Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara
(An Autonomous College)

New Syllabus For

Bachelor of Science

Part – III

Seed Technology

Syllabus

Implemented w. e. f. June, 2022

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

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

1. TITLE: **Seed Technology**

2. YEAR OF IMPLEMENTATION: **2022 – 2023**

5. DURATION: 01 year

6. PATTERN: CBCS Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

1) FITTH 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)	BBST 501	Genetics and Plant Breeding	06	04	Practical BBSP-505	10	04
		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 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

Seed Technology Practical I: Practical's based on Theory paper BBST 501 502

B. Sc. III 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

Botany Practical II: Practical's based on Theory paper BBST 601, 602

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

Semester: V

- BBST 501 Genetics and Plant Breeding

Course Objectives: Students will be able to

1. Understand the basic knowledge of mendelian genetics.

2. Imbibe the basic knowledge of linkage, recombination and quantitative inheritance.

3. Study the basic knowledge of variations in chromosome number and structure.

4. Imbibe the knowledge of crop improvement.

Credits=4	**SEMESTER - V** **BBST 501 Genetics and Plant Breeding**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Mendelism and extra chromosomal inheritance**	**12**
	Introduction Principles of inheritance - a) Law of Dominance; b) Law of Segregation; c) Law of Independent Assortment; d) Back Cross and Test Cross Gene interaction - a) Complementary gene interaction b) Supplementary gene interaction	

	Epistasis- Introduction, Dominant Epistasis, Recessive Epistasis Extra-chromosomal Inheritance: Introduction, Plastid Inheritance and Mitochondrial Inheritance (with classical as well as latest examples)	
Credit –I **Unit II**	**Linkage, Recombination and Quantitative inheritance** Linkage: Definition, Linkage groups, types, Coupling and Repulsion Phase, significance in plant breeding Recombination (Crossing over): Definition, types, mechanism of crossing over, significance in plant breeding 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	**11**
Credit –I **Unit - III**	**Variation in Chromosome Number and Structure** Chromosome number: Euploidy, Aneuploidy and Polyploidy Chromosomal structure: Deletion, Duplication, Inversion and Translocation Mutation: Spontaneous and Induced mutation. Types of mutagens – Physical and Chemical, Significance of mutations in plant breeding.	**11**
Credit –I **Unit - IV**	**Plant Breeding** Introduction, Definition, Aims and objectives 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 Multiple Allelism: Introduction, Definition, Self-incompatibility in plants, significance in plant breeding.	**11**

Course outcomes: Students will able to

1) Understand genetic basis of inheritance and extra chromosomal inheritance. Unit IV .
2) Imbibe the concept of linkage and recombination and concept of quantitative inheritance. Unit II
3) Understand the concepts regarding chromosome structure and variation and explain the concept of mutation and its importance in crop improvement. Unit III
4) Understand concept of plant breeding and its significance and Explain different methods of plant breeding. Unit Iv

2. References

1. Allard A.W. *Principles of Plant Breeding*. Wiley Publications, 2010. Unit –IV

2. Chahal G.S., Gosal S.S. *Principles and Procedures of Plant Breeding*: *Biotechnological and Conventional Approaches*. New Delhi: Narosa Publishing Co., 2010. Unit –IV Unit –II.

3. Gardener J., Simmons H.J., Snustad D.P. *Principles of Genetics*. 8th ed., New York: John Wiley & Sons, 1991. Unit –II.

4. Gupta P.K. *Cytogenetics*. Meerut: Rastogi Publications, 2018. Unit –II. III

5. Gupta P.K. *Genetics*. Meerut: Rastogi Publications, 1997. Unit –II.

6. Hartl D.L., Jones E.W. *Genetics*: *Principles and Analysis*. 4th ed., Massachusetts, USA: Jones and Barlett Publishers, 1998. Unit –II.

