

## **B. Sc. (Hons) Agriculture**

### **Agricultural Botany**

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

## B. Sc. (Hons) Agriculture

### Department wise list of courses

#### Botany (Genetics and Plant Breeding, Physiology and Seed Technology)

Sr. No.	Semester	Course No.	Credits	Course Title
1	II	GPB 121	3(2+1)	Fundamentals of Genetics
2	II	BOT 121	2(1+1)	Fundamentals of Crop Physiology
3	III	GPB 232	2(1+1)	Fundamentals of Plant Breeding
4	IV	GPB 243	3(1+2)	Principles of Seed Technology
5	IV	ELE GPB 244	3(2+1)	Commercial Plant breeding
6	IV	ELE BOT 242	3(1+2)	Micropropagation Technologies
7	V	GPB 355	2(1+1)	Crop Improvement – I (Kharif Crops)
8	V	BOT 353	1(1+0)	Intellectual Property Right
9	VI	GPB 366	2(1+1)	Crop Improvement – II (Rabi crops )
10	VIII	ELM BOT 481	10(0+10)	Seed production and Technology
11	VIII	ELM.BOT 482	10=0+10	Tissue culture Technologies

<b>Course :</b>	GPB 121		<b>Credit:</b>	3(2+1)	<b>Semester-II</b>
<b>Course title:</b>	Fundamentals of Genetics				

## Syllabus

### Theory

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory of inheritance- cell cycle and cell division- mitosis and meiosis. Probability and Chi-square. Dominance relationships, Epistatic interactions with example.

Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

### Practical

Study of microscope. Study of cell structure. Mitosis and Meiosis cell division. Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and Chi-square test. Determination of linkage and cross-over analysis (through two point test cross and three point test cross data). Study on sex linked inheritance in *Drosophila*. Study of models on DNA and RNA structures.

## Teaching Schedule

### A) Theory

Lecture	Topic	Weightages (%)
1	<p><b>Pre and post Mendelian concepts of heredity:</b>  <b>Pre Mendelian concepts: (500 BC -1850 A.D.)</b>            1. Pre formation Theory            2. Theory Epigenesis            3. Theory of Acquired characters            4. Theory of Pangenesis            5. Germplasm theory            Other contributions during pre-Mendelian era  <b>Mendelian Era: (1850 -1900):</b> Contributions during Mendelian era  <b>Post Mendelian concepts:</b> Contributions during Post-Mendelian era and recent advances after 1900.            Role of different disciplines in the advancement of Genetics.</p>	2

Lecture	Topic	Weightages (%)
	Impact of Genetics and its applications in different disciplines (Role in Agriculture)	
2	<b>Mendelian principles of heredity:</b> Laws of Mendel, Reasons of Mendel's success Mendelian deviations or exceptions or anomalies	3
3 & 4	<b>Cell division: Mitosis, Meiosis:</b> Cell: Ultra structure, Cell organells & their functions. Types of Cell, Difference between animal cell and plant cell. <b>Stages of mitosis &amp; meiosis.</b> Significance of mitosis & meiosis Difference between mitosis & meiosis.	4
5	<b>Dominance relationships:</b> Different patterns of dominance relationship like Complete dominance, Incomplete dominance, Co-dominance, Overdominance and Lethal gene action.	2
6, 7 & 8	<b>Gene interaction, Epistasis interactions with examples:</b> Difference and similarities between epistasis and dominance. 1. Recessive epistasis (Supplementary gene action) 2. Dominant epistasis (Simple epistasis) 3. Dominant Inhibitory epistasis (Inhibitory gene action) 4. Duplicate recessive epistasis (Complementary gene action) 5. Duplicate dominant epistasis (Duplicate gene action) 6. Polymeric gene action 7. Typical dihybrid ratio	8
9	<b>Multiple alleles:</b> Important features of multiple alleles Examples of multiple alleles 1) Fur colour in a rabbit, 2) ABO blood group in man	3
10	Pleiotropism, pseudo-alleles, penetrance and expressivity	2
11 & 12	<b>Sex determination and sex linkage, Sex limited and sex influenced traits.</b> Introduction, Importance of Sex determination, Difference between autosomes and allosomes. Allosomal sex determination: 1. XX-XY System 2. XX-XO System 3. XO-XX System 4. ZW-ZZ (XY-XX) System Sex linked characters: (Colour blindness in human being) Difference between Sex limited and sex influenced traits:	6
13	<b>Linkage and its estimation:</b> Introduction, Features of Linkage, Phases of Linkage, Types of Linkage, Linkage and pleiotropy, Significance of Linkage.	4
14	<b>Crossing over mechanisms:</b> Introduction; main features of crossing over; Types of crossing over; Molecular Mechanism of Crossing over; Factors affecting crossing over, Interference and Coincidence; Differences between crossing over and linkage; Significance of Crossing over.	4

