

DEPARTMENT OF BOTANY

UNIVERSITY OF KASHMIR, SRINAGAR

The revised curriculum for Seed Technology to be adopted for B. Sc 1st and 2nd Semester from the academic session 2015 and subsequently for B. Sc 3rd and 4th Semester from the academic session 2016 and B. Sc 5th and 6th Semester 2017.

Course Structure: The course will comprise of 6 papers, one paper in each semester to be named as ST-01 to ST-06. Each paper will be of 100 marks, 20 for internal assessment and 80 for external examination. For each semester there will be one practical course to be named as L-01 to L-06 worth 50 marks, out of which 25 will be for internal assessment and 25 for external examination. Students will have to submit their practical note books as well as a plant collection herbarium at the time of practical examination..

The revised curriculum is to be adopted for B. Sc 1st Semester from academic session 2015

- i. The question paper shall be of 2 1/2hrs duration
- ii. Each subject shall have internal as well as external components of examination.

Internal Examination at College Level

This test shall be called as Internal Assessment Test, it shall consist of two components:

- a. **Attendance**
- b. **Mid term test/assignment/project work**

The distribution of marks per semester is reflected in the table as under:

Theory (External)	80
Attendance (Internal)	5 marks: wherein distribution will be as 2 mark (75-80%) 3 marks (80-90%) 5 marks (90-100%)
Theory (Mid term test/ project work/assignment- Internal)	15 marks
Total (Internal Assessment)	5+15=20
G. Total (Internal+ External)	100

- i. Number of units to be covered under Internal Assessment Test shall be left to college concerned.
- ii. Composition of marks among three components of part (b) i.e. midterm examination/project work/assignment shall be decided by the college.
- iii. Student must have a minimum 75% of attendance in each semester.
- iv. Student has to secure minimum of 36% percent marks in midterm test/project work/assignment. If college offers all the three, the 36% pass percentage in each component shall be applicable.

External Examination

- i. For external examination the syllabus of each course will be divided into four equal units.
- ii. Examination will be conducted by the Controller of Examinations, University of Kashmir at the end of each semester
- iii. There will be two types of questions in the question paper i.e. medium and long answer type questions comprising of Section A and Section B, respectively
- iv. In Section “A” there will be four medium type questions, one question with internal choice from each unit. All the four questions will be compulsory.
- v. There will be four long answer type questions in Section “B”, one from each unit and the student will be required to attempt any two questions.
- vi. The distribution of marks is reflected in the table as under:-

Theory paper carrying 80 marks
Section A
4 medium answer type questions each carrying 12 marks (4x12) =48
Section B
2 long answer type questions each carrying 16 marks (2x16) =32
<u>Theory component</u>
Internal examination = 20 marks; Minimum pass marks=8
External examination = 80 marks; Minimum pass marks=32
Total (20+80) =100 marks
<u>Practical Component</u>
Internal Assessment: 25 marks; Minimum pass marks = 9
External Examination: 25 marks; Minimum pass marks = 9

- vi. Pass percentage shall remain unchanged i.e 36% for both internal and external examinations.
- vi. Re-evaluation scheme as provided under the existing statute shall ' remain unchanged. Eligibility shall be determined on the basis of 75 marks and 100 marks in case of theory paper carrying an aggregate 100 marks and 150 marks respectively. Internal Assessment shall not be subject to any re-evaluation.

The single paper in no way shall affect the present eligibility norms for promotion to the next class.

Private candidates

Private candidates shall be subject to same external examination pattern as is applicable to the candidates in regular mode. In the case of regular candidates the internal assessment marks shall be added with the marks secured in the external examination. Since, there won't be any internal assessment for the private candidates the marks of the candidates will be raised strictly in proportion to the percentage of marks obtained in the external examination.

Seed Technology Syllabus Revised as per Semester scheme

ST-01 (B. Sc. 1st Semester)

UNIT: I

1. Flower structure, Development of male and female gametophytes.
2. Fertilization.
3. Endosperm and embryo development.
4. Apomixis.