7. Singh B.D. *A text Book of Plant Breeding: Adynamic 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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SEMESTER - V

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

Course Objectives: Students will be able to

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

Credits=4	**SEMESTER - V** **BBST 502 Microbiology, Plant Pathology and Mushroom Cultivation Technology**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Microbiology** General characters of microbes: Bacteria, Viruses, Actinomycetes and Phytoplasma Methods in Microbiology: Staining for microbes-bacteria and, PPLO, Sterilization Methods, Pure Culture Techniques 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	**10**

Credit –I **Unit II**	**Microbial Genetics** Bacterial genome Recombination in Bacteria: Transformation and Transduction DNA and RNA viruses Importance of microbial genetics	**10**
Credit –I **Unit - III**	**Plant Pathology** Concept and Importance of Plant Pathology, General symptoms of plant diseases Transmission of Pathogen: Air, Seed, Soil and Water Methods of plant disease management: Physical, Mechanical,Chemical and Biological Role of quarantine in plant disease management Study of Plant Diseases w. r. t. pathogen, symptoms and management i) Grassy Shoot of Sugarcane (Phytoplasma), ii) Citrus Canker (Bacterial), iii) Yellow Vein Mosaic of Bhendi (Viral), iv) White Rust of Crucifers (Fungal) v) Early leaf spot (Tikka) disease of ground nut (Fungal)	**15**
Credit –I **Unit - IV**	**Plant Breeding** **Mushroom cultivation technique** Introduction, History, General life cycle of mushrooms, Economic importance of mushrooms Types of Mushrooms: Non-edible (Poisonous) mushrooms and Edible (Non-poisonous) - Button, Oyster, Shiitake and Black ear mushrooms Cultivation Technology: Preparation of spawn, Sterilization and preparation of mushroom bed, Spawning, Factors affecting quality of	**10**

	mushroom beds, Harvesting of mushrooms Storage: Short Term (Refrigeration), Long Term Storage (Canning, Pickles, Papads) and Drying in Salt Solutions Nutritional Value: Proteins, Carbohydrates, Mineral Elements, Vitamins, Crude Fiber Content of Mushrooms. Medicinal value of Mushrooms	

Course Outcomes Students will be able to

1) Understand the microbes and different Microbial techniques and different application of microbes in industries.
2) Understand about microbial genetics and application of microbial genetics.
3) Understand the define concepts regarding chromosome structure and variation and explain the concept of mutation and its importance in crop improvement.
4) Study the plant pathology and plant diseases and management practices of different plant diseases.

References

1. Agrios G.N. Plant Pathology. London: Academic Press. 1997. Unit III
2. Anonymous. *Economics of mushroom cultivation*. Solan, India: National Centre for Mushroom Research and Training. 1991. Unit IV

   Clifton A. *Introduction to the Bacteria*. New York: McGraw Hill Co. 1958. Unit I
3. Gunasekaran P. *Laboratory Manual in Microbiology*. New Delhi: New Age International Pvt., Ltd. 1995. Unit I
4. Hackett P.B., Fuchs J.A., Messing J.W. *An Introduction to Recombinant DNA Techniques*: *Basic Experiments in Gene Manipulation*. Menlo Park, California: The Benjamin /Cummings Publishing Co., Inc.1988. Unit I
5. Mandahar C.L. *Introduction to plant Viruses*. New Delhi: S. Chand and Company Ltd. 1998. Unit I
6. Meynell E., Meynell G.G. *Theory and Practice in Experimental Bacteriology*. Cambridge: University Press. 1970. Unit II

7. Primrose S.B., Twyman R., Old B. *Principles of Gene Manipulation*: *An Introduction to Genetic Engineering*. 6th ed. Oxford, UK: Blackwell Scientific Publications. 2001.

8. Rangswamy G., Mahadevan A. *Diseases of Crop Plants in India*. 4th ed., India: PHI Learning. 1999. Unit II

9. Suman B.C., Sharma V.P. *Mushroom Cultivation in India*. Delhi: Daya Publishing House. 2007. Unit III

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SEMESTER - V

Practical BBSP 508 - based on theory paper BBST 501 and 502

Course objectives:

Students will be able to

1. Understand different concepts in genetics.
2. Understand various processes in plant breeding.
3. Study of Microbial techniques (culture media, soil dilution, inoculation and staining).
4. Study the plant diseases, symptoms and causal organism.

Credits=4	**SEMESTER - V** **BBSP 508 : PRACTICAL COURSE – V**	**No. of hours per unit/ Credits 45**
Credit –2 **UNIT I**	**Genetics and Plant Breeding**	**10**
	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 *Allium* / *Cyanotis*. *5.* Detection of meiotic anomalies in chromosomes in *Tradeschantia.* 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.	
Credit –2 UNIT II	**Microbiology, Plant Pathology and Mushroom Cultivation Technology**	**10**
	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 genetics and perform basic cytological techniques.
2. Study plant breeding and identify the centers of origin of cultivated plants.
3. Study companies and research centers and perform microbial techniques (culture media, soil dilution, inoculation and staining).

