

Rayat Shikshan Sanstha's
**Yashavantrao Chavan Institute of Science,
Satara
(Autonomous)**

**New Syllabus For
Bachelor of Science
Part – III
Seed Technology**

Academic Year 2023 – 2024

Rayat Shikshan Sanstha's
Yashwantrao Chavan Institute of Science, Satara (Autonomous)

Syllabus for Bachelor of Science B. Sc. Part – III

1. TITLE: **Seed Technology**

2. YEAR OF IMPLEMENTATION: **2023 – 2024**

3. PREAMBLE:

The B. Sc. III Seed Technology course under autonomy will be effective from the academic year 2023– 2024. It has been prepared keeping in view the unique requirements of B. Sc. Seed Technology students. The contents have been drawn up to accommodate the widening horizons of the discipline of biological sciences. The emphasis is to provide students the latest information along with due weightage to the concepts of classical botany so that they are able to understand and appreciate the current interdisciplinary approaches in the study of plant sciences and its role in societal development. The course content also lists new practical exercises so the students get a hands on experience of the latest techniques that are currently in use. The course will also inspire students to pursue higher studies in botany, for becoming an entrepreneur and enable students to get employed in plant based industries.

4. GENERAL OBJECTIVES OF THE COURSE:

1. To impart the knowledge of science is the basic objective of education.
2. To develop scientific attitude among the students and to make the students open minded, critical and curious.
3. To develop skill in practical work, experiments and laboratory materials.
4. To understand scientific terms, concepts, facts, phenomenon and their relationships.
5. To make the students aware of natural resource and environment.
6. To enable the students to acquire knowledge of plants and related subjects so as to understand nature and environment in the benefit of human beings.
7. To develop ability for the application of acquired knowledge to improve agriculture and related fields to make the country self-reliant.

5. DURATION: 01 year

6. PATTERN: CBCS Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

1) FIFTH SEMESTER (NO. OF PAPERS – 04)

Sr. No.	Course title	Theory				Practical		
		Course code	Course title	No. of lectures per week	Credits	No. of lectures Per week	Credits	
1	Botany-Seed Technology (Common)	Paper IX: BBST 501	Genetics and Plant Breeding	06	04	Practical BBSP-505	10	04
		Paper X: BBST 502	Microbiology, Plant Pathology and Mushroom Cultivation Technology					
2	Botany-Seed Technology (Elective)	BBST 503	Vegetable Seed Production	06	04	Practical BBSP 506	10	04
		BBST 504	Seed Legislation and Certification					
3	Skill Enhancement	SECCBT 507	Basic Numerical Skills	01	01	SECCBP 510	03	01
4	AECC			02	02			

2) SIXTH SEMESTER (NO. OF PAPERS – 04)

Sr. No.	Course Title	Theory				Practical		
		Course Code	Title of Course	No. of lectures per week	Credits	No. of lectures Per week	Credits	
1	Botany-Seed Technology (Common)	BBST 601	Plant Biochemistry and Molecular Biology	06	04	Practical Paper – X: BBSP 605	10	04
		BBST 602	Bioinformatics, Biostatistics and Economic Botany					
2	Botany-Seed Technology (Elective)	BBST 603	Instrumentation and Techniques in Seed Technology	06	04	Practical Paper – X: BBSP 606	10	04
		BBST 604	Seed Farm Management and Marketing					
3	Skill Enhancement	SECCBT 607	Entrepreneurship Development	01	01	SECCBP 610	03	01
4	AECC			02	02			

2) Structure and titles of papers of B. Sc. Course

B. Sc. III Seed Technology Semester V

BBST 501: Genetics and Plant Breeding

BBST 502: Microbiology, Plant Pathology and Mushroom Cultivation Technology

BBST 503: Vegetable Seed Production

BBST 504: Seed Legislation and Certification

Practical BBSP 505 (based on BBPT 501 and 502)

Practical BBSP 506 (based on BBPT 503 and 504)

Skill Enhancement Paper-I (SECCBT 507) Basic Numerical Skills

Ability Enhancement Compulsory Course Paper-III

B. Sc. III Seed Technology Semester VI

BBST 601: Plant Biochemistry and Molecular Biology

BBST 602: Bioinformatics, Biostatistics and Economic Botany

BBST 603: Instrumentation and Techniques in Seed Technology

BBST 604: Seed Farm Management and Marketing

Practical BBSP 605 (based on BBPT 601 and 602)

Practical BBSP 606 (based on BBPT 603 and 604)

Skill Enhancement Paper-II (SECCBT 607) Entrepreneurship Development

Ability Enhancement Compulsory Course Paper-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 Trier

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Syllabus introduced from June 2023

Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: V
BBST 501 Genetics and Plant Breeding

Course Objectives: The Students will be able to.....

1. Impart the basic knowledge of mendelian genetics.
2. Impart the basic knowledge of linkage, recombination and quantitative inheritance.
3. Impart the basic knowledge of variations in chromosome number and structure.
4. Impart the knowledge of crop improvement.

Unit	SEMESTER – V BBST 501 Genetics and Plant Breeding	No. of hours per unit/ Credits 45
Unit-I	Mendelism and extra chromosomal inheritance	12
	1.1 Introduction	
	1.2 Principles of inheritance - a) Law of Dominance; b) Law of Segregation; c) Law of Independent Assortment; d) Back Cross and Test Cross	
	1.3 Gene interaction - a) Complementary gene interaction b) Supplementary gene interaction	
	1.4 Epistasis- Introduction, Dominant Epistasis, Recessive Epistasis	
	1.5 Extra-chromosomal Inheritance: Introduction, Plastid Inheritance and	

	Mitochondrial Inheritance (with classical as well as latest examples)	
Unit-II	Linkage, Recombination and Quantitative inheritance	11
	2.1 Linkage: Definition, Linkage groups, types, Coupling and Repulsion Phase, significance in plant breeding 2.2 Recombination (Crossing over): Definition, types, mechanism of crossing over, significance in plant breeding 2.3 Quantitative inheritance: a) Polygene inheritance – Concept, examples 1] Kernel colour in wheat, and 2] Ear length in Maize along with latest updates b) Population genetics – Hardy-Weinberg’s Law	
Unit - III	Variation in Chromosome Number and Structure	11
	3.1 Chromosome number: Euploidy, Aneuploidy and Polyploidy 3.2 Chromosomal structure: Deletion, Duplication, Inversion and Translocation 3.3 Mutation: Spontaneous and Induced mutation. Types of mutagens – Physical and Chemical, Significance of mutations in plant breeding.	
Unit – IV	Plant Breeding	11
	4.1 Introduction, Definition, Aims and objectives 4.2 Methods of Plant Breeding a) Introduction and Acclimatization b) Selection: i) Mass Selection; ii) Pure Line Selection; iii) Clonal Selection c) Hybridization techniques in Self- and Cross-pollinated crops d) Male Sterility and its significance e) Mutation Breeding: Gamma Garden 4.3 Multiple Allelism: Introduction, Definition, Self-incompatibility in plants, significance in plant breeding.	