Lecture	Topic	Weightages (%)
15	<b>Probability and Chi-square :</b> Definition of Probability and Chi-square; The application and requirement of Chi-square test.	2
16	<b>Chromosome mapping:</b> Definition and Concept.	2
17	<b>Structural changes in chromosome:</b> Introduction; Types of Structural chromosome changes; Genetic effects and Significance.	4
18 & 19	<b>Mutation:</b> Introduction; Characteristics of Mutation; classification of Mutation; Kinds of Mutation, Mutagenic agents and induction of mutation; Application in crop improvement.	8
20	<b>Qualitative &amp; quantitative traits, Polygenes and continuous variations:</b> Introduction; Characteristics of Qualitative & quantitative traits; Examples of Qualitative & quantitative traits.	4
21	<b>Multiple factor hypothesis:</b> Introduction; Concept of multiple factor hypothesis by Nilsson – Ehle in Wheat.	4
22	<b>Cytoplasmic inheritance:</b> Introduction; Characteristics of Cytoplasmic inheritance; Difference between mendelian inheritance and Cytoplasmic inheritance; classes of cytoplasmic inheritance; Plastid and mitochondrial inheritance; Significance of Cytoplasmic inheritance in crop improvement.	3
23	<b>Genetic disorders:</b> Introduction; Gene action in man, diseases caused by metabolic disorders like Alkaptonuria, Phenyl ketonuria, Albinism, tyrosinosis and Goitrosus Cretinism, Sickle cell anemia.	3
24 & 25	<b>Nature, structure &amp; replication of genetic material:</b> Introduction; DNA as a genetic material, Structure of DNA; Replication of DNA- Dispersive, Conservative, Semi-Conservative. Difference between DNA and RNA	8
26 & 27	<b>Protein synthesis, Transcription and translational mechanism of genetic material:</b> Introduction; Transcription; mechanism of transcription; Translational; mechanism of translational; Difference between transcription and translational.	8
28 & 29	<b>Gene concept :</b> Gene structure, fine structure of gene, Classical and modern concept of gene, Benzer concept of fine structure of gene., Citron, Recon, Muton	8
30, 31 & 32	<b>Gene function and gene regulations, Lac and operons:</b> Introduction; Mechanism of gene regulation 1. Negative regulation 2. Positive regulation The Operon Model	8
	<b>Total</b>	<b>100</b>

## B) Practical

Exercise	Topic
1	Study of microscopes
2	Study of cell structure
3	Preparation of microscopic Slides of mitosis - onion root tips
4	Preparation of microscopic Slides of meiosis – tradescantia /onion /Wheat inflorescence
5.	Methods of finding out the gametes and gametic recombination
6.	Problems on monohybrid ration and its modification
7	Problems on dihybrid ratio and its modification
8	Experiments on test cross and back cross
9	Gene interaction – I Gene interaction without modification of F <sub>2</sub> ratio (comb-shape ) and complementary gene interaction.
10	Gene interaction – II Gene interaction with modification of F <sub>2</sub> ratio: supplementary factor, epistatis factor, inhibitory factor
11	Gene interaction – III Gene interaction with modification of F <sub>2</sub> ratio: Additive factor, duplicate factor and lethal factor
12	Problems on probability and Chi-square test
13	Chi-square test Problems on
14	Determination of linkage and cross over analysis (though two point test cross and three point test cross data)
15	Study on sex linked inheritance in Drosophila
16	Study of models on DNA and RNA structure

### Suggested Reading:

Sr. No	Title of Book	Author/Authors	Publisher
1.	Principle of Genetics	E. J. Gardner , M. J. Simmons, D. P. Snustad	Wiley India (P) Ltd.
2.	Genetics	P. K. Gupta	Restogi publication Meerut - (p)
3.	Fundamentals of Genetics	B. D. Singh	Kalyani Publication, New Delhi.
4.	Genetics	M.W. Strickbearer	Peerson education, Inc.
5.	Elements of Genetics	Phundansingh	Kalyani Publication, New Delhi
6.	Genetics	Sushant Elrod and William Stansfield	McGraw Hill Publishing company Limited, New Delhi.

<b>Course :</b>	BOT 121		<b>Credit:</b>	2(1+1)	<b>Semester-II</b>
<b>Course title:</b>	Fundamentals of Crop Physiology				

## Syllabus

### Theory

Introduction to Crop Physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C<sub>3</sub>, C<sub>4</sub> and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.

### Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO<sub>2</sub> assimilation by Infra Red Gas Analyser (IRGA).

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightage (%)
1	Introduction to Crop Physiology and its importance in Agriculture	5
2	Plant cell- structure, cell organelles and their role	5
3-4	Absorption of water and path of water. Ascent of sap and theories of ascent of sap	10
5	Transpiration- Definition, types , structure of stomata, physiology of stomata, factors affecting transpiration, Water use efficiency & factors affecting W.U. E.	5
6	Mineral nutrition of plants. Classification of mineral element, criteria of essentiality. General and specific role of mineral element and deficiency symptoms, mechanism of mineral element uptake.	10
7-8	Photosynthesis : Definition pigment involved, structure of chloroplast, light reaction- Photolysis of water, Emerson effect, Cyclic and non cyclic electron transfer, Significance of light reaction.	10
9	Dark reaction- C <sub>3</sub> , C <sub>4</sub> and CAM plants factors affecting photosynthesis, Photorespiration	5
10	Respiration- Definition, types, glycolysis TCA cycle and electron transport chain	10

<b>Lecture</b>	<b>Topic</b>	<b>Weightage (%)</b>
11	Fat metabolism- fatty acid synthesis and break down	5
12	Plant Growth Regulators, Definition, types , physiological role and Agricultural uses of PGRS.	10
13	Growth : Definition, types of growth, measurement of growth, growth analysis	5
14-15	Physiological aspects of growth and development of important cereals, pulses and oil seed crops	15
16	Photoperiodism- Definition, types, SDP, LDP and Day neutral plants- Induction a flowering and florigene concept	5
Total		100

### **b) Practical**

<b>Experiment</b>	<b>Topic</b>
1	Study of plant cell
2	Study of imbibitions
3	Study of osmosis
4	Study of plasmolysis
5	Study of root pressure
6	Measurement of rate of transpiration
7	Study of structure and distribution of stomata
8	Estimation of relative water content of tissue
9	Study of separation of photosynthetic pigment through paper chromatography
10	Measurement of rate of photosynthesis by different methods
11	Study of respiration and respiratory quotient
12	Rapid tissue tests for macro-elements
13	Rapid tissue tests for micro-elements
14	Study of use of PGR in fruit ripening
15	Effect of osmotic pressure on seed germination.
16	Measurement of Plant growth.