UNIT: II

1. Development of fruit and seed, seed structure
2. General introduction to plant breeding:- Definition, History, Nature, scope and objectives
3. Pollination: - Self-pollination, cross pollination, agencies for cross pollination.

Unit: III

1. Self-incompatibility:- Genetics and biochemical basis
2. Male sterility: - Cytoplasmic, genetic and cytoplasmic-genetic, and its utility in plant breeding

3. Testing for cultivar genuineness: Objectives, General principles & methods.
4. Variety descriptors: importance in variety release system, Dus system.
5. Sequential approach in testing.

Unit: IV

6. Procedure for plant introduction and its achievements in field crops and flowers.
7. Pure-line selection-method, importance, Mass selection, Clonal selection procedure and uses. Maintenance of parental lines
8. Hybridization in self- pollinated and cross pollinated plants, application and objectives, development of single cross and double cross hybrids, development of synthetic and composite varieties. Achievements in field crops vegetables and fruit crops.

Lab. Course: L-01

1. Morphology of dicot and monocot seeds.
2. Seeding morphology and adult plant morphology in same major crops for identification of a variety in Green House Expt.
3. Phenol test in wheat and paddy.
4. Peroxidase test, 2h-D test.
5. G.A test in wheat and other crops.
6. Electrophoreses NaOH list.
7. Factors affecting germination. Temperature, moisture, substratum. Light pattern of water adsorption (starchy/protein and oil).
8. Dormancy behaviour and its release hard seededness.
9. Seed leachate conductivity test.
10. Quick viability test.
11. Accelerated ageing test.
12. Invigoration treatments.
13. Menstem culture.
14. Cytological techniques for the study of chromosomes in plants Preparation and uses of pretreatment solution (Colchicine, B-HO.PDB) Fixatives Preservatives Stains (Aceto orein, Acetocarmine, Propinocarmine, Feulgen etc) Study of Somatic Chromosomes in shoot tip and root tip meristems.
15. Preparation of slides for the study of mitosis and meiosis Mitosis in root or shoot meristem (Acetocarmine method, Feulgen method) Meiosis in micro sporogenesis (smear preparation in acetocarmine/propinocarmine)

ST-02 (B. Sc. 2nd Semester)

UNIT: I

1. Procedures of mutation breeding and achievements in crop improvement.
2. Production of polyploides and their role in plant breeding
3. Seed germination: Factors affecting germination.
4. Dormancy: Types, Causes, Methods of overcoming dormancy.
5. Seed as basic input in Agriculture concept and uses of quality seeds.
6. System of breeding & testing for crops, system of release & notification of varieties for general cultivation.

UNIT: II

1. Concept of genetic purity and the methods of its maintenance
2. Modification of flowering in crop plants for hybride seed production , various factors and floral characters which affect seed set.
3. Seed deterioration during storage, Factors affecting seed deterioration and it implication on seed quality.
4. Seed vigour, its measurements and crop productivity.

UNIT:III

1. Treatments to minimize seed ageing, Orthodox and recalcitrant seeds.
2. Micro propagation: - Definition, technique and uses, future prospects.
3. Seed pelleting and coating: Artificial seed production (synthetic seeds)
4. Factors affecting the choice of area of seed production (soil types, climate, nutrition weed status, insect, pest & disease incidence, compact area approach in seed production), seed village concept.

UNIT:IV

1. Effect of environment before & after harvest in seed quality, benovalent & malovalent effects on germination quality. Harvesting & threshing, precautions of this operation especially in high value seeds, post-harvest handling of seeds.
2. Systems of seed production in India, Agencies responsible for seed production and planing Indian & international seed industry.
3. Detailed seed production procedures in following crops with reference to soil isolation requirement, special Agronomic management, Rogueing, harvesting & threshing. a) Wheat (b) Rice (c) Maize (d) Mustard (e) Rajmash

Lab. Course: L-02

1. Hybridization techniques Floral biology Selection of parents with specific objectives Study of anthesis, pollen fertility & viability Collection of pollen Dusting of pollen and bagging Harvest of FO (hybride) seed Raising F4 progeny Screening of F1 hybrids