Course outcomes: The students should be able to.....

- 1) Discuss & describe genetic basis of inheritance and extra chromosomal inheritance.

- 2) Describe and point out concept of linkage and recombination and concept of quantitative inheritance.
- 3) Explain the concepts and describe the chromosome structure and variation and explain the concept of mutation and its importance in crop improvement.
- 4) Describe and demonstrate different methods of plant breeding.

References

1. Allard A.W. *Principles of Plant Breeding*. Wiley Publications, 2010.
2. Chahal G.S., Gosal S.S. *Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches*. New Delhi: Narosa Publishing Co., 2010.
3. Gardener J., Simmons H.J., Snustad D.P. *Principles of Genetics*. 8th ed., New York: John Wiley & Sons, 1991.
4. Gupta P.K. *Cytogenetics*. Meerut: Rastogi Publications, 2018.
5. Gupta P.K. *Genetics*. Meerut: Rastogi Publications, 1997.
6. Hartl D.L., Jones E.W. *Genetics: Principles and Analysis*. 4th ed., Massachusetts, USA: Jones and Barlett Publishers, 1998.
7. Singh B.D. *A text Book of Plant Breeding: A dynamic View Designed for Under Graduate Courses of Indian Universities*. 3rd ed., New Delhi: Kalyani Publications, 2011.
8. Singh B.D. *Cytogenetics and Plant Breeding, Cytogenetics and Plant Breeding*. New Delhi: Kalyani Publications, 2010.
9. Singh B.D. *Genetics*. New Delhi: Kalyani Publications, 2009.
10. Singh B.D. *Plant Breeding: Principles and Methods*. New Delhi: Kalyani Publications, 2018.
11. Verma, P.S., Agarwal, V.K. S. *Cell Biology, Genetics, Evolution and Ecology*. New Delhi: Chand and Company Ltd., 2001.

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: V

**Course - BBST 502 Microbiology, Plant Pathology and
Mushroom Cultivation Technology**

Course Objectives: The Students will be able to....

1. Impart the knowledge of microbes, microbial techniques, and industrial microbiology.
2. Impart the basic knowledge of microbial genetics.
3. Impart the knowledge of plant pathology, plant diseases and their management.
4. Impart the knowledge of mushroom cultivation, storage and its economic importance.

Unit	SEMESTER – V BBST 502 Microbiology, Plant Pathology and Mushroom Cultivation Technology	No. of hours per unit/ Credits 45
Unit-I	<p style="text-align: center;">Microbiology</p> <p>1.1 General characters of microbes: Bacteria, Viruses, Actinomycetes and Phytoplasma</p> <p>1.2 Methods in Microbiology: Staining for microbes-bacteria and, PPLO, Sterilization Methods, Pure Culture Techniques</p> <p>1.3 Industrial Microbiology: Applications of micro-organisms with reference to production of Antibiotics (Penicillin), Organic Acids (Lactic Acid), Alcohol (Ethyl Alcohol), Microbial Pesticides: Concept, Types and Significance</p>	10

Unit II	Microbial Genetics	10
	<p>2.1 Bacterial genome</p> <p>2.2 Recombination in Bacteria: Transformation and Transduction</p> <p>2.3 DNA and RNA viruses</p> <p>2.4 Importance of microbial genetics</p>	
Unit - III	Plant Pathology	15
	<p>3.1 Concept and Importance of Plant Pathology, General symptoms of plant diseases</p> <p>3.2 Transmission of Pathogen: Air, Seed, Soil and Water</p> <p>3.3 Methods of plant disease management: Physical, Mechanical, Chemical and Biological</p> <p>3.4 Role of quarantine in plant disease management</p> <p>3.5 Study of Plant Diseases w. r. t. pathogen, symptoms and management</p> <p style="padding-left: 20px;">i) Grassy Shoot of Sugarcane (Phytoplasma),</p> <p style="padding-left: 20px;">ii) Citrus Canker (Bacterial),</p> <p style="padding-left: 20px;">iii) Yellow Vein Mosaic of Bhendi (Viral),</p> <p style="padding-left: 20px;">iv) White Rust of Crucifers (Fungal)</p> <p style="padding-left: 20px;">v) Early leaf spot (Tikka) disease of ground nut (Fungal)</p>	
Unit – IV	Mushroom cultivation technique	10
	<p>4.1 Introduction, History, General life cycle of mushrooms, Economic importance of mushrooms</p> <p>Types of Mushrooms: Non-edible (Poisonous) mushrooms and Edible (Non-poisonous) - Button, Oyster, Cordyceps ,Shiitake and Black ear mushrooms</p> <p>4.2 Cultivation Technology: Preparation of spawn, Sterilization and preparation of mushroom bed, Spawning, Factors affecting quality of mushroom beds, Harvesting of mushrooms</p> <p>4.3 Storage: Short Term (Refrigeration), Long Term Storage (Canning, Pickles, Papads) and Drying in Salt Solutions</p> <p>4.4 Nutritional Value: Proteins, Carbohydrates, Mineral Elements, Vitamins, Crude Fiber Content of Mushrooms. Medicinal value of</p>	

	Mushrooms	
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Course Outcomes Students will be able to.....

- 1) Discuss about microbes, Microbial techniques and different application of microbes in industries.
- 2) Solve the problem related microbial genetics and discuss application of microbial genetics.
- 3) Define concepts regarding chromosome structure and variation and explain the concept of mutation and its importance in crop improvement.
- 4) Identify plant diseases discuss their management.
- 5) Setup mushroom cultivation, storage and predicts its economic importance

References

1. Plant Pathology Agrios. G. N..Academic Press London. 1997.
2. Economics of mushroom cultivation. National Centre for Mushroom Research and Training, Solan, India. Anonymous, 1991
3. Cultivation Technology and Technical standards of components of Integrated Button Mushroom Unit, Protected Production under NHB Scheme. National Horticulture Board. Anonymous, 2011
4. Mushroom cultivation the past and the present of oyster mushroom. Kerteszetes Szoleszet. Balazs, S. 1985.
5. Introduction to the Bacteria. Clifton, McGraw Hill Co., New York. 1958
6. Laboratory Manual in Microbiology. Cunasekaran P New Age International Pvt. Ltd. 1995.
7. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. Hackett. P.B. Fuchs. J.A. and Messing J.W. The Benjamin /Cummings Publishing Co., Inc., Menlo Park California. 1988.
8. Growing Wild Mushrooms: A Complete Guide to Cultivating Edible and Hallucinogenic
Mushrooms. Harris, Bob. Homestead Book Company. Revised edition.