## Suggested Readings:

SR	Name of Book	Author	Publisher
1	A Text Book Plant Physiology*	Dr. V. Verma	Emkay Publisher, Delhi-110 051
2	Plant Physiology*	S. N. Pandey & B. K. Sinha	Vikas Publishing House, New Delhi-110 014
3	Practical Plant Physiology*1967	Amar Singh	Kalyani Publisher, Ludhiana
4	Plant Physiology*2005	C. P. Malik	Kalyani Publisher, Ludhiana
5	Plant Physiology@	K. N. Dhumal, T. N. More and M. R. Munnali	Niraliprakashan, Pune
6	Plant Physiology	Robert M. Devlin & Francis H. Witham	CBS Publisher & Distributors, Delhi-110 032
7	Plant Physiology@	H. S. Shrivastava	Rustogi Publications, Meerut-250 002
8	Crop Physiology*	C. N. Chore, S. R. Ghadekar & R. K. Patil	Agromet Publisher, Nagpur-440 010
9	Plant physiology 2005@	S. Mukharji and A. K. Ghosh	New central book agency, Kolkatta
10	Plant physiology*2010	Taiz & Zeiger, E	Sinaurasso.Inc, USA
11	Introductory Plant physiology* 2013	G. Roy Noggle & George friz	PHI learning pvt ltd, N. Delhi
12	A Text Book Plant Physiology* 2005	c. P. Malik & A. K. Srivastava	Kalyani publisher, Ludhiyana
13	Plant Physiology@1993	S. Chandra Datta	Wiley Eastern ltd, Daryaganj, N. Delhi
14	Experiment in Plant Physiology –A Lab. Manual * 1998	Dayanand Bajracharya	Narosa publishing house, panchshil park, N. Delhi
15	Plant Physiology – fundamentals & applications @2005	Arvindkumar & S. S. Purohit	Agrobios ( India ), Jodhpur
16	Modern Plant physiology 2007@	R. K. Sinha	Narosa publishing house, panchshil park, N. Delhi

\*Text book & practical book

@Reference book

<b>Course :</b>	GPB 232	<b>Credit:</b>	2(1+1)	<b>Semester-III</b>
<b>Course title:</b>	Fundamentals of Plant Breeding			

## Syllabus

### Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes- Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

### Practical

Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightages (%)
1.	Definition, history of plant breeding, aims and general objective of plant breeding Land marks of plant breeding, Indian plant breeders, General objectives of plant breeding Major achievements, Future Prospects	8

Lecture	Topic	Weightages (%)
2.	<b>Self incompatibility-</b> Definition, classification, heteromorphic SI, its features, distyly, tristyly, homomorphic SI, its types i.e. gametophytic SI and sporophytic SI, its features, utilization of self incompatibility in plant breeding	6
3	<b>Male sterility-</b> Definition, Classification/types, Genetic MS, Thermosensitive Genetic MS, Photosensitive Genetic MS, Transgenic MS, Cytoplasmic MS, Cytoplasmic Genetic MS, Chemical Hybridizing Agents	6
4	<b>Heritability-</b> Definition, types-narrow and broad sense heritability <b>Components of genetic variation-</b> Classification, definition and features of additive, dominance and epistatic variance, gene action	5
5	<b>Concepts of population genetics-</b> Definition and concept of population genetics, random mating population, gene and genotypic frequency <b>Hardy-Weinberg law-</b> Law, its validity, factors affecting gene frequency	5
6	<b>Breeding Methods in self pollinated crops</b> <b>List of breeding methods</b> <b>Plant Introduction-</b> Definition, purpose, types i.e. primary and secondary introduction, advantages and disadvantages <b>Acclimatization-</b> Definition, concept, factors affecting acclimatization	5
7	<b>Pure line selection-</b> uses of pure line, merits, demerits, achievements <b>Mass selection-</b> Definition, genetic basis, main features, positive and negative selection, detailed procedure of development of variety by mass selection, its merits, demerits, achievements	5
8	<b>Handling of segregating population through Pedigree method-</b> detailed procedure of pedigree method, its merits, demerits, achievements	5
9	<b>Handling of segregating population through Bulk method-</b> Concept of bulk method, short term, long term, its application, procedure of bulk method, its merits, demerits, achievements <b>Handling of segregating population through Single seed descent method-</b> concept of SSD method, its application, detailed procedure of SSD method, its merits, demerits, achievements	4
10	<b>Back cross method-</b> Definition of backcross, its objective, requirements and applications of backcross method, procedure for transfer of dominant gene <b>Back cross method-</b> procedure for transfer of recessive gene, merits, demerits, achievements of backcross method	5
11	<b>Methods of breeding in cross pollinated crops-</b> list of plant breeding methods for cross pollinated crops <b>Modes of selection-</b> Recurrent selection, its types and its procedure	5
12	<b>Hybridization techniques-</b> Definition, aim and objectives, types	10

