduction to Seed Technology**

**(09)**

- 1.1 Need and Role of Seed Technology
- 1.2 Concept of Seed, Definition and types (based on endosperm, no. of cotyledons and viability), difference between Seed and Grain, importance of seed to plant and human.
- 1.3 Morphology of crop and seed for identification of varieties of following crops- Potato, Onion, Jowar, Wheat, Soybean & Sugarcane. (Any two locally cultivated varieties)

**Unit II Crop Families and Embryology**

**(09)**

- 2.1 Classification of crops (based on season, lifecycle, uses), Major crops belonging to the Dicotyledons and Monocotyledons families –Fabaceae (*Phaseolus*, *Glycine*), Brassicaceae (*Brassica*, *Raphanus*), Solanaceae (Brinjal, Tomato), Poaceae (Jowar, Maize)
- 2.2 Structure of anther, structure and development of male gametophyte.
- 2.3 Structure of ovule, Structure and development of female gametophyte.
- 2.4 Fertilization, Endosperm formation & Embryo.

**Unit III Reproductive Biology**

**(09)**

- 3.1 Structure of Dicotyledonous and Monocotyledonous flowers- Unisexual (Cucurbits and Maize) and Bisexual (Beans and Jowar); Monoecious, Dioecious Plants.
- 3.2 Pollination, Autogamy, Allogamy, Pollinating agents.
- 3.3 Apomixis & Polyembryony
- 3.4 Effect of environmental factors on floral biology

**Unit IV Seed structure and Development**

**(09)**

- 4.1 Structure of Dicotyledon and Monocotyledon seeds, external and internal characters e.g. Cotton, Pea, Castor and Maize.
- 4.2 Seed ripening and maturation process.

#### 4.3 Factors affecting seed setting

#### 4.4 Storage of reserve food in seeds.

#### **Learning Outcomes:**

After completion of Unit - I students are able to:

1. Learn about concept of seed technology.
2. Learn about seed identification based on morphological characters

After completion of Unit - II students are able to:

1. Learn major crop families.
2. Learn basic concepts of plant embryology and its importance.

After completion of Unit - III students are able to:

1. Get knowledge about reproductive biology of plants.
2. Learn different concepts of embryology.

After completion of Unit - IV students are able to:

1. Get knowledge of structure of seeds.
2. Get knowledge of process in development of seeds.

#### **References:**

1. Singh, Pande, and Jain, A text book of Botany Angiosperms (Rastogi publication. New Delhi.)
2. P. Maheshwari, An Introduction to Embryology of Angiosperms (Mc Graw Hill Book Co., New York 1950).
3. S. S. Bhojwani and S. P. Bhatnagar, Embryology of Angiosperms, (Vikas Publishing Pvt. Ltd., New Delhi 1999)
4. ICAR, Hand book of Agriculture, New Delhi.
5. A. A. Khan, Physiology and Biochemistry of Seed Dormancy and germination (North Holland, Amsterdam).
6. B. D. Singh, Plant Breeding Principles and Methodology, (Kalyani Publishers, New Delhi, 2018)
7. D. K. Jha, Seed Pathology, (Vikas Publishing House Pvt. Ltd., New Delhi)
8. Mondal and Saha, Seed Production and field crops (New India Publishers Agency, New Delhi).
9. A. K. Joshi, B. D. Singh, Seed Science and Technology (Kalyani Publishers New Delhi 2017)
10. R. L. Agarwal, Seed Technology (Oxford and IBHJ Publication, New Delhi 1995)
11. V. N. Naik, Taxonomy of Angiosperms (New Delhi: Tata McGraw-Hill Publication Com. Ltd., 1984)

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**Syllabus introduced from June 2020**  
**Bachelor of Science (B.Sc.) Part - I: Botany (Seed Technology)**  
**Semester: I**  
**Theory Course II (BBST 102) Plant Breeding**

**Learning Objectives:**

1. Student should understand the concept and various aspects of plant breeding.
2. Student should learn the genetic basis of plant breeding and various methods of hybridization in plants.
3. Student should learn about resources of seeds along with centers of origin.

**Total lectures 36**

**Unit I Concepts in Plant Breeding**

**(09)**

- 1.1 Plant breeding: Introduction, History, Objectives and important achievements in crop improvement.
- 1.2 Plant breeding methods (Introduction and acclimatization, Selection, Mutation breeding, (with suitable examples and achievements)
- 1.3 Male Sterility: Definition, methods of induction, applications and achievements.
- 1.5 Self-Incompatibility: Definition, types, mechanisms, methods of induction, applications and examples.
- 1.6 Institutes practicing plant breeding in India.(2-3 examples).