9. Introduction to plant Viruses Mandahar, C. L.. Chand & Ltd., Delhi. 1998
10. Plant Protection. Mehta P.R. and Verma,
11. Theory and Practice in Experimental Bacteriology Meynell, E and Meynell, G.G. University Press, Cambridge. 1970
12. Old R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation. Old R.W. and Primrose, S.B. Blackwell Scientific Publications. Oxford. UK. 1989
13. Microbiology. Peicar and Reid
14. Diseases of Crop Plants in India. Rangswamy, G. and Mahadevan A. 1999
15. Mushroom Cultivation in India. Suman B C and Sharma V P, 2007

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Syllabus introduced from June 2023

Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: V
Practical BBSP 505 - based on theory paper BBST 501 and 502

Course objectives: The Students will be able to.....

1. Give practical knowledge to students about different concepts in genetics.
2. Give the practical knowledge about various processes in plant breeding.
3. Give the practical knowledge of Microbial techniques (culture media, soil dilution, inoculation and staining).
4. Give the practical knowledge of plant diseases, symptoms and causal organism.

Section	SEMESTER – V Practical BBSP 505 - based on theory paper BBST 501 and 502	No. of hours per unit/ Credits 45
	Genetics and Plant Breeding	
Section- I	1. Genetic examples on Linkage. 2. Genetic examples on Crossing over 3. Genetic examples on Polygene inheritance 4. Determination of chromosome count in PMCs in <i>Allium</i> / <i>Cyanotis</i> . 5. Detection of meiotic anomalies in chromosomes in <i>Tradeschantia</i> . 6. Preparation of ideogram by using karyotype or chromosomal photographs. 7. Methods of emasculation 8. Breeding techniques in a) Malvaceae b) Fabaceae c) Poaceae 9. Study of World map to show Vavilov's centers of origin of cultivated	

	plants. 10. Visit to Krishi Vidnyan Kendra/ Seed Company and submission of visit reports.	
Section-II	Microbiology, Plant Pathology and Mushroom Cultivation Technology	
	11. Preparation and sterilization of culture media – PDA (slants and plates). 12. Isolation and separation of soil fungi by serial dilution method. 13. Methods of inoculation - slants and plates. 14. Study of different types of stains: Cotton blue, Dien’s stain, Gram’s stain and other stains. 15. Study of plant diseases - Grassy Shoot disease of Sugarcane. 16. Citrus Canker and Yellow Vein Mosaic of Bhendi. 17. Study of plant diseases - White Rust of Crucifers and Early leaf spot (Tikka) disease of ground nut. 18. Seed treatment by dipping and seed dressing. 19. Demonstration of Mushroom Cultivation. 20. Demonstration of Harvesting and Storage of mushrooms. 21. Submission of local plant /crop diseases (any ten).	

Course Outcome: Student should be able to.....

1. Understand the knowledge about genetic problems.
2. Practice basic techniques in cytology.
3. Study plant breeding and identify the centers of origin of cultivated plants.
4. Understand the knowledge about basic techniques in genetics and plant breeding.
5. Study companies and research centers and perform microbial techniques (culture media, soil dilution, inoculation and staining).
6. List plant diseases, symptoms and causal organism.

7. Understands knowledge about collection and identification of plant pathological specimens in fields.
8. Understands knowledge about seed treatment by seed dipping and seed dressing.

References:

1. Bendre A. *Practical Botany*. Meerut: Rastogi Publications. 2010.
2. Dawson C. *Practical Research Methods*. New Delhi: UBS Publishers. 2002.
3. Pandey B.P. *Modern Practical Botany*. Vol. I. New Delhi: S. Chand and Company Ltd. 2011.
4. Pandey B.P. *Modern Practical Botany*. Vol. II. New Delhi: S. Chand and Company Ltd. 2011.
5. Sadasivam S., Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers. 2008.
6. Wallis C.J. *Practical Botany for Advanced Level and Intermediate Students*. 5th ed. Oxford, UK: Elsevier Science. 2013.

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: V

BBST 503 Vegetable Seed Production

Course Objectives: The Students will be able to....

1. Impart different aspects of hybrid vegetable seed production.
2. Imbibe hybridization techniques.
3. Impart breeding and recent advances of vegetable seed production.
4. Impart vegetable crops.

Unit	SEMESTER – V BBST 503 Vegetable Seed Production	No. of hours per unit/ Credits 45
Unit-I:	Vegetable seed Production	11
	1.1 Historical account, present status, importance and future of vegetable seed production, objectives of vegetable seed production., Recent advances in vegetable seed production	
	1.2 Classification of vegetable crops- Root crops, bulb crops, leafy crops, flowering crops and fruit crops.	
	1.3 Reproduction- Asexual reproduction: vegetative, apomixis, Artificial (Synthetic) seeds: concept, production, limitations and uses, Sexual reproduction male and female gamete formation and fertilization.	
	Techniques in hybridization	11

Unit II	<p>2.1 Pollination: Types, natural cross pollination, Self-Pollination extent of it in vegetable crops, factors determining NCP, its role in vegetable seed production, pollination vectors in vegetable crop.</p> <p>2.2 Hybridization: Definition, techniques, steps, equipment's used in hybridization, uses of gametocides in emasculation, methods of pollination- hand pollination, rubbing, hooking, electric bees, crosses between the parents- single, double, three ways, back and triple cross.</p>	
Unit - III	<p style="text-align: center;">Breeding and Recent Advances</p> <p>3.1 Introduction: Definition, Types of breeding, role and significance of breeding technique</p> <p>3.2 Breeding methods</p> <p>a) Pedigree method: Definition, methods, and achievements,</p> <p>b) Bulk method: Definition, method, and achievements,</p> <p>c) Backcross method: Definition, method, and achievements,</p>	11
Unit - IV	<p style="text-align: center;">Requirements of Vegetable Seed Production</p> <p>a) Land requirement b) Seedling/Root production c) Nursery management d) Planting e) Cultural practices f) Breeding methods used g) Plant protection h) Seed harvesting i) Seed drying j) Seed grading k) Seed extraction (Wet - dry methods) with respect to following crops: Fruit crop: Tomato; Root crop: Radish; Bulb crop: Onion; Flower crop: Cauliflower.</p>	12

Course Outcomes: Student should be able to.....

1. Discuss the hybrid vegetable seed production.
2. Understand hybridization techniques.
3. Get knowledge of breeding and recent advances of vegetable seed production.
4. Understand knowledge of vegetable crops.