Lecture	Topic	Weightages (%)
	of hybridization, steps and procedure of hybridization programme <b>Wide hybridization-</b> Definition, types, main features, interspecific and intergeneric hybridization, its examples, incompatibility barriers for wide hybridization, techniques for overcoming incompatibility barriers, achievements	
13	<b>Composite and synthetic varieties-</b> Definition, steps for development of composites and synthetics, procedure of developing composites and synthetics, its merits, demerits and achievements	5
14	<b>Breeding methods in asexually propagated crops:</b> List of breeding methods for asexually propagated crops. <b>Clonal selection-</b> Definition, features of asexually propagated crops, procedure of clonal selection, its merits and demerits <b>Hybridization-</b> steps and procedure of hybridization in clonal crops	6
15	<b>Mutation breeding method and its uses</b> – Definition of mutation breeding, conditions in which mutation is rewarding, procedure of mutation breeding for seed and vegetatively propagated crops, applications, its merits, demerits and achievements <b>Polyploidy in relation to plant breeding-</b> Definition of haploid, monoploid, diploid, polyploid, genome, heteroploidy, annuploidy, euploidy, types of annuploidy its application in crop improvement, types of polyploidy (natural occurring and artificial) and its role in crop improvement, effects of polyploidy, its application in crop improvement and limitation	12
16	<b>Heterosis-</b> Definition, heterosis and hybrid vigour, effects and estimation of heterosis, genetic basis/theories of heterosis <b>Inbreeding depression-</b> Definition, effects of inbreeding	8
<b>Total</b>		<b>100</b>

### b) Practical

Experiment	Exercise
1	Plant Breeder's kit
2	Study of germplasm of various crops
3	Study of floral structure of self pollinated crops
4	Study of floral structure of cross pollinated crops
5	Emasculation and hybridization techniques in self pollinated crops : Green gram, Black gram, Rice, Wheat, Groundnut, Soybean,
6	Emasculation and hybridization techniques in self pollinated crops : Sesame, Chickpea, Okra, Tomato, Brinjal, Chilli,
7	Emasculation and hybridization techniques in cross pollinated crops : Maize, Bajra, Sunflower, Papaya, Sugarcane,
8	Emasculation and hybridization techniques in often cross pollinated crops : Cotton, Sorghum, Pigeonpea, Safflower

<b>Experiment</b>	<b>Exercise</b>
9	Consequences of inbreeding on genetic structure of resulting populations
10	Study of male sterility system
11	Handing of segregation populations
12	Methods of calculating mean, range, variance, standard deviation, heritability
13	Designs used in plant breeding experiment
14	Analysis of Randomized Block Design
15	To work out the mode of pollination in a given crop and extent of natural out crossing
16	Prediction of performance of double cross hybrids

### **Suggested Readings:**

<b>Sr. No</b>	<b>Title of Book</b>	<b>Author/Authors</b>	<b>Publisher</b>
1.	Plant Breeding Principles and Methods	B. D. Singh	KalyaniPublication New Delhi.
2.	Essentials of Plant Breeding	Phundansingh	Kalyani Publication New Delhi
3.	Principles and Practices Plant Breeding	J. R. Sharma	McGraw Hill Publishing company Limited , New Delhi.
4.	Plant Breeding Theory and Practices	V. L. Chopra	Oxford and IBH. Publishing Company , New Delhi.
5.	Introduction to Plant Breeding	R. C. Choudhary	Oxford and IBH. Publishing Company , New Delhi.
6.	Elementary Principles of Plant Breeding	R. C. Choudhary	Oxford and IBH. Publishing Company , New Delhi.

<b>Course :</b>	GPB 243		<b>Credit:</b>	3(1+2)	<b>Semester-IV</b>
<b>Course title:</b>	Principles of Seed Technology				

## Syllabus

### Theory

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed. Foundation and certified seed production of important **cereals, pulses, oilseeds, fodder and vegetables**. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed production.

Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.

### Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum, Bajra and Ragi. Seed production in major pulses: Urd, Mung, Pigeonpea, Lentil, Gram, Field bean, pea. Seed production in major oilseeds: Soybean, Sunflower, Rapeseed, Groundnut and Mustard. Seed production in important vegetable crops. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigour test. Genetic purity test: Grow out test and electrophoresis. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightages (%)
1	Seed and seed technology : introduction, definition and importance	5
2	Deterioration causes of crop varieties and their control & Maintenance of genetic purity during seed production	5
3	Seed quality : definition. Characters of good quality seed	4
4	Different classes of seed.	4

Lecture	Topic	Weightages (%)
5	Foundation and certified seed production of important cereals ( <b>Wheat, Sorghum, Maize, Rice &amp; Bajara</b> )	5
6	Foundation and certified seed production of important pulses ( <b>Pigeon Pea, Green Gram, Black Gram &amp; Chick Pea</b> )	5
7	Foundation and certified seed production of important oil seeds ( <b>Soybean, Sunflower, Safflower ,Groundnut and Cotton</b> )	5
8	Foundation and certified seed production of important fodder crops ( <b>Fodder Sorghum, Lucern, Berseem,</b> )	5
9	Foundation and certified seed production of important vegetable crops ( <b>Tomato, Brinjal, Chilli, Onion &amp; Okra</b> )	5
10	Seed certification, phases of certification, procedure for seed certification, field inspection	4
11	Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds control order 1983.	5
12	Varietal identification through Grow Out Test and Electrophoresis. <b>Molecular and biochemical test. Detection of genetically modified crops. Transgene contamination in non-GM crops, GM crops and organic seed production.</b>	15
13	Seed drying, processing and their steps. Seed testing for quality assessment.	5
14 & 15	Seed treatment, its importance, method of application and seed packing. Seed storage : general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage	14
16	Seed marketing : structure and organization, sales generation activities ,promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing.	14
	Total	100