4. Understand symptoms and causal organism and do the seed treatments by seed dipping and seed dressing methods.

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. Walllis C.J. *Practical Botany for Advanced Level and Intermediate Students*. 5th ed. Oxford, UK: Elsevier Science. 2013.

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SEMESTER - V

BBST 503 Vegetable Seed Production

Course Objectives: Students will be able to

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

Credits=4	**SEMESTER - V** **BBST 503 Vegetable Seed Production**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Vegetable seed Production** Historical account, present status, importance and future of vegetable seed production, objectives of vegetable breeding. Classification of vegetable crops- Root crops, bulb crops, leafy crops, flowering crops and fruit crops. Reproduction- Asexual reproduction: vegetative, apomixis, Artificial (Synthetic) seeds: concept, production, limitations and uses, Sexual reproduction male and female gamete formation and fertilization.	**11**

Credit –I **Unit II**	**Techniques in hybridization** Pollination: Types, natural cross pollination, extent of it in vegetable crops, factors determining NCP, its role in vegetable seed production, pollination vectors in vegetable crop. Hybridization: Definition, techniques, steps, equipment's, 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.	**11**
Credit –I **Unit - III**	**Breeding and Recent Advances** Introduction: Definition, collection, maintenance, evaluation, storage, role and utilization. Selection: a) Pedigree method: Definition, methods, and achievements, b) Bulk method: Definition, method, and achievements, c) Backcross method: Definition, method, and achievements, 3.3 Recent advances in vegetable seed production: Pollen derived plants, diploid pollens, pollen-based gene technology.	**11**
Credit –I **Unit - IV**	**Requirements of Vegetable Seed Production** 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.	**12**

Course Outcomes: Student should be able to: -

1. Study the hybrid vegetable seed production.
2. Study hybridization techniques.
3. Understand Breeding and recent advances of vegetable seed production.
4. Study Recognize 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. Unit III

2. Arya P.S. *Vegetable breeding and seed production*. Ludhiana: Kalyani Publication. 2016. Unit III

3. Chandarshekharan S.N. *Cytogenetics and Plant Breeding*. Jaipur: Prakash Publisher. 1933. Unit III

4. Chopra V.L. *Plant Breeding Field crops*. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 2001. Unit III

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. Unit I

7. Khare D., Bhale M.S. *Seed Technology*. 2nd ed. Jodhpur: Scientific Publisher. 2014. Unit II

8. Prasad R. *Textbook of Field Crop Production*. New Delhi: Directorate of information and Publication of agriculture. 2004. Unit IV

9. Ram H.H., Singh H.G. *Crop Breeding and Genetics*. New Delhi: Kalyani Publisher. 1994. Unit I

10. Sharma J. R. Plant Breeding. New Delhi: Tata-McGraw Hill Publishing Company Ltd. 1994. Unit I

11. Singh B.D. *Plant Breeding*. 2 nd ed. Ludhiana: Kalyani Publication. 2006. Unit I

12. Singh B.D. *Plant Breeding*: *Principles and Methods*. Ludhiana: Kalyani Publication. 2001. Unit I

13. Singh C.B. *Handbook of Seed Testing*. New Delhi: Anmol Publication. 2014. Unit III

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SEMESTER - V

Theory Paper - BBST 504 Seed Legislation and Certification

Course Objectives: Students will be able to

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

Credits=4	**SEMESTER - V** **BBST 503 Vegetable Seed Production**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Seed Quality**	**11**
	Historical development of Seed Industry in India Seed quality: concept and factors affecting seed quality during different stages of production, processing and handling Seed quality control: concept and objectives Central Seed Certification Board (CSCB)	
Credit –I **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 Policy regarding seeds, plant materials; New Seed Bill-2004 etc. 2.2 Introduction, objectives and relevance of plant quarantine, regulations and plant quarantine set up in India.	
Credit –I **Unit – III**	**Seed Certification** Seed Certification: History, concept and objectives of seed certification; Seed certification agency/organization and staff requirement; legal status and phases; formulation, revision and publication of seed certification standards; 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.	**11**
Credit –I **Unit – IV**	**Seed Organization** Introduction to WTO and IPRs Plant Variety Protection and its significance UPOV and its role DUS testing: principles and applications; essential features of PPV & FR Act, 2001 and related Acts.	**12**