References:

1. Agrawal R.L. *Fundamentals of Plant Breeding and Hybrid Seed Production*. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 1998.
2. Arya P.S. *Vegetable breeding and seed production*. Ludhiana: Kalyani Publication. 2016.
3. Chandarshekharan S.N. *Cytogenetics and Plant Breeding*. Jaipur: Prakash Publisher. 1933.
4. Chopra V.L. *Plant Breeding Field crops*. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 2001.
5. Chopra V.L. *Plant Breeding Theory and Practices*. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 2005.
6. Fagaria M.S., Choudhary B.R., Dhaka R.S. *Vegetable Crops Production Technology*. New Delhi: Kalyani Publisher. 2003.
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8. Prasad R. *Textbook of Field Crop Production*. New Delhi: Directorate of information and Publication of agriculture. 2004.
9. Ram H.H., Singh H.G. *Crop Breeding and Genetics*. New Delhi: Kalyani Publisher. 1994.
10. Sharma J. R. *Plant Breeding*. New Delhi: Tata-McGraw Hill Publishing Company Ltd. 1994.
11. Singh B.D. *Plant Breeding*. 2nd ed. Ludhiana: Kalyani Publication. 2006.
12. Singh B.D. *Plant Breeding: Principles and Methods*. Ludhiana: Kalyani Publication. 2001.
13. Singh C.B. *Handbook of Seed Testing*. New Delhi: Anmol Publication. 2014.

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: V
Theory Paper - BBST 504 Seed Legislation and Certification

Course Objectives: The Students will be able to....

1. Impart knowledge of seed quality control.
2. Impart the legislation and different Acts related to seed.
3. Imbibe the process and importance of seed certification.
4. Impart about the national and global seed industry.

Unit	SEMESTER - V BBST 504 Seed Legislation and Certification	No. of hours per unit/ Credits 45
Unit-I	Seed Quality	11
	1.1 Historical development of Seed Industry in India 1.2 Seed quality: concept and factors affecting seed quality during different stages of production, processing and handling 1.3 Seed quality control: concept and objectives 1.4 Central Seed Certification Board (CSCB)	
Unit II	Seed Legislation	11
	2.1 Seed legislation and seed law enforcement as a mechanism of seed quality control; the Seed Act (1966), Seed Rules (1968), Seed (Control) Order 1983; Essential Commodities Act (1955); Plants, Fruits and Seeds Order (1989); National Seed Development Policy (1988) and EXIM	

	<p>Policy regarding seeds, plant materials; New Seed Bill-2004 etc.</p> <p>2.2 Introduction, objectives and relevance of plant quarantine, regulations and plant quarantine set up in India.</p>	
Unit – III	Seed Certification	11
	<p>3.1 Seed Certification: History, concept and objectives of seed certification;</p> <p>3.2 Seed certification agency/organization and staff requirement; legal status and phases; formulation, revision and publication of seed certification standards;</p> <p>3.3 Indian Minimum Seed Certification Standards (I.M.S.C.S.): general and specific crop standards including GM varieties, field and seed standards; planning and management of seed certification programmes: eligibility of a variety for certification, area assessment, cropping history of the seed field, multiplication system based on limited generation concept, isolation and land requirements.</p>	
Unit – IV	Seed Organization	12
	<p>4.1 Introduction to WTO (World Trade Organization) and IPRs (Intellectual property rights)</p> <p>4.2 Plant Variety Protection and its significance</p> <p>4.3 UPOV (International Union for the Protection of New Varieties of Plants) and its role</p> <p>4.4 DUS (Distinctness, Uniformity and Stability) testing: principles and applications; essential features of PPV(protection of plant varieties) & FR(Farmers' Rights) Act, 2001 and related Acts.</p>	

Course outcomes: Student should be able to.....

1. Understand the concept of seed quality control.
2. Aware about legislation and different Acts related to seed.
3. Discuss the process and importance of seed certification.
4. Known various national and global seed industry

References:

1. Agarwal R.L. *Seed Technology*. 1st ed. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 1998.
2. Agarwal R.L. *Seed Technology*. 2nd ed. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 2003.
3. Joshi A.K., Singh B.D. *Seed Science and Technology*. New Delhi: Kalyani Publishers. 2005.
4. Khare D., Bhale M.S. *Seed Technology*. 2nd ed. Jodhpur: Scientific Publisher. 2014.
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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: V

Practical Course BBSP 506- Practical's based on BBST 503 and 504

Course Objectives: The Student should be able to.....

1. Give practical knowledge vegetable seed production, hybrid seed production in different crop plants.
2. Give practical knowledge about methods of seed testing and certification.

Section	SEMESTER - V BBSP 506- Practical's based on BBST 503 and 504	No. of hours per unit/ Credits 45
	Practical's based on BBST 503	
Section - I	1. Study of Hybridization technique. 2. Study of self-pollinated 3. Study of cross-pollinated crops. 4. Study of synthesis of artificial seed. 5. Study of pollen germination by sucrose solution. 6. Identification of weed and other crop seeds as per specific crops. 7-10. Study of vegetable crops: Fruit crop- Tomato; Root crop- Radish; Bulb crop- Onion; Flower crop- Cauliflower.	
Section-II	Practical's based on BBST 504	
	11. General procedure of seed certification. 12. Field inspection at different stages of a crop and observations recorded on contaminants and reporting of results 13. Inspection and sampling at harvesting or threshing, processing and	

	<p>after processing for seed law enforcement.</p> <p>14. Testing physical purity, germination and moisture; specifications for tags and labels to be used for certification purpose.</p> <p>15. Data collection from websites regarding seed organizations in India and abroad.</p> <p>16. Visits to regulatory seed testing laboratory, including plant quarantine lab and seed certification agency.</p>	
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Course outcomes: Student should be able to.....

1. Understand hybridization techniques and perform the pollen germination by sucrose solutions.
2. Perform and prepare synthetic seeds.
3. Know vegetable seed production.
4. Study procedure of seed certification and do field inspections.
5. Understand seed testing laboratory, plant quarantine and seed certification agency.

References:

1. Singh B.D. *Plant Breeding*. 2nd ed. Ludhiana: Kalyani Publication. 2006.
2. Singh B.D. *Plant Breeding: Principles and Methods*. Ludhiana: Kalyani Publication. 2001.
3. Arya P.S. *Vegetable breeding and seed production*. Ludhiana: Kalyani Publication. 2016.
4. Singh C.B. *Handbook of Seed Testing*. New Delhi: Anmol Publication. 2014.
5. Khare D., Bhale M.S. *Seed Technology*. 2nd ed. Jodhpur: Scientific Publisher. 2014.
6. Prasad R. *Textbook of Field Crop Production*. New Delhi: Directorate of information and Publication of agriculture. 2004.
7. Agarwal R.L. *Seed Technology*. 2nd ed. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 2003.
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9. Ransingh S., Kalhapure A. *Principals of Seed Technology*. Pune: Universal Publication. 2013.