### b) Practical

Experiment	Topic
1	Seed production in major cereals : Wheat and Rice
2	Seed production in : Sorghum and Bajara
3	Seed production in : Maize.
4	Seed production in major pulses : Green gram and Black gram
5	Seed production in pulses : Pigeonpea and Lentil
6	Seed production in pulses : Gram and Field pea
7	Seed production in major oil Seeds : Soybean, Rapeseed & Mustard
8	Seed production in major vegetable crops :Brinjal and Tomato.
9	Seed production in vegetable crops :Chilli and Okra.
10	Seed production in vegetable crops : Onion
11	Seed production in : Pumpkin, Bottle gourd
12	Seed production in : Bitter gourd, Ridge gourd, Sponge gourd

<b>Experiment</b>	<b>Topic</b>
13	Seed sampling and testing procedure
14	Physical purity test
15	Seed moisture test
16	Germination test – types of germination
17	Germination test – different methods of germination
18	Seed viability test
19	Seed and seedling vigour test
20	Genetic purity test : Grow Out Test
21	Genetic purity test : Electrophoresis
22	Seed certification : Procedure
23	Field inspection, preparation of field inspection report
24	Visit to seed production farms of cereal crops
25	Visit to seed production farms of oilseed crops
26	Visit to seed production farms of pulse crops
27	Visit to seed production farms of fiber crops
28	Visit to seed testing laboratories
29 & 30	Visit to seed processing plant

### **Suggested Readings:**

<b>Sr. No</b>	<b>Title of Book</b>	<b>Author/Authors</b>	<b>Publisher</b>
1.	Seed Technology	R. L. Agrawal	Oxford and IBH. Publishing Company , New Delhi.
2.	Seed Science and Technology	SubirSen N Ghosh	Kalyani Publication New Delhi
3.	Principles of Seed Technology	Phundan Singh	KalyaniPublication New Delhi.
4.	Seed Science and Technology	N. C. Singhal	KalyaniPublication New Delhi.
5.	Seed Technology	DhirenderKhare and Mohan Bhale	Scientifice Publishers, JodhaPur
6.	Vegetable Seed Production	Nempal Singh, D.K. Singh, Y.K. Singh and Virendirekumar	International Book Distribution Company, Lucknow.



<b>Course :</b>	ELE GPB 244		<b>Credit:</b>	3(1+2)	<b>Semester-IV</b>
<b>Course title:</b>	Commercial Plant Breeding				

## Syllabus

### Theory

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production. Genetic purity test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.

### Practical

Floral biology in self and cross pollinated species, selfing and crossing techniques. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system. Learning techniques in hybrid seed production using male-sterility in field crops. Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing viz., grading and packaging. Visit to public private seed production and processing plants.

## Teaching Schedule

### a) Theory

Lecture	Topics to be covered	Weightage (%)
1.	Types of Crop: Classifications of crops.	4
2-3	Male sterility-Definition, Transfer of MS to a new strain, maintenance of MS, Production of hybrid seed and limitations in using male sterility systems.	12
4-5	Hybrid varieties & features, Development of hybrid varieties: Development and evaluation of inbred lines, selection of productive inbred lines & production of hybrid seeds. Maintenance of nucleus & breeder seed in self and cross pollinated crops, Maintenance of pre-released or newly released varieties; Breeder seed of established varieties, Maintenance of nucleus & breeder seed of inbred lines.	14
6	Genetic purity test of commercial hybrids: Maintenance of genetic purity and safeguards for maintenance of genetic purity, Factor affecting genetic purity.	6

Lecture	Topics to be covered	Weightage (%)
7-9	Advances in hybrid seed production of Rice, Sorghum, Maize, Pearl-millet, Sunflower, Cotton, Pigeon-pea, etc. Steps and factor affecting hybrid seed production.	20
10	Principles of quality seed production of vegetables crops under open and protected environment	6
11	Development of parental lines and cultivars: Haploid production by anther and pollen culture.	8
12	IPR issue in commercial plant breeding	2
13-14	DUS testing -The Protection of Plant Varieties and Farmer's Right Act, 2001 (PPVFR, 2001): Main objective, Power and duties of PPV & FR Authority, Criteria for protection, Registration, Plant varieties qualifying for registration and Compulsory licensing. DUS testing centers.	10
15	Variety testing, release and notification major steps in India, General procedure for variety testing. Central Variety Release Committee, State Variety Release Committee. Seed production organizations; NSC, MSSC.	10
16	Genetic and Agronomic principles of quality seed production and its characteristics	8
<b>Total</b>		<b>100</b>

#### b) Practical

Experiment	Title
1.	Floral Biology in self pollinated species
2.	Floral Biology in cross pollinated species
3	Selfing techniques in different crops
4.	Crossing techniques in different crops
5.	Learning techniques in hybrid seed production using male-sterility in fields crops
6.	Techniques of seed production using A, B and R systems in self pollinated crops.
7.	Techniques of seed production using A, B and R systems in cross pollinated crops.
8	Techniques of seed production using two line systems in self and cross pollinated crops.
9	Problems in hybrid seed production.
10	Tools and Techniques for optimizing hybrid seed production
11	Multiplication and purification of line in hybrid seed production
12	Rouging concept in seed production plot
13	Role of pollinators in hybrid seed production