**Unit II Genetic basis of Plant Breeding, Plant Exploration and Plant Introduction**  
**(09)**

- 2.1 Genetic Basis of Crop improvement: brief account of Mendelian principles of inheritance, gene interactions, Gene and Environment, Inheritance of quantitative traits
- 2.2 Plant Exploration: Centers of Origin, Centers of genetic diversity
- 2.3 Concept of Seed Banks: Introduction, types of seed collection, types of seed banks, role of seed banks in local germplasm conservation.
- 2.4 Plant Introduction and Acclimatization: Concept, objectives, types, merits and demerits, achievements

**Unit III Selection Methods of Plant Breeding**

**(09)**

- 3.1 Selection: Concept, procedure, merits and demerits, achievements.
- 3.2 Mass Selection: Concept, procedure, merit, demerits and achievements
- 3.3 Pure-line Selection: Concept, procedure, merit, demerits and achievements.

3.4 Clonal Selection: Concept, procedure, merit, demerits and achievements.

#### **Unit IV Hybridization Method of plant breeding**

**(09)**

4.1 Introduction, concept, objectives, merits and demerits.

4.2 Techniques of hybridization: Selection and evaluation of parents, emasculation bagging and tagging, pollination, collection and storage of F<sub>1</sub> seeds and growing of F<sub>1</sub> generation.

4.3 Hybridization in cross pollinating crops, development of inbred lines, effect of selfing, single cross and double cross hybrids

4.4 Hybridization in self-pollinated crops, concept of heterosis.

#### **Learning Outcomes**

After completion of Unit - I students are able to:

1. Learn basic concepts in plant breeding.
2. Learn basic techniques used in crop improvement.

After completion of Unit - II students are able to:

1. Learn genetic basis of plant breeding.
2. Learn about basic concepts of plant exploration and plant introduction.

After completion of Unit - III students are able to:

1. Learn significance and applications of pure line selection in plant breeding.
2. Learn significance and applications of mass selection in plant breeding.

After completion of Unit - IV students are able to:

1. Learn different methods of hybridization.
2. Learn different concepts in plant breeding.

#### **References**

1. J. H. Fehlgan and D. Borthakur, Breeding Asian Field Crops (Oxford and IBH publishing company, New Delhi 1972)
2. H. K. Chaudhari Elementary Basic of plant breeding, Oxford & IBH Publishing Company, New Delhi 1984)
3. B. D. Singh, Plant Breeding Principles and Methodology, (Kalyani Publishers, New Delhi, 2018)
4. V. L. Chopra, Plant Breeding, (Oxford & IBH Publishing Company, New Delhi 2008)
5. J. R. Sharma, Principles and practices of plant breeding, (Tata McGraw Hill Publishing Company, New Delhi, 1994)

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**Syllabus introduced from June 2020**  
**Bachelor of Science (B.Sc.) Part - I: Botany (Seed Technology)**  
**Semester: I**  
**Practical Course - I (BBSP 103) Practicals based**  
**on Theory Course - I and - II**

**Learning Objectives:**

1. Student should understand the practical aspects of plant breeding.
2. Student should learn about resources of seeds along with centers of origin.
3. Student should be able to understand the practical concept of seed technology.
4. Student should be able to identify seeds identification based on morphological characters.

**Practicals:**

1. Study of family Fabaceae. [1]
2. Study of family Brassicaceae. [1]
3. Study of family Solanaceae. [1]
4. Study of family Poaceae. [1]
5. Morphology of Dicotyledon seeds: Castor and Groundnut. [1]
6. Morphology of Monocot seeds: Maize and Jowar. [1]
7. Seedling morphology of monocotyledon and dicotyledon crops. [1]
8. Adult plant morphology for the identification of any two varieties of the following crops – Soybean, Sugarcane, Jowar. [1]
9. Study of tools and equipments required for plant breeding [1]
10. Demonstration of hybridization techniques in crops (any two suitable crops with self and cross pollination). [2]
11. Cytological techniques for the study of chromosomes [2]  
Study of Mitosis and Study of Meiosis.

## **Learning Outcomes:**

### **After completion of**

Practical 1-4 Students should learn taxonomic account of major crop plants.

Practical 5-6 Students should learn morphology of dicotyledonous and monocotyledonous seeds.

Practical 7 Students should know seedling morphology of dicotyledonous and monocotyledonous plants.

Practical 8 Student should learn about identification of crop varieties based on morphological differences.

Practical 9-10 Students should learn tools and equipments in plant breeding along with demonstration of hybridization techniques.

Practical 11-14 Student should learn about different cytological techniques useful in plant breeding.