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Bachelor of Science (B. Sc.) Part – III: Plant Protection

Semester V

Theory Paper I (SECCBT 507) Basic Numerical Skills

Learning Objectives: The Student will able to.....

1. Impart the basic knowledge of mathematics.
2. Impart the knowledge of application of mathematics in biological studies.

Unit	SEMESTER – V (SECCBT 507) Basic Numerical Skills	No. of hours per unit/ Credits 45
Unit-I	Basics of Mathematics	8
	1.1 Number systems: Natural numbers, Whole Numbers, Integers, Rational numbers, Irrational numbers, Real Number, Even Numbers, Odd Numbers, Prime Numbers, Composite Numbers, Perfect Numbers. 1.2 Rules of calculation: Division on numbers, Rules of Divisibility, factors and multiples, VBODMAS Rule, Basic formulae for real numbers. 1.3 H.C.F and L.C.M. 1.4 Unitary Method	
Unit-II	Fractions, Decimal System and Roots	3
	2.1. Fractions: Concept and types, Addition, subtraction, multiplication and division of fractions	

	2.2 Decimal System: Concept, types, recurring and non- recurring decimals, Addition, subtraction, multiplication and division of decimals. 2.3 Powers and Roots	
Unit – III	Probability, Average and percentage	3
	3.1 Probability: concept, types, application in biological sciences	
	3.2 Average: Concept, types, applications in biological sciences 3.3 Percentage: Concept, applications in biological sciences	
Unit – IV	Logarithms, Factorials, Absolute value, Matrices and Venn Diagrams	6
	4.1 Logarithms and Anti- Logarithms: Concept, applications in biological sciences	
	4.2 Factorials: Concept, applications in biological sciences	
	4.3 Absolute Value: Concept, applications in biological sciences	
	4.4 Matrices: Concept, applications in biological sciences	
	4.5 Venn Diagrams: Concept, applications in biological Sciences	

Learning Outcomes: The students should be able to.....

1. Understand the basic mathematical concepts.
2. Define concepts of mathematics.
3. Apply mathematical concepts in his academics.
4. Formulate and solve problems in plant science using mathematical concepts

References:

1. Mathematics, Class IX, NCERT, Delhi
2. Mathematics. Class X, NCERT, Delhi
3. Mathematics, Class XI, NCERT, Delhi
4. Mathematics, Class XII, NCERT, Delhi

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Bachelor of Science (B. Sc.) Part - III: Plant Protection

Semester V

Practical SECC Paper I (SECCBP 510) Practical's based on Basic Numerical Skills

Learning objectives: The Student will be able to.....

1. Give practical knowledge to students about applications of mathematics in biological sciences.
2. Give the practical knowledge about use of computers in solving the mathematical applications in biological sciences.

Section	SEMESTER – V (SECCBP 510) Practical's based on Basic Numerical Skills	No. of hours per unit/ Credits 45
Section –I	<ol style="list-style-type: none">1. Calculations of percent (%), molar (M), normal (N) and PPM solutions.2. Preparation of standard curves.3. Use of Excel Software for solving mathematical problems related to Addition, Subtraction, Division and Multiplication.4. Use of Excel Software for solving mathematical problems related to percentage and Average.	

Learning Outcomes: The students should be able to.....

1. Understand the molar (M), normal (N) and PPM solutions
2. Apply Excel Software to mathematical problems related to percentage and Average.

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: VI

Course BBST 601 Plant Biochemistry and Molecular Biology

Course Objectives: Students will be able to.....

1. Impart knowledge of carbohydrates.
2. Impart the basic knowledge of lipids.
3. Impart basic knowledge of proteins.
4. Impart the knowledge of Molecular biology.

Unit	SEMESTER – VI BBST 601 Plant Biochemistry and Molecular Biology	No. of hours per unit/ Credits 45
Unit-I:	Carbohydrates	11
	1.1 Introduction, broad classification and properties of carbohydrates. 1.2 Isomerism: definition, types of isomers: epimers, anomers and enantiomers with suitable examples. 1.3 Structure of monosaccharides (pentose and hexose), oligosaccharides (sucrose and lactose), and polysaccharides (starch and cellulose) 1.4 Functions of carbohydrates in biological system	
Unit II	Lipids	12
	2.1 Introduction and Classification of Lipids 2.2 Structure and properties of saturated fatty acids (Stearic and Palmitic acid) and unsaturated fatty acids (Oleic acid, Linoleic and Linolenic acids) 2.3 Beta Oxidation: Gluconeogenesis and its role in mobilization of fatty	

	acids during seed germination 2.4 Significance of Lipids in plants.	
Unit – III	Proteins	11
	3.1 Introduction, structure, properties and classification of amino acid	
	3.2 Brief outline of biosynthesis of amino acids – proline	
	3.3 General structure, classification of proteins	
	3.4 Protein biosynthesis in eukaryotes	
3.5 Significance of proteins in plants.		
Unit – IV	Lipids	11
	4.1 Composition and structure of nucleotide	
	4.2 DNA as a carrier of genetic information (early experiment)	
	4.3 DNA: Watson and Crick Model, forms of DNA (A, B and Z)	
	4.4 DNA replication in eukaryotes	
	4.5 RNA: types, structure and role of RNA	
	4.6 Regulation of gene expression- Lac Operon, Tryptophan Operon	

Course Outcomes: Student should be able to.....

1. Describe the concept plant biochemistry and carbohydrates, classification and their significance.
2. Study concepts regarding molecular biology and explain the lipids synthesis, oxidation and biological significance.
3. Understand structure, properties and classification of amino acids and explain the general classification of protein and their synthesis.
4. Understand concepts of nucleic acids and their types and write answers and brief notes about plant biochemistry and molecular biology.

References

1. Essentials of Biochemistry, Ahmad, M., Merit Publisher Multan Ltd.

2. Molecular Biology of Cell; Alberts B., et al., 6th edition; Garland Science, Taylor. (2014)
3. The Cell: Molecular Approach; Cooper, G.M., Housemen, R.E 7th edition. ., (2015)
4. Fundamentals of Biochemistry, Jain, J.L., Jain, S., Jain, N., S. Chand & Company Ltd.
5. Principles of Biochemistry. Lehninger, A.L., 4th Edition, W.H. Freeman Ltd. (2004)
6. Cell Biology Lewis, J., Sarup and sons, New Delhi. (2004)
7. Biochemistry Simplified Textbook of Biochemistry for Medical Students, Manjeshwar, P.R.: Paras Medical Publishers.
8. Elements of Molecular Biology Mitra, S.,, McMillan India Ltd., N. Delhi. Cell Biology; Powar, C.B., Himalaya Publishing House. (1992)
9. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma, P.S., Agarwal, V.K.: S. Chand & Company Ltd.
10. Biochemistry. Voet, D., Wiley Ltd. (1995)

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: VI

Course BBST 602 Bioinformatics, Biostatistics and Economic Botany

Course Objectives: The Students will be able to.....