2. Studies on segregation using mixture of coloured seeds. Separation and counting of two types of seeds. Finding a segregation ratio between two classes. Testing the goodness of fit of the ratio by χ^2 test.
3. Studies on independent assortment. Using seeds of different shapes and colour Seed hardness Separation and counting of seeds in each class Finding a ratio among different categories Seed structure/tests. Testing the goodness of fit of the ratio by χ^2 test.
4. Studies on gene interaction Simple interaction Complementary gene interaction Epistatic gene interaction.
5. Embryo rescue and media preparation for cultures Embryo rescue techniques Preparation of media for embryo culture, anther culture and tissue culture
6. Visit to research farms to observe Experimental layout Varietal trails for yield evaluation Segregation of characters in standing F₂ generation. Germ plasm evaluation for agronomic traits, disease resistance insect resistance etc. Breeding methods used.
7. Preparation of agro climatic maps (India and states) for soil and climatic condition.
8. Identification of different crops seeds.
9. Seed production planning for hybrids and varieties. Computation of areas and seed.
10. Visit of foundation and certified seed plots study of the techniques of seed production.
11. Seed planning cost of seed production.

ST-03 (B. Sc. 3rd Semester)

UNIT:I

1. Introduction, definition and basis of heterosis
2. Estimations and exploitation of heterosis at commercial scale and fixation of heterosis.
3. Commercial exploitation of heterosis through Male sterility.
4. Role of gemetocides in hybrid seed production.
5. Seed quality and its control systems

UNIT:II

1. Seed legislation
2. IP and Plant variety protection
3. National and International organizations in seed quality control
4. Hybrid seed production and their economic importance

UNIT:III

1. Seed production planning, land isolation requirement and Agronomic management
2. Seed certification concept and History
3. Seed certification agencies, their organization and certification standards.
4. Sampling for seed quality evaluation, quality issue of certificate and revalidation of

seed lots

UNIT: IV

1. Scope and importance of vegetable breeding
2. Hybridization with reference to vegetable crops
3. Principles and procedures of vegetables seed production
4. Procedures for vegetable seed production

Lab. Course: L-03

1. Studies of inflorescence, floral management, floral morphology of some important crop plants like cotton, castor, pea, maize, cucurbits, mustard and capsicum
2. Artificial emasculation and pollination studies in maize, rice and mustard.
3. Studies on proogynous and protandrous nature of flowers in sunflower and linum.
4. Detailed study of ray florets, disc florets, thalamus, anthesis, stigma, extrusion and pollination in sunflower.
5. Floral structure of "A" line "B" line and "R" line in reference to essential parts of the flower.
6. Studies on synchronisation problem in maize and sunflower.
7. Genetic male sterility and maintenance of female line in pegenypa hybrid:-
 - i. Identification of genetic male sterile plants at but initiation stage.
 - ii. Methods of identification of male sterile anthers by structure and colour.
 - iii. Laboratory method of confirmation by acetecarmine test under microscope and in potassium iodine test
8. Sample registration and determination of the relative efficiency of various mixing and dividing techniques.
9. Raising of nursery and planting:- Nursery requirement and management for different vegetables. Seeding age for transplanting. Precautions, irrigation etc.
10. Floral biology of vegetables
Time for opening of flower
Time for anther maturity
Dehiscence of anthers, hermaphrodite flowers
11. Study of pollen grains of vegetables Collection of pollen Germination of pollen grains in water, sugar-solution, pollen jelly and other media.
12. Selfing and crossing techniques in vegetables,. Cucurbits, solanaeceous crops, onion, carrot, pea, beans, palak, lettuce
13. Identification of vegetables seeds. Temperature, tropical and temperate-tropical vegetables.

ST-04 (B. Sc. 4th Semester)

UNIT: I

1. Management of seed certification programme, Composition and function of control seed committee, central sub-committee on crop standards notification and release, control seed certification board, state seed committees.