Experiment	Title
14-17	Hybrid seed production techniques in field crops: Sorghum, pearl-millet, maize, rice, sunflower, pigeon-pea, cotton crops.
18-20	Hybrid seed production techniques in vegetable crops: Okra, Brinjal, Onion, Chilli, tomato etc.
21	Seed sampling.
22	Physical purity test and detection of spurious seed.
23	Genetic purity test under field and laboratory conditions.
24	Seed drying
25	Storage structure in quality seed management
26	Seed screening techniques during seed processing: Seed grading
27	Seed screening techniques during seed processing :Seed packaging
28-29	Visit to public / private seed production plots
30-31	Visit to public / private seed processing plants
32	Economics of commercial seed production

### Suggested Readings:

- 1) Hybrid Seed Production in Field Crops: Principles and Practices by N. C. Singhal, 2003, a. Kalyani publication, Delhi
- 2) Principles of Seed Technology by P.K. Agrawal, 2002, Oxford
- 3) Seed Production of Vegetables. By Prabhakar Singh and B. S. Asati
- 4) Seed Technology, 1996, Agarwal R L, Oxford
- 5) Plant Breeding; Principles and Methods by B.D. Singh, 2006, Kalyani publication, Delhi
- 6) Genetics 2002 by P. K. Gupta, Rastogi publication
- 7) An Introduction to Seed Technology by Thomson J.R.
- 8) Seed science and technology laboratory manual, 1997 by M. B. Mdonald and L.O.
- 9) Copeland, Chapman & hill.
- 10) Seed Technology by DhirendraKhare and Mohan S. B. Bhale, 2005
- 11) Principles and practices of plant breeding by Sharma J. R.1984, Tata McGraw –Hill.
- 12) Practical plant breeding by Gupta S. K. 2004, Agribios publication
- 13) Principles of Vegetable Seed Production by Prem Narayan
- 14) Principles Plant Breeding, 1981 by Allard R W, Jhon Willy and sons
- 15) Fundamentals of Plant Breeding, 2005 Kalyani publication, Delhi
- 16) Fundamentals of Plant Breeding & hybrid seed production, 1996, Agarwal R L, Oxford

<b>Course :</b>	ELE BOT 242		<b>Credit:</b>	3(1+2)	<b>Semester-IV</b>
<b>Course title:</b>	Micro-propagation Technologies				

## Syllabus

### Theory

Introduction, History, Advantages and limitations; Types of cultures (seed, embryo, organ, callus, cell), Stages of micropropagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture), Organogenesis (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures, Production of secondary metabolites, Somaclonal variation, Cryopreservation

### Practical

Identification and use of equipments in tissue culture Laboratory, Nutrition media composition, sterilization techniques for media, containers and small instruments, sterilization techniques for explants, Preparation of stocks and working solution, Preparation of working medium, Culturing of explants: Seeds, shoot tip and single node, Callus induction, Induction of somatic embryos regeneration of whole plants from different explants, Hardening procedures.

## Teaching Schedules

### a) Theory

Lecture	Topic	Weightages (%)
1 & 2	Meaning and concept of <i>in vitro</i> culture and micro-propagation, Historical milestones.	05
3	Tissue culture methodology: Sterile techniques	10
4	Synthetic and natural media components, growth regulators, environmental requirement.	10
5	Totipotency, dedifferentiation; genetic control of regeneration;	05
6	Plant regeneration pathways - Organogenesis and Somatic embryogenesis;	10
7	Organogenesis- Purpose, methods and requirements for organogenesis, indirect and direct organogenesis;	10
8, 9 & 10	Somatic embryogenesis- Procedures and requirements for organogenesis, indirect and direct embryogenesis; Differences between somatic and gametic embryogenesis,	15
11, 12 & 13	Micro-propagation- Definition, methods, stages of micro-propagation and its significance; Advancement and future prospects of micro-propagation.	20
14 & 15	Micropropagation - Axillary bud proliferation approach- Shoot tip and meristem culture;	10
16	Synthetic seed- Concepts, necessity, procedure and requirements for production of synthetic seeds.	5
	<b>Total</b>	<b>100</b>

**b) Practical**

<b>Experiment</b>	<b>Topic</b>
1	Laboratory organization of Plant Tissue Culture Laboratory
2	Safety Measures in Laboratory
3, 4, 5	Sterilization techniques: Common Contaminant in Laboratory, Sterilization of glassware, Working of Laminar air flow cabinet
6, 7	Culture Media: Definition, Components of Media, Stock Solution, Working Solution, Sterilization of Media.
8, 9	Preparation and sterilization of growth regulators/thermolabile compounds.
10,11	Preparation of working medium
12,13	Experimentation on determining optimum concentration of growth regulators.
14	Sterilization techniques for explants.
15, 16, 17, 18	Callus induction from different parts of plants
19, 20, 21, 22	Regeneration of whole plants from induced callus using different parts of plants.
23, 24	Induction of somatic embryos.
25, 26	Experiments of synthetic seeds production and testing storability and germination efficiency.
27, 28, 29, 30, 31 ,32	Direct regeneration into whole plants using bud, node and other tissues.