## **References**

1. B. D. Singh, Plant Breeding Principles and Methodology, (Kalyani Publishers, New Delhi, 2018)
2. J. R. Sharma, Principles and practices of plant breeding (Tata McGraw Hill Publishing Company, New Delhi, 1994)

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**Syllabus introduced from June 2020**  
**Bachelor of Science (B.Sc.) Part - I: Botany (Seed Technology)**  
**Semester: II**  
**Theory Course III (BBST 201) Seed Physiology**

**Learning Objectives:**

1. The Students should understand the physiological processes involved in seed development.
2. The students should be able to understand the concept, causes and mitigating measures of seed dormancy.
3. The students should be able to understand the process of Seed germination.
4. The students should be aware of the latest technologies used for seeds.

**Total lectures 36**

**Unit I Physiology of Seed Development** **(09)**

- 1.1 Chemical composition of seed.
- 1.2 Synthesis of food reserves (carbohydrates, proteins and lipids).
- 1.3 Seed vigour, its measurement and crops productivity.

**Unit II Seed Dormancy** **(09)**

- 2.1 Concept, types and causes of seed dormancy.
- 2.2 Methods of breaking seed dormancy.
- 2.3 Advantages and disadvantages of seed dormancy.
- 2.4 Seed viability, Seed longevity
- 2.5 Seed storage: Introduction, types of seed storage, factors affecting, seed deterioration during storage.
- 2.6 Methods to minimize seed aging and deterioration.

**Unit III Seed Germination** **(09)**

- 3.1 Concept, types and requirements of seed germination.
- 3.2 Pattern of water absorption.
- 3.3 Metabolism of storage product during seed germination.
- 3.4 Respiratory pathways during seed germination.
- 3.5 Seedling abnormalities and their causes.

**Unit IV Concept of Advanced Seed** **(09)**

- 4.1 Seed longevity behaviour: orthodox and recalcitrant seed

4.2 Seed pelleting and coating (Artificial or synthetic seed production)

4.3 Micropropagation: techniques, significance, use, scope and limitations.

### **Learning Outcomes:**

After the completion of Unit - I, the Students will be able to:

1. Understand the physiological processes involved in seed development.
2. Understand the biochemistry of seed.

After the completion of Unit - II, the Students will be able to:

1. Understand the concept, causes and mitigating measures of seed dormancy.
2. Understand the concept of seed viability

After the completion of Unit - III, the Students will be able to:

1. Understand the process of seed germination.
2. Understand the different pre-treatments for seed germination.

After the completion of Unit - IV, the Students will be able to:

1. Understand the latest technologies used for seeds.
2. Understand the micropropagation techniques.

### **References**

1. H. K. Hayes, F. R. Immer and D. C. Smith, Methods of Breeding, (Mc Graw Hill. Book Co. International, New York, 1955)
2. A. A. Khan, Physiology and biochemistry of seed dormancy and germination. (North Holland, Amsterdam)
3. B. D. Singh, Plant Breeding Principles and Methodology, (Kalyani Publishers, New Delhi, 2018)
4. R. W. Allard, Principles of Plant Breeding (W. John and Sons Inc., New York, 1999)
5. D. R. Murray, Seed Physiology: Development, (Academic Press, New York, 1985)
6. A. K. Joshi, B. D. Singh, Seed Science and Technology (Kalyani Publishers New, Delhi 2017)
7. R. L. Agarwal, Seed Technology (Oxford and IBHJ Publication, New Delhi 1995)

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**Bachelor of Science (B.Sc.) Part - I: Botany (Seed Technology)**  
**Semester: II**  
**Theory Course IV (BBST 202) Seed Production**

**Learning objectives:**

1. The students should be able to understand the concept of and factors affecting quality of seeds.
2. The students should be able to understand the process of hybrid seed production.
3. The students should be able to understand the concept and application of genetic purity of varieties.
4. The students should be able to understand the procedures utilized for seed production.

**Total lectures 36**

**Unit I Seed Quality Concept**

**(09)**

1.1 Seed quality: Concept, role of high-quality seeds in increasing crop production, seed quality control, characteristics of sowing quality seeds.

1.2 Modes of reproduction of crop plants and choice of method for seed production.

1.3 Choice of area of seed production. Factor affecting the choice of area of seed production – soil types, climate, nutrition, weed status, insect pests and disease incidence.

1.4 Seed production organization in India: National Seed Corporation (NSC) and State Seed Corporation (SSC), Any private seed organization and their role in seed industry. E.g. MAHYCO, MAHABEEJ etc.