2. Seed testing history and development
3. Seed sampling techniques: Heterogeneity test.

Unit: II

1. Reporting of seed testing results and record keeping.
2. Storage of guard samples.
3. Seed testing in relation to Seed Act and marketing.
4. Seed production planning land and isolation requirement,

Unit: III

1. Hybrid seed production in Field crops: Maize, Rice, Mustard, Sunflower, Cotton & castor.
2. Hybrid seed production in vegetable crops: Brinjal, Tomato, Capsicum, Cabbage, Cauliflower, Onion & Turnip
3. Physical purity test of seeds

Unit: IV

4. Determination of other distinguishable varieties and inert Matter
 - i) Moisture testing
 - ii) Germination testing
 - iii) Raped test for seed quality determination
 - iv) Testing of pelleted seeds
5. Biochemical methods: electrophoresis, phenol colour, peroxidase test, GA3 test and RFLP maps, RAPD, AFLP, and STS techniques.

Lab. Course: L-04

1. Visits of the vegetables breeding farm. Experiments on vegetable seed production, collection of seed, separation from pulp, drying seed planning.
2. Obtaining working sample, making separation, weighing, identification of purity components and reporting results.
3. Testing of the germination substrates and determination and MHC of seed.
4. Planting of seeds for germination, seeding evaluation and reporting of results.
5. Pretreatments, pre-drying and pre-chilling, chemicals (KMNO₃, GA₃) scarification, hot water treatment and delinting of cotton seed.
6. Tetrazolium testing of agriculture, vegetable and forestry seed.
7. Moisture testing by oven drying method.
8. Handling of moisture metres and determination of relative efficacy of moisture testers.
9. Fitting of application form for seed certification.
10. Exercise in field area measurement and field map preparation.
11. Checking of seed source, isolation requirements.

12. Observation in field inspection. Identification of objectionable weed plants and inseparable other crop plants. Study of stable morphological characters useful in identifying off-types in seed producing plots.

13. Taking of field counts and filling of inspection reports of important field crops both hybrid and Vass.

14. Study of sampling techniques and equipment.

15. Study of varietal purity through examination of seeds, seeding and plants recording of data and filling result forms.

ST-05 (B. Sc. 5th Semester)

Unit: I

1. History of Seed pathology: Economic significance of seed born diseases

- i. Mechanisms of seed transmission of seed pathogens: Seed born fungi, bacteria, viruses and nematodes; Storage fungi and their impact on animal and human health; tolerance limits of seed borne pathogens
- ii. Inoculum density of seed borne pathogens and their relationship with diseases severity yield issue
- iii. Concept, objectives and importance of seed processing:
Physical characteristics used to separate seeds; basic flow pattern in seed processing.

Unit: II

1. Preparing seed for processing – the sealper, the debearder , the scarificier; maize sheller
2. Seed drying : Importance and advantage of seed, the air moisture content in recalcitrant/orthodox seed; methods of seed moisture determination, theory and methods of seed drying advantage of mechanical drying over sun-drying, construction and operation of mechanical drying equipment, dehumidification and drying of heat sensitive seeds, relative humidity and equilibrium moisture content of seeds.
3. Seed separation:
 - a) The air screen cleaner cum grader, selection of screen for seed separation, adjustment of air screen.
 - b) Indented disc and indented cylinder separators- construction and operation.

Unit: III

1. Specific gravity separators:

Construction and operation, stratification and separation of seeds on the separating deck; separating problems and their rectification; recleaning the middling product;

the stoner, aspirators and pneumatic separators.

2. i) Surface texture separation:- the roll mill –construction; working and operation
- ii) Liquid separation – the magnetic separators- construction, working and operation .
- iii) Shape or roundness separation- the spiral separators (the draper best and electrostatics)- working, operation and cleaning.
- iv) Electronic (cocovi sortex) working

Unit: IV

1. Seed health testing (TZ and G.T testing) Objective , procedures for sampling of seed health testing; methods of seed health testing
2. Inoculum density of seed borne pathogens and their relationship with diseases severity, yield losses
3. Seed treatment : Equipment, slurry seed treator, mist-o-matic seed treator, their construction and operation; labeling of treated seeds, safety of machine operators and seed users
4. Quality control and measurement of machine performance, sampling of project and reject from seed handling machines, seed blending.