**Suggested readings:**

- 1) Plants from Test Tubes: An introduction to Micropropagation (Fourth Edition) – Lydiane Kyte, John Kleyn, Holly Scoggins and Mark Bridgen (Timber Press)
- 2) Introduction to Plant Tissue Culture- M. K. Razdan (Science Publisher)
- 3) Somatic Embryogenesis: Fundamental Aspects and Application – Loyola-Vargas, Victor, Ochoa-Aleja, Neftali (Springer)
- 4) Plant Tissue Culture, Techniques and Experiment – Robert H Smith (AP)
- 5) Plant Tissue Culture- Protocols in Plant Biotechnology - M.C. Gayatri and R. Kavyashree (Narosa Publishing)
- 6) Practical biotechnology and Plant Tissue Culture- Prof. Santosh Nagar, Dr. Madhavi Adhav (S Chand)

<b>Course :</b>	GPB 355		<b>Credit:</b>	2(1+1)	<b>Semester-V</b>
<b>Course title:</b>	Crop Improvement –I ( <i>Kharif Crops</i> )				

## Syllabus

### Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

### Practical

Floral biology, emasculation and hybridization techniques in different crop species; viz., Rice, Jute, Maize, Sorghum, Pearl millet, Ragi, Pigeonpea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Caster, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different *kharif* crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Kharif* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightages (%)
1	Centre of origin, Distribution of species, wild relative in different crops <b>Cereals-</b> Rice, Maize, Sorghum, Pearl millet, Ffinger millet. <b>Pulses-</b> Pigeonpea, Urdbean, Black gram, Mung bean, Cowpea, Soybean. <b>Oil seed-</b> Groundnut, Castor, Sesame, Sunflower.	4
2	<b>Fodder:</b> Berseem, Lucerne, rice bean. <b>Cash crops:</b> Cotton, Tobacco. <b>Vegetable:</b> Ridge gourd, bottle gourd, Snake gourd, Bitter gourd. <b>Horticultural crop-</b> Mango, Cashewnut, Citrus, Pomegranate, Guava.	4
3	Definition of PGR, Gene pool, Kinds of germplasm, gene pool concept, Genetic erosion, Germplasm collection and conservation, Types and methods.	10
4 &5	Floral Biology- Emasculation and mode of pollination (Definition and Types) Study of genetics of qualitative and quantitative characters-	10

Lecture	Topic	Weightages (%)
	Inheritance of qualitative characters, pleiotrophy, Penetrance and Expressivity, Threshold character and modifying genes. Inheritance of quantitative character- Multiple factor hypothesis, Transgenic segregation, Role of environment of quantitative inheritance, Difference between quantitative and qualitative character	
6'7 &8	Major Specific Breeding objective, Conventional Breeding methods- Introduction, Mass selection, pure line selection, Pedigree method, Bulk method and backcross method along with examples of varieties. Modern innovative approaches- somatic Hybridization, transgenic breeding and marker assisted selection.	20
9& 10	<b>Biotic stress tolerance: Breeding for disease and insect resistance</b> <b>Disease resistance:</b> Introduction, mechanism of disease resistance genetic resistance type of genetic resistance, gene for gene hypothesis, Genetics of resistance sources of resistance breeding methods and practical achievement. <b>Insect resistance:</b> Introduction, mechanism of insect resistance basis of insect resistance, Genetics of insect resistance sources of insect resistance, breeding methods, practical achievement.	12
11 & 12	<b>Breeding for Abiotic stress:</b> <b>Drought resistance-</b> Drought introduction, Drought resistance, Mechanism of drought resistance, Basis of drought resistance sources of drought resistance, breeding method. <b>Salinity:</b> Breeding for salt tolerance, breeding approaches, screening techniques, practical achievements. <b>Breeding for quality:</b> Introduction, Quality traits, Nutrition and nutrients, Nutritional quality of cereals and pulses, Genetic of nutritional traits, Sources of nutritional quality, Breeding methods, screening techniques, Breeding for low toxic substance, practical achievements.	12
13	<b>Seed production technology in self pollinated crops-</b> Rice wheat, Cross pollinated -Maize, Sorghum Vegetatively propagated crop. Potato, Sugarcane	8
14	Hybrid seed production of Maize, Rice Sorghum, Pigeonpea and Pearl millet.	8
15 & 16	Ideotype concept in crop improvement- Introduction, Types of ideotype, characteristics of Ideotype, Major steps in Ideotype breeding, Ideotype of Rice, wheat, Sorghum, practical achievements, merits and demerits. Characteristics of climate resilient crops Viz. Wheat, Sorghum, maize, soybean, cotton,	12
	<b>Total</b>	<b>100</b>

**b) Practical**

<b>Experiment</b>	<b>Topic</b>
1	Emasculation and hybridization techniques in different crop species : Rice, Maize
2	Emasculation and hybridization techniques in Sorghum & Pearl Millet
3	Emasculation and hybridization techniques in Ragi&Pigeonpean
4	Emasculation and hybridization techniques in Urdbean&Mungbean, Soybean
5	Emasculation and hybridization techniques in Groundnut, Sesame& Sunflower
6	Emasculation and hybridization techniques in Caster, Cotton
7	Emasculation and hybridization techniques in Cowpea & Tobacco
8	Maintenance breeding of different Kharif crops
9	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods
10	Study of field techniques for seed production and hybrid seeds production in Kharif crops
11	Estimation of heterosis, inbreeding depression and heritability
12	Layout of field experiments
13	Study of quality characters, donor parents for different characters
14	Visit to seed production plots
15	Visit to AICRP plots of pulse & sorghum
16	Visit to AICRP plots of oilseed & cotton