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. Understood 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. Unit I

2. Agarwal R.L. *Seed Technology*. 2nd ed. New Delhi: Oxford and IBH Publishing Company Pvt. Ltd. 2003. Unit II

3. Joshi A.K., Singh B.D. *Seed Science and Technology*. New Delhi: Kalyani Publishers. 2005. Unit III

4. Khare D., Bhale M.S. *Seed Technology*. 2nd ed. Jodhpur: Scientific Publisher. 2014.

5. Ransingh S., Kalhapure A. *Principals of Seed Technology*. Pune: Universal Publication. 2013. Uni IV

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SEMESTER - V
B. Sc. Part - III

Semester V

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

Course objectives Student should be able to:

1. Understand vegetable seed production, hybrid seed production in different crop plants.
2. Understand methods of seed testing and certification.
3. Participate students in experiential learning with these practicals.

Credits=4	**SEMESTER - V** **BBSP 506 : PRACTICAL COURSE – VI**	**No. of hours per unit/ Credits 45**
Credit –2 **UNIT - I**	**BBST 503 Vegetable Seed Production**	**10**
	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.	

Credit –2 UNIT II	BBST 504 Seed Legislation and Certification	10
	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 after processing for seed law enforcement. 14. Testing physical purity, germination and moisture; specifications for tags and labels to be used for certification purpose. 15. Data collection from websites regarding seed organizations in India and abroad. 16. Visits to regulatory seed testing laboratory, including plant quarantine lab and seed certification agency.	

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*. 2 nd 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.
8. Joshi A.K., Singh B.D. *Seed Science and Technology*. New Delhi: Kalyani Publishers. 2005.
9. Ransingh S., Kalhapure A. *Principals of Seed Technology*. Pune: Universal Publication. 2013.

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SEMESTER - VI
Course BBST 601 Plant Biochemistry and Molecular Biology

Course Objectives: Students will be able to

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

Credits=4	**SEMESTER - VI** **BBST 601 Plant Biochemistry and Molecular Biology**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Carbohydrates**	**11**
	Introduction, broad classification and properties of carbohydrates. Isomerism: definition, types of isomers: epimers, anomers and enantiomers with suitable examples. Structure of monosaccharides (pentose and hexose), oligosaccharides (sucrose and lactose), and polysaccharides (starch and cellulose) Functions of carbohydrates in biological system	
Credit –I **Unit II**	**Lipids**	**12**
	Introduction and Classification of Lipids Structure and properties of saturated fatty acids (Stearic and Palmitic acid) and unsaturated fatty acids (Oleic acid, Linoleic and Linolenic	

	acids) Beta Oxidation: Gluconeogenesis and its role in mobilization of fatty acids during seed germination Significance of Lipids in plants.	
Credit –I **Unit – III**	**Proteins** Introduction, structure, properties and classification of amino acid Brief outline of biosynthesis of amino acids – proline General structure, classification of proteins Protein biosynthesis in eukaryotes Significance of proteins in plants.	**11**
Credit –I **Unit – IV**	**Lipids** Composition and structure of nucleotide DNA as a carrier of genetic information (early experiment) DNA: Watson and Crick Model, forms of DNA (A, B and Z) DNA replication in eukaryotes RNA: types, structure and role of RNA Regulation of gene expression- Lac Operon, Tryptophan Operon	**11**