1. Imbibe different bioinformatics databases and tools.
2. Study Bioinformatics tools in biological research.
3. Impart use biostatistics concepts in their academics and research.
4. Impart economic aspects of plants and their use in day-to-day life.

Unit	SEMESTER - VI BBST 602 Bioinformatics, Biostatistics and Economic Botany	No. of hours per unit/ Credits 45
Unit-I	Bioinformatics	14
	1.1 Introduction, Aim, Scope and Branches of Bioinformatics 1.2 Biological Databases- Classification Format and Retrieval system of Biological Database, National Center for Biotechnological Information (NCBI), Basic Local Alignment Search Tool (BLAST) 1.3 Protein Information Resource (PIR) - Concept, Resources, Databases and Data Retrieval 1.4 Genome Information Resources (GIR) – Concept, Resources, Databases 1.5 Applications of Bioinformatics- BLAST, Molecular Phylogeny (Concept, Methods, Analysis and Consistency, use of MEGA 6 software).	
	Biostatistics	11

Unit II	<p>2.1 Introduction, definition, terminology.</p> <p>2.2 Collection and presentation of data- Types of data, techniques of data collection- Census method, sampling method- simple random, stratified and systematic sampling. Classification, tabulation, graphical representation- Histogram and polygon.</p> <p>2.3 Measures of central tendency and Dispersion- Arithmetic mean, Mode, Median, Range, Deviation, Mean deviation, Standard Deviation, Coefficient of Variation.</p> <p>2.4 Statistical methods for testing the hypothesis- i) Students' T-test; ii) Chi-square test.</p>	
Unit – III	<p style="text-align: center;">Economic Botany: Cereals, Legumes and Oils</p> <p>3.1 Origin of Cultivated Plants - Concept of centers of origin, their importance with reference to Vavilov's work.</p> <p>3.2 Cereals- Origin, Botanical Name, Morphology, Sources and Economic importance of Jowar and Wheat.</p> <p>3.3 Legumes- Origin, Botanical Name, Morphology, Sources and Economic importance of Gram and Pigeon Pea.</p> <p>3.4 Oils and Fats- Origin, Botanical Name, Morphology, Parts used and uses of Ground nut and soybean.</p>	10
Unit – IV	<p style="text-align: center;">Economic Botany: Spices, Beverages and Fibers</p> <p>4.1 Spices and Condiments - Origin, Botanical Name, Morphology, Parts used and uses of Ginger and Chilly</p> <p>4.2 Beverages - Origin, Botanical Name, Morphology, Parts used and uses of Tea , coffee & Garcina</p> <p>4.3 Fiber yielding Plants - Origin, Botanical Name, Morphology, Parts used and uses of Cotton, Agave <i>and Hemp</i></p>	10

Course Outcomes: Student should be able to.....

1. Understand bioinformatics tools and databases and Use of different bioinformatics databases and tools in biological research.
2. Understand Biostatistics and do data collection, analysis and use of different statistical programmes in their research work.

3. Study the centers of origin of crop plants and explain the different classes of economically important crop plants.
4. Understand the significance of economically important crops with their representative examples and learn the scope of economic uses of the plants.

References

1. Introduction to Bioinformatics. Attwood, T.K., Perry-Smith, D.J., Phukan, S., Pearson Education. (2008)
2. Statistical Methods for Biologists. Deshmukh, S.D., Vision Publications. (2008)
Genetics. Gupta, P.K., Rastogi Publications, Meerut. (1997)
3. Economic Botany in Tropics Kocchar, S.L., 2nd edition. MacmillanIndia Ltd., New Delhi. (1998)
4. A Textbook of Economic Botany Sambamurthy, A.V.S.S., Subramanyam, N.S., Wiley Eastern Ltd., New Delhi. (1989)
5. Sharma, O.P., (1996) Hill's Economic Botany. Sharma, O.P., Tata McGraw Hill Publishing Company Ltd., New Delhi. (1996)
6. Economic Botany - Plants in Our World. Simpson, B.B., Conner-Ogorzaly, M., McGraw Hill, New York. (1986)
11. Introduction to Bioinformatics; Sundara Rajan, S., Balaji, R.: Himalaya Publishing House.

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Semester: VI

Practical Course -BBSP 605 based on BBST 601 and 602

Course objectives: The Student should be able to.....

1. Give practical knowledge to students about different concepts in plant biochemistry.
2. Give the practical knowledge about concepts in molecular biology.
3. Give practical knowledge about the bioinformatics and biostatistics applications in plants sciences.
4. Give practical knowledge about the economic uses of the plants around them.

Section	SEMESTER – VI Course -BBSP 605 based on BBST 601 and 602	No. of hours per unit/ Credits 45
Section-I	Practical's based on Theory paper BBST 601	
	1-2. Qualitative test for sugars, proteins and lipids in suitable plant material 3. Estimation of sugars by DNSA method 4. Estimation of proteins by Lowry's method 5. Determination of fatty acid value of oil sample 6. Separation and identification of amino acids by TLC (Thin Layer Chromatography). 7. Isolation of genomic DNA	

	<p>8. Estimation of genomic DNA</p> <p>9. Estimation of carotene and anthocyanin pigments</p> <p>10. Visit to molecular biology laboratory and report submission.</p>	
Section-II	Practical's based on Theory paper BBST 602	
	<p>11. Study of biological databases NCBI, DDBJ, EMBL and UniProt</p> <p>12. Nucleotide sequence retrieval from NCBI database</p> <p>13. Study of molecular phylogeny using Mega 6 software.</p> <p>14. Study of measures of central tendency, frequency distribution of given data and its graphical representation</p> <p>15. Determination of Standard deviation and standard error of the given data.</p> <p>16. Study of Botanical Name, Morphology, Parts used and Economic importance of Jowar and Wheat.</p> <p>17. Study of Botanical Name, Morphology, Parts used and Economic importance of Gram and Pigeon pea.</p> <p>18. Study of Botanical Name, Morphology, Parts used and Economic importance of Ginger, Chilly, Tea and Coffee and Garcina</p> <p>19. Study of Botanical Name, Morphology, Parts used and Economic importance of Groundnut and Soybean.</p> <p>20. Study of Botanical Name, Morphology, Parts used and Economic importance of Cotton and <i>Agave</i> and Hemp</p> <p>21. Assignment based on Biostatistics/ Bioinformatics</p>	

Learning Outcomes: The students should be able to.....

1. Analyze the nutritional composition of plants.
2. Understand the isolation and estimation of nucleic acid.
3. Understand the knowledge of separation techniques used in plant sciences.
4. Understand the knowledge of computational biology.
5. Apply knowledge of biostatistics and data analysis in plant sciences.