Lab. Course: L-05

1. Demonstration and handling of stereobinocular microscope.
2. Symptoms of important seed borne pathogens.
3. Visual examination of dry seed for disease symptoms.
4. Viability test space germination and tetrazium tests.
5. Infection sites studies by planting seed components.
6. Detection of important seed farm fungi- various detection methods.
7. Various methods for detection of seed borne viruses.
8. Study of external morphology of insect type, type of mouthmorphic, antenna an legs.
9. Identification of important storage pests, metamorphic stages of insects

ST-06 (B. Sc. 6th Semester)

Unit: I

1. Site selection for processing plant on a seed production farm; layout of machines for efficient product and men movement; mechanical injury to seeds in post- harvest phase, maintenance and repairs of seed processing equipments
2. Seed conveyers and elevators; bucket elevators, belt covneyers, screen coveyers, separating and oscillating conveyer, installation of bucket elevator, computing the required height of bucket elevators, capacity determination of bucket elevators

3. A. packaging seeds – bagger, weigher, bag closing, portable and conveyer type bag closers, labeling and maintaining lot identity, lot numbers, seed pellets-handling and stacking; maintenance of seed processing records
 - c. Seed storage structures:- construction, operation and maintenance; installation storage-aeration, air conditioning, dehumidification and stacking; moisture and heat proofing of seed storage structures, seed storage management

Unit: II

1. Introduction to seed entomology: definition, methods of insect classification orders of insects of economic importance; role of insects in seed protection
2. Morphology and types of appendages of insect body; stages of insect development; complete and incomplete metamorphosis
3. Insect ecology: Definition, ecological factors governing insect development and population importance of insect ecology
4. Economic entomology: Important insect pests of seed crops, the nature of damage and management in:
 - (a) Cereals: Paddy, maize and wheat
 - (b) Pulses: I) Kharif- Mung, rajmas, pigeon pea
II) Rabi- Garden pea (Matar)
 - (c) Oil seeds: Mustard, ground nut, sesame, lin seeds
 - (d) Vegetables: Brassicaceous and solonaceous vegetables

Unit: III

1. Farm management:- Introduction:- Basic principles and scope of f
2. Decision making approaches: Decision making based on production, cost and capital investment. Cost analysis law of diminishing returns, opportunity cost, most profitable combination of inputs and outputs
3. Planning and management of crops, building and machinery:
 - (a) Concept pertaining to crop production operation, viz tillage, irrigation, sowing, plant protection harvesting threshing, maintenance of soil fertility, weeds and their control, mixed cropping, multiple cropping and dry land farming
 - (b) Machinery selection and their management, determination of field capacity and field efficiency, machinery adjustment, licensing of machines.
 - (c) Consideration in farm buildings, implement shed and storage structures.

Unit: IV

1. Beneficial insects:

- (a) Types of beneficial insects and their role in seed production
- (b) Honey bees: Structure and management (Bee- keeping)
- 2. Insect control: (a) Methods of insect control – Culture, mechanical, physical, chemical, quarantine, preharvest
- (b) Insecticide formulation and preparation of spray solution, safe application of pesticides
- 3. Storage entomology: i. Types of insect pests and mites in storage
- ii Sources and development of infestation
- iii. Detection of infestation
- iv Fumigants and methods of fumigation
- v Seed protectants and their effect on seed viability
- vi. IPM strategies for important pests
- 4. Plant protection equipments:
 - (a) Types of equipments and their principles of working
 - (b) Safe handling, maintenance and use of machines
 - (c) Rodents and their control in field and in seed godowns
- 5. Marketing of seeds:- Farm business: Farm size, factors affecting profit and economic size of farm, farm business analysis

Lab. Course: L-06

- 1. Detection of seed borne insects and estimation of infestation.
- 2. Collection and submission of stored product pests visit to warehouse and godowns.
- 3. Study of morphological characters of different crop seeds.
- 4. Measurement of seed moisture content by direct and indirect methods drying methods.
- 5. Soil sampling for fertility and moisture content.
- 6. Cost analysis.
- 7. Farm planning and budgeting.
- 8. Record keeping.