Course Outcomes: Student should be able to: -

1. Understand 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. Ahmad M. *Essentials of Biochemistry*. Merit Publisher Multan Ltd. 2008. Unit I
2. Alberts B., Lewis J., Raff M., Johnson A., Roberts K., Walter P., Bray D., Watson J. *Molecular Biology of Cell*. 6th ed. New York: Garland Science. 2014. Unit II
3. Cooper G.M., Housemen R.E. *The Cell*: *A Molecular Approach*. 6th ed. Sunderland, MA: Sinauer Associates. 2015. Unit III
4. Jain J.L., Jain S., Jain N. *Fundamentals of Biochemistry*, New Delhi: S. Chand and Company Ltd. 1979.
5. Lewis J. *Cell Biology*. New Delhi: Sarup and Sons. 2004.
6. Manjeshwar P.R. *Biochemistry Simplified Textbook of Biochemistry for Medical Students*. Paras Medical Publishers. 2018.
7. Mitra S. *Elements of Molecular Biology*. New Delhi: McMillan India Ltd. 1980. Unit III
8. Nelson D.L., Cox M.M. *Lehninger Principles of Biochemistry*. 4th ed. New York: WH Freeman Ltd. 2004.
9. Powar C.B. *Cell Biology*. New Delhi: Himalaya Publishing House. 1992. Unit IV
10. Verma P.S., Agarwal V.K. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. New Delhi: S. Chand Company Ltd. 2004.
11. Voet D. *Biochemistry*. Wiley Science Ltd., 2018.

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SEMESTER – VI
B. Sc. Part - III
Semester: VI

Course BBST 602 Bioinformatics, Biostatistics and Economic Botany

Course Objectives: Students will be able to

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

Credits=4	**SEMESTER - VI** **BBST 602 Bioinformatics, Biostatistics and Economic Botany**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Bioinformatics**	**14**
	Introduction, Aim, Scope and Branches of Bioinformatics Biological Databases- Classification Format and Retrieval system of Biological Database, National Center for Biotechnological Information (NCBI), Basic Local Alignment Search Tool (BLAST) Protein Information Resource (PIR) - Concept, Resources, Databases and Data Retrieval 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).	
Credit –I **Unit II**	**Biostatistics** Introduction, definition, terminology. 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. Measures of central tendency and Dispersion- Arithmetic mean, Mode, Median, Range, Deviation, Mean deviation, Standard Deviation, Coefficient of Variation. Statistical methods for testing the hypothesis- i) Students' T-test; ii) Chi-square test.	**11**
Credit –I **Unit – III**	**Economic Botany: Cereals, Legumes and Oils** Origin of Cultivated Plants - Concept of centers of origin, their importance with reference to Vavilov's work. Cereals- Origin, Botanical Name, Morphology, Sources and Economic importance of Jowar and Wheat. Legumes- Origin, Botanical Name, Morphology, Sources and Economic importance of Gram and Pigeon Pea. Oils and Fats- Origin, Botanical Name, Morphology, Parts used and uses of Ground nut and soybean.	**10**
Credit –I **Unit – IV**	**Economic Botany: Spices, Beverages and Fibers** Spices and Condiments - Origin, Botanical Name, Morphology, Parts used and uses of Ginger and Chilly Beverages - Origin, Botanical Name, Morphology, Parts used and uses of Tea and coffee. Fiber yielding Plants - Origin, Botanical Name, Morphology, Parts used and uses of Cotton and *Agave*.	**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.

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Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(Autonomous)

Syllabus introduced from June 2022
B. Sc. Part – III
SEMESTER - VI
Course BBSP 608 based on BBST 601 and 602

Course objectives **Student should be able to: -**

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

Credits=4	**SEMESTER – VI** **BBSP 608 :** **PRACTICAL COURSE – VII**	**No. of hours per unit/ Credits** **45**
Credit –2 UNIT I	**BBST 601 Plant Biochemistry and Molecular Biology**	**10**
	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 8. Estimation of genomic DNA	

	9. Estimation of carotene and anthocyanin pigments 10. Visit to molecular biology laboratory and report submission.	
Credit –2 UNIT II	**BBST 602 Bioinformatics, Biostatistics and Economic Botany**	**10**
	11. Study of biological databases NCBI, DDBJ, EMBL and UniProt 12. Nucleotide sequence retrieval from NCBI database 13. Study of molecular phylogeny using Mega 6 software. 14. Study of measures of central tendency, frequency distribution of given data and its graphical representation 15. Determination of Standard deviation and standard error of the given data. 16. Study of Botanical Name, Morphology, Parts used and Economic importance of Jowar and Wheat. 17. Study of Botanical Name, Morphology, Parts used and Economic importance of Gram and Pigeon pea. 18. Study of Botanical Name, Morphology, Parts used and Economic importance of Ginger, Chilly, Tea and Coffee. 19. Study of Botanical Name, Morphology, Parts used and Economic importance of Groundnut and Soybean. 20. Study of Botanical Name, Morphology, Parts used and Economic importance of Cotton and *Agave*. 21. Assignment based on Biostatistics/ Bioinformatics	

Course outcomes: Student should be able to: -

1. Analyse the nutritional composition of plants and perform separation techniques used in plant sciences.
2. Understand the process and importance of seed certification, isolation and estimation of nucleic acid.
3. Estimate pigments in plants and working in molecular biology research laboratory.