6. Understand the knowledge of utilization of economically important plants

References:

1. Bendre A. *Practical Botany*. Meerut: Rastogi Publications. 2010.
2. Dawson C. *Practical Research Methods*. New Delhi: UBS Publishers. 2002.
3. Pandey B.P. *Modern Practical Botany*. Vol. I. New Delhi: S. Chand and Company Ltd. 2011.
4. Pandey B.P. *Modern Practical Botany*. Vol. II. New Delhi: S. Chand and Company Ltd. 2011.
5. Sadasivam S., Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers. 2008.
6. Wallis C.J. *Practical Botany for Advanced Level and Intermediate Students*. 5th ed. Oxford, UK: Elsevier Science. 2013.

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: VI

BBST 603 Instrumentation and Techniques in Seed Technology

Course Objectives: The Students will be able to.....

1. Impart the knowledge of instrumentation.
2. Impart the basic knowledge of seed processing machines.
3. Impart the basic knowledge of seed treatment, seed processing plants.
4. Impart the importance of the seed storage and packaging.

Unit	SEMESTER - VI BBST 603 Instrumentation and Techniques in Seed Technology	No. of hours per unit/ Credits 45
Unit-I	Instrumentation for Seed processing	11
	1.1 Concept and objectives of seed processing: concept and importance, Basic flow pattern, seed processing pathway of seed improvement, physical characteristics used to separate seeds. 1.2 Instruments for seeds processing: Scalper, Debearder, Maize Scarifier and Sheller, licensing of machines. 1.3 Seed drying: Importance and advantages of seed drying, moisture content, Orthodox / recalcitrant methods of seed moisture measurements, Theory of seed drying (wet and dry seeds), advantages of mechanical drying equipment's dehumidification and drying of heat sensitive seeds,	

	relative humidity and equilibrium, moisture content of seeds.	
Unit II	Seed processing machines	12
	<p>2.1 Principle, construction, working, adjustments, cleaning and uses of seed processing machines:</p> <ul style="list-style-type: none"> i. Air screen cleaner cum grader, ii. Specific gravity separator, aspirators, pneumatic aspirators, stoner iii. Roll mill iv. Magnetic separators v. Spiral separators, dropper best separator, electrostatic separators. 	
Unit – III	Seed treatment and Seed processing plant	11
	<p>3.1 Seed Treatment: Principle, construction, working, adjustments and uses of slurry seed treater, mist-o-matic seed treater, storage and labeling of treated seeds, seed user’s safety.</p> <p>3.2 Seed processing plant: Site selection, layout of machines in a seed processing plant for efficient product, seeds in post-harvest phase, conservation of energy and production.</p> <p>3.3 Seed conveyors and elevator: bucket elevator, belt conveyor, screen conveyor, oscillation conveyor, pneumatic conveyor.</p>	
Unit – IV	Seed storage and packing	11
	<p>4.1 Seed storage: Structures and their management.</p> <p>4.2 Packing and marketing of seeds- Bagger, weigher, bag closing, portable and conveyor type of bag closer, labeling and maintaining lot identity, lot numbers, seed pellets, handling and stacking, maintenance of seed processing records.</p>	

Course Outcomes: Student should be able to.....

1. Understand instrument related to seed processing.

2. Get Knowledge of seed processing machines.
3. Know different seed treatment, seed processing plants.
4. Apply seed storage and packaging methods.

References:

1. Bindra D.S. *Plant Protection and equipments*. New Delhi: Oxford and IBH Publishing Company.
2. Carl W.H. *Drying Farm Crops*. Westport CT: Avi Publishing Company, Inc. 1980.
3. Chakravarty A. *Post-Harvest Technology and cereals, pulses & oil seeds*. Publisher: New Delhi: Oxford and IBH Publishing Company. 1988.
4. Gregg B.R., Law A.G., Viridi S.S., Bali J.S. *Seed Processing*. New Delhi: National Seeds Corporation. 1970.
5. Henderson S.M., Perry R. *Agricultural process Engineering*. 5th ed. A Westport CT: Avi Publishing Company, Inc. 1976.
6. ICAR. *Handbook of Agriculture*. 6th ed. New Delhi: Indian Council of Agricultural Research. 2017.
7. Joshi A.K., Singh B.D. *Seed Science and Technology*. New Delhi: Kalyani Publishers. 2005.
8. Khare D., Bhale M.S. *Seed Technology*. 2nd ed. Jodhpur: Scientific Publisher. 2014.

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Bachelor of Science (B. Sc.) Part – III Seed Technology

Semester: VI

Course BBST 604 Seed Farm Management and Marketing

Course Objectives: The Students will be able to.....

1. Impart the knowledge of the seed farm management.
2. Impart the basic knowledge of different field practices and machinery management.
3. Impart the basic knowledge the farm resource management and analysis.
4. Impart the basic knowledge of of seed marketing strategies in India and around the globe.

Unit	SEMESTER - VI BBST 604 Seed Farm Management and Marketing	No. of hours per unit/ Credits 45
Unit-I	Seed Farm Management	11
	1.1 Scope, basic principles in farm management, decision making operations and control with respect to production. 1.2 Cost analysis law of diminishing returns, opportunity cost, most profitable combination of input and output.	
Unit II	Field Practices and machinery management	11
	2.1 Concepts of various crop productions, field practices as tillage, irrigation, sowing, plant protection, harvesting and threshing, maintenance of soil fertility, weeds & their control. Crop rotation mixed cropping,	

	multiple cropping & dry land farming. 2.2 Machinery selection & their management.	
Unit – III	Farm Resource Management and Analysis	12
	3.1 Farm planning, Construction of farm buildings, Implementation of shed, Strong structures. 3.2 Farm business analysis, farm size, factors affecting profit and economic size of farm. 3.3 Farm budgeting procedure and uses, farm efficiency measures, farm records & their uses. 3.4 Farm surveys, data collection & analysis. 3.5 Acquisition & management of land, labour & capital.	
Unit – IV	Seed marketing	11
	4.1 Marketing- Basic concepts, supply & demand, price equilibrium, seed transportation, storage, cost & returns, cost processing, packing and marketing, Organization for seed marketing, seed markets in India, structure & working. 4.2 Seed market surveys, seed industry in relation to global market, concept of WTO, GATT, IPR, and PBR.	

Course Outcomes: The Student should be able to.....

1. Get knowledge about farm management.
2. Learned different field practices and machinery management.
3. Discuss & apply knowledge farm resource management and analysis.
4. Understand the seed marketing strategies in India and around the globe.