**Unit II Hybrid Seed Production**

**(09)**

2.1 Seed production of forage legumes and vegetables. Improvement of pollination in hybrid seed production. (Any two examples from each title).

2.2 Feasibility of hybrid seed production by use of hand emasculation, detasseling, male sterility, gametocides and self-incompatibility.

2.3 System of breeding in self-pollinated and cross-pollinated crops. System of release and notification of varieties for general cultivation.

**Unit III Genetic Purity of Varieties**

**(09)**

3.1 Genetic purity of varieties: concept, factors responsible for their deterioration.

3.2 Methods of maintenance of genetic purity.

3.3 System and methods of production of nucleus, breeder, foundation and certified seed.

## **Unit IV Seed Production Procedures**

**(09)**

Seed production procedure of following crops with special reference to requirement, isolation, agronomic management, rouging, harvesting and threshing

4.1 Sunflower and Groundnut

4.2 Mung and Soybean

4.3 Jowar, and Maize

4.4 Brinjal and Tomato

### **Learning outcomes:**

1. After the completion of Unit I, the students will be able to understand the concept of and factors affecting quality of seeds.
2. After the completion of Unit II, the students will be able to understand the process of hybrid seed production.
3. After the completion of Unit III, the students will be able to understand the concept and application of genetic purity of varieties.
4. After the completion of Unit IV, the students will be able to understand the procedures utilized for seed production.

### **References**

1. H. K. Hayes, F. R. Immer and D. C. Smith, Methods of Breeding, (Mc Graw Hill. Book Co. International, New York 1955)
2. A. A. Khan, Physiology and biochemistry of seed dormancy and germination. (North Holland, Amsterdam)
3. B. D. Singh, Plant Breeding Principles and Methodology, (Kalyani Publishers, New Delhi, 2018)
4. R. W. Allard, Principles of Plant Breeding (W. John and Sons Inc., New York, 1999)
5. D. R. Murray, Seed Physiology: Development, (Academic Press, New York 1985)
6. A. K. Joshi, B. D. Singh, Seed Science and Technology (Kalyani Publishers New Delhi 2017)
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**Yashavantrao Chavan Institute of Science, Satara (Autonomous) Syllabus**  
**introduced from June 2020**  
**Bachelor of Science (B.Sc.) Part - I: Botany (Seed Technology)**  
**Semester: II**  
**Practical Course II (BBSP 203)**  
**Practicals Based on Theory Courses of**  
**III and IV**

**Learning Objectives:**

1. The Students should understand the physiological processes involved in seed development.
2. The students should be able to conduct practical to understand the concept, causes and mitigating measures of seed dormancy.
3. The students should be able to understand the process of Seed germination.
4. The students should be aware of the latest technologies used for seeds.
5. The students should be able to understand the procedures utilized for seed production.

**Practicals:**

1. Phenol test (Wheat and Paddy) and NaOH test (Any seed); Peroxidase and GA tests. [2]
2. Study of seed germination (epigeal and hypogeal) in 3 - 4 suitable / available crops. (2 monocot and 2 dicot) [1]
3. Study of effects of environmental factors (Light and temperature) on seed germination. [1]
4. Study of seed viability with the biochemical tests. [1]
5. Study of Pollen sterility and fertility (any four crops). [1]
6. Seed pelleting and coating (artificial seed) [2]
7. Demonstration of micropropagation. Preparation of culture (MS) medium, Sterilization and Inoculation [2]
8. Floral Biology of crop plants as per theory (any five crops) Sunflower, Maize, Bean, Wheat, Jowar and Groundnut. [2]
9. Field visits to different seed production farms / units, seed Production Company (At least two visits). [2]

## **Learning Outcomes:**

### **After completion of Practical No.**

1. The student will be able to perform and analyze biochemical tests in seeds.
- 2-3. The student will be able to perform germination studies and study the factors affecting seed germination.
4. The student will be able to perform seed viability tests.
5. The student will be able to determine pollen fertility in plants.
6. The student will be able to prepare artificial seeds.
7. The student will be able to prepare culture media and perform micropropagation studies.
8. The student will be able to study the floral biology of the crop plants.
9. The student will study the steps involved in seed production by visiting a seed production unit.

## **References**

1. A. A. Khan, Physiology and biochemistry of seed dormancy and germination. (North Holland, Amsterdam)
2. B. D. Singh, Plant Breeding Principles and Methodology, (Kalyani Publishers, New Delhi, 2018)
3. A. K. Joshi, B. D. Singh, Seed Science and Technology (Kalyani Publishers New, Delhi 2017)
4. R. L. Agarwal, Seed Technology (Oxford and IBHJ Publication, New Delhi 1995)

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