**Suggested Reading:**

<b>Sr. No</b>	<b>Title of Book</b>	<b>Author/Authors</b>	<b>Publisher</b>
1.	Crop Breeding and Biotechnology	HariHar Ram	KalyaniPublication New Delhi.
2.	Breeding of Asian Field crops	D. A. Sleper J.M. Poehlman	Blackwell Publishers
3.	Principle and Procedures of Plant Breeding Biotechnological and Conventional Approach	G. S. Chahal S. S. Gosla	Narosa Publishers House. New Delhi.
4.	Plant Breeding Principle and Methods.	B. D. Singh	KalyaniPublication New Delhi.



<b>Course :</b>	BOT 353		<b>Credit:</b>	1(1+0)	<b>Semester-V</b>
<b>Course title:</b>	Intellectual Property Right				

## Syllabus

### Theory

Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.

Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights,

Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets. Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights. Traditional knowledge-meaning and rights of TK holders.

Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.

## Teaching Schedule

Lecture	Topic	Weightage (%)
1-2	Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO	10
3	Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.	5
4-5	Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.	15
6-7	Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation,	12
8	Penalties for infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.	4
9-10	<b>UPOV-</b> Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV	14
11-12	PPV&FR Act of India, Plant breeders rights, Registration of plant	14

<b>Lecture</b>	<b>Topic</b>	<b>Weightage (%)</b>
	varieties under PPV&FR Act 2001	
13-14	Researcher and farmers rights, Traditional knowledge-meaning and rights of TK holders.	<b>12</b>
15-16	Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological diversity Act,2002 and its salient features, access and benefit sharing	<b>14</b>
	<b>Total</b>	<b>100</b>

### **Suggested Readings:**

- 1) Introduction to Intellectual Property Rights by H.S. Chawla, Oxford & IBH Publishing Co. Pvt. Ltd. 113-B ShahpurJat, 2nd Floor, *Asian Games Village side* New Delhi 110 049, India
- 2) Encyclopedia of Intellectual Property rights Volume No. 1 to 10 by Priyanjan Trivedi (2008)
- 3) Plant Breeding by B.D. Singh (2006), Kalyani Publication
- 4) Intellectual Property Right Under Golbalization by Tawar S. Serials Publication, New Delhi.

<b>Course :</b>	GPB 366		<b>Credit:</b>	2(1+1)	<b>Semester-VI</b>
<b>Course title:</b>	Crop Improvement- II ( <i>Rabi crops</i> )				

## Syllabus

### Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology of *rabi* crops. Ideotype concept and climate resilient crop varieties for future.

### Practical

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard, Sunflower, Safflower, Potato, Berseem. Sugarcane, Tomato, Chilli, Onion; Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Rabi* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightage (%)
1	Cereals –Wheat, oat and barley - Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	10
2	Pulses –Chickpea- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	8
3	Oilseeds –Sunflower and Safflower- Centers of origin, Distribution of species, Wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	10

Lecture	Topic	Weightage (%)
4	Oilseeds –Linseed, Rapeseed and Mustard- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	8
5	Fodders –Napier, Bajra, Sorghum, Maize and Berseem- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	5
6	Cash -Sugarcane - Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	6
7	Vegetable-Potato- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	5
8	Vegetable-Field pea- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	5
9	Horticultural crops-Mango, Aonla and Guava- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	8
10-11	Plant genetic resources, its utilization and conservation	8
12	Adaptability and stability	5
13- 14	Hybrid seed production technology in Rabi crops -Sunflower, Safflower, Castor, Rabi Sorghum	12
15 - 16	Ideotype concept and climate resilient crop varieties for future- Wheat, Rice, Maize, Sorghum and Cotton	10
	<b>Total</b>	<b>100</b>

**b) Practical**

<b>Experiment</b>	<b>Exercise</b>
1	Emasculation and hybridization techniques in wheat, oat & barley
2	Emasculation and hybridization techniques in chickpea & lentil
3	Emasculation and hybridization techniques in field pea, rapeseed & mustard
4	Emasculation and hybridization techniques in sunflower
5	Emasculation and hybridization techniques in potato & berseem
6	Emasculation and hybridization techniques in sugarcane & cowpea
7	Emasculation and hybridization techniques in safflower
8	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods
9	Study of field techniques for seed production and hybrid seeds production in Rabi crops
10	Estimation of heterosis, inbreeding depression and heritability
11	Layout of field experiments
12	Study of quality characters, study of donor parents for different characters
13	Visit to seed production plots
14	Visit to AICRP plots of Safflower & Chickpea
15	Visit to AICRP plots of Sunflower & Rabi sorghum

**Suggested Readings:**

<b>Sr. No</b>	<b>Title of Book</b>	<b>Author/Authors</b>	<b>Publisher</b>
1.	Crop Breeding and Biotechnology	HariHar Ram	KalyaniPublication New Delhi.
2.	Breeding of Asian Field crops	D. A. Sleper J.M. Poehlman	Blackwell Publishers
3.	Principle and Procedures of Plant Breeding Biotechnological and Conventional Approach	G. S. Chahal S. S. Gosla	Narosa Publishers House. New Delhi.
4.	Plant Breeding Principle and Methods.	B. D. Singh	KalyaniPublication New Delhi.