References:

1. Acharya S.S. *Agricultural Marketing in India*. 6th ed. New Delhi: CBS Publisher. 2011.
2. Hunt D. *Farm Power & Machinery Management*. Illinois, USA: Waveland Press Inc. 2007.
3. Johl S.S., Kapoor T.R. *Fundamentals of Farm Business Management*. Ludhiana: Kalyani Publishers. 1973.
4. Kadlec J.E. *Farm Management, Decision Operation Control*. London, UK: Pearson Education, Limited 1985.
5. Joshi A.K., Singh B.D. *Seed Science and Technology*. New Delhi: Kalyani Publishers. 2005.
6. Kahlon A.S., Singh K. *Economics of Farm Management in India*. Mumbai: Allied Publishers. 1980.
7. Boehlje M.D., Eidman V.R. *Farm management*. New York: Wiley.1984.
8. Raju V.T., Rao D.V. *Economics of Farm Production and Management*. Oxford and IBH Publishing Company Pvt. Ltd. 2017.

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Semester: VI

Practical Course BBSP 606 Practical's based on paper BBST 603 and 604

Course objectives: The Student should be able to.....

1. Give the practical knowledge to students about seed storage and machinery management.
2. Give the practical knowledge about record keeping of farm management.

Section	SEMESTER - VI Practical Course BBSP 606 Practical's based on paper BBST 603 and 604	No. of hours per unit/ Credits
Section-I	Practical's based on paper BBST 603	
	<ol style="list-style-type: none"> 1. Study of bucket elevator, screw conveyers and pneumatic elevators. 2. Study of threshing machine and its use. 3. Fumigation-principle and practical application. 4. Demonstration & handling of stereo binocular microscope. 5. Study of seed processing machines (air screen cleaner cum grader, magnetic separator, specific gravity separator, seed treatment machines, seed packaging equipment, pre-cleaner, Maize sheller & dehusker) (Any Five). 6. Measurement of seed moisture content by OSWA & moisture meter/ oven drying method. 7. Visits to warehouse, godowns and market. 8. Visit to a seed processing & storage complex and familiarization 	

	with different machines.	
Section-II	Practical's based on paper BBST 604	
	<ol style="list-style-type: none"> 1. Study of Visual examination of dry seeds for disease symptoms. (Any five) 2. Study of types of insecticide formulations, their preparation and safe use. 3. Study of physical characteristics of different crop seeds and their shapes. 4. Study of farm implements viz. Weeders, hoes, harrow. 5. Study of Cost analysis. 6. Study of Farm planning and budgeting 7. Study of record keeping 	

Course outcomes: The Student should be able to.....

1. Know threshing machines and bucket elevator, screw conveyers and pneumatic elevators.
2. Determine seed moisture content by OSWA & moisture meter/ oven drying method.
3. Know about warehouse, godowns, market and get the knowledge about seed processing, storage complex unit and familiarization with different machines.
4. Identify and examine dry disease symptoms of seeds., Prepare insecticidal formulations and knows about safe handling of insecticides., Do the cost analysis, Farm planning and budgeting, record keeping

References:

1. ICAR. *Handbook of Agriculture*. 6th ed. New Delhi: Indian Council of Agricultural Research. 2017.
2. Joshi A.K., Singh B.D. *Seed Science and Technology*. New Delhi: Kalyani Publishers. 2005.
3. Khare D., Bhale M.S. *Seed Technology*. 2nd ed. Jodhpur: Scientific Publisher. 2014.
4. Bindra D.S. *Plant Protection and equipments*. New Delhi: Oxford and IBH Publishing Company.

5. Carl W.H. *Drying Farm Crops*. Westport CT: Avi Publishing Company, Inc. 1980.
6. Acharya S.S. *Agricultural Marketing in India*. 6th ed. New Delhi: CBS Publisher. 2011.
7. Hunt D. *Farm Power & Machinery Management*. Illinois, USA: Waveland Press Inc. 2007.
8. Johl S.S., Kapoor T.R. *Fundamentals of Farm Business Management*. Ludhiana: Kalyani Publishers. 1973.
9. Raju V.T., Rao D.V. *Economics of Farm Production and Management*. Oxford and IBH Publishing Company Pvt. Ltd. 2017.

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Semester VI

Theory Paper II (SECCT 607) Entrepreneurship Development

Learning Objectives: The Student should be able to.....

1. Identification of opportunities for development
2. Learn the mechanism of finance and fund raising
3. Impart the basic knowledge of marketing for better business opportunities
4. Impart the plant based industrial sector in India and abroad.

Unit	SEMESTER – VI (SECCT 607) Entrepreneurship Development	No. of hours per unit/ Credits
	Entrepreneurship Development	
Unit-I	Introduction to entrepreneurship, Identification of opportunities for entrepreneurship, Concept of different occupations: - business, employment and profession. Functions of an entrepreneur. Business idea and plan, Types of businesses / ownerships – Sole Proprietorship, Partnership, Private limited company, Public limited company, Joint stock Company, Co-operative society.	5
	Business Finance & Accounts	05

Unit-II	Preparation of project report for business, Sources of finance – government and nongovernment agencies, Working capital, Cash flow, Fund flow, Preparation of basics of financial statements, costing and pricing, Policies and incentives.	
Unit - III	Enterprise Management and Modern Trends	05
	Small business management and entrepreneurship, Woman entrepreneurship, Features of small business firms, Process of management in small business, Concept of data and information, Information as a commodity, Study of marketing strategy and marketing mix, Decision-making models, Types of decisions, Decision Support Systems, Introduction to e-commerce, types –B2B, B2C, C2B, C2C.	
Unit - IV	Entrepreneurship opportunities in Plant Sciences	05
	Plant based industries in India and abroad both in food and non- food sectors, Import and export regulations of plant based products, Case study on successful as well as unsuccessful small scale plant based industries in India.	

Learning Outcomes: The students should be able to.....

1. Get the idea about IP rights
2. Avail the financial and marketing skill
3. Prepare the proposal for small scale industry.
4. Identify opportunities in the plant based industrial sector.

Recommended Books:

1. Entrepreneurship. Alpana Trehan Wiley India
2. A complete guide to successful Entrepreneurship, G. N. Pandey Vikas Publishers India

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Semester VI

Learning objectives: The Student will be able to.....

1. Give the practical Exposure to a work environment, common practices, employment opportunities and work ethics in their relevant field.

Section	SEMESTER - VI SECCBP 610 (based on SECCBT 607)	No. of hours per unit/ Credits 45
Section	Course Work: Industrial training (25)	
	15 Days internship program and report writing	

Learning Outcomes: The students should be able to.....

1. Participate in the projects in industries during his or her industrial training.
2. Describe use of advanced tools and techniques encountered during industrial training and visit.
3. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
4. Develop awareness about general workplace behavior and build interpersonal and team skills.
5. Prepare professional work reports and presentations.