4. Handle computational biology tools used in plant science research and know the utilization of economically important plants.

5. Know the applications of statistical / bioinformatics tools for data analysis in plant sciences.

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Syllabus introduced from June 2022
Bachelor of Science B. Sc. Part – III
SEMESTER - VI
BBST 603 Instrumentation and Techniques in Seed Technology

Course Objectives: Students will be able to

1. Understand the instrumentation.
2. Study seed processing machines.
3. Study seed treatment, seed processing plants.
4. Understand the seed storage and packaging.

Credits=4	**SEMESTER - VI** **BBST 603 Instrumentation and Techniques in Seed Technology**	**No. of hours per unit/ Credits 45**
Credit –I **Unit-I:**	**Instrumentation for Seed processing**	**11**
	Concept and objectives of seed processing: concept and importance, Basic flow pattern, seed processing pathway of seed improvement, physical characteristics used to separate seeds. Instruments for seeds processing: Scalper, Debearder, Maize Scarifier and Sheller, licensing of machines. 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.	
Credit –I **Unit II**	**Seed processing machines** Principle, construction, working, adjustments, cleaning and uses of seed processing machines: 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.	**12**
Credit –I **Unit – III**	**Seed treatment and Seed processing plant** 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. 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. Seed conveyors and elevator: bucket elevator, belt conveyor, screen conveyor, oscillation conveyor, pneumatic conveyor.	**11**
Credit –I **Unit – IV**	**Seed storage and packing** Seed storage: Structures and their management. 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.	**11**

Course Outcomes: Student should be able to: -

1. Understand instrument related to seed processing.
2. Study seed processing machines.
3. Understand different seed treatment, seed processing plants.
4. Understand seed storage and packaging methods.

References

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Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(Autonomous)

Syllabus introduced from June 2022
B. Sc. Part – III
SEMESTER - VI
Course BBST 604 Seed Farm Management and Marketing

Course Objectives: Students will be able to

1. Understand the seed farm management.
2. Understand the different field practices and machinery management.
3. Study the farm resource management and analysis.
4. Understand seed marketing strategies in India and around the globe.

Credits=4	**SEMESTER - VI** **BBST 604 Seed Farm Management and Marketing**	**No. of hours per unit/ Credits 45**
Credit –I **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.	
Credit –I **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.	
Credit –I **Unit – III**	**Farm Resource Management and Analysis** Farm planning, Construction of farm buildings, Implementation of shed, Strong structures. Farm business analysis, farm size, factors affecting profit and economic size of farm. Farm budgeting procedure and uses, farm efficiency measures, farm records & their uses. Farm surveys, data collection & analysis. Acquisition & management of land, labour & capital.	**12**
Credit –I **Unit – IV**	**Seed marketing** 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. Seed market surveys, seed industry in relation to global market, concept of WTO, GATT, IPR, and PBR.	**11**

Course Outcomes: Student should be able to: -

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

References

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Bachelor of Science B. Sc. Part – III
SEMESTER - VI
Practical Course BBSP 609 Practical's based on paper BBST 603 and 604

Course objectives Student should be able to:

1. Understand practical knowledge to students about seed storage and machinery management.
2. Give the practical knowledge about record keeping of farm management.
3. Experiential learning with these practical's.

Credits=4	**SEMESTER - VI** **BBSP 609: PRACTICAL COURSE – VIII**	**No. of hours per unit/ Credits**
Credit –2 **UNIT I**	**BBST 603 Instrumentation and Techniques in Seed Technology**	**10**
	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.	
Credit –2 UNIT II	**BBST 604 Seed Farm Management and Marketing**	**10**
	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: 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:

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In charge	**Chairman**	**Head**
B. Sc. III Seed Technology	Board of Studies	Department of Botany