

### TEACHING PLAN: Fundamentals of Plant Breeding

SCHOOL: (SOAS) SHOOL OF AGRICULTURAL SCIENCES		ACADEMIC SESSION: 2023-2024		FOR STUDENTS' BATCH: 2022-2026		
1	Course No.	AGN-T-201				
2	Course Title	Fundamental of Plant Breeding				
3	Credits	2				
4	Learning Hours		Contact Hours	54		
			Assessment	20		
			Guided Study	26		
			Total hours	100		
5	Course Objective	<div>1. List out various contribution, the significance of plant breeding and its milestone in the field of agriculture</div> <div>2. Develop the understanding about modes of selection, the evolution of crops, conservation of genetic resources, population genetics and significance of IPR in crop improvement</div> <div>3. Sketch the breeding objectives and implementation of different selection methods and hybridization techniques for various field crop</div> <div>4. Distinguish the breeding method for self, cross and asexually propagated crops</div>				
6	Course Outcomes	<div>1. Establish the concept of plant breeding and idea about commercial plant breeding company to developed new superior crops varieties</div> <div>2. Develop the insect and disease resistant varieties for environment friendly management of disease and insect with better understanding of genetic and plant morphology</div> <div>3. Develop the idea of Plant Breeding to serve quality food in the market by developing high yield and nutritive varieties</div> <div>4. Increase the farm yield to get higher income on farm by developing higher yield crop varieties.</div> <div>5. Start a consultant company to guide &amp; supply the better hybrid and varieties to the farmers and to develop skill of molecular breeding</div>				
7	Outline syllabus:					
7.01	Paper Code	Unit	Introduction		Page Numbers <sup>1</sup>	Lectures
7.02	AGN-T-201	Unit I	Unit-1: Historical development, concept. nature and role of plant breeding, major achievements and future prospects Unit-2: Genetics in relation to plant breeding Unit-3: Modes of reproduction and apomixes and self-incompatibility Unit-4: Modes of reproduction male sterility-genetic consequences		4-39	1 to 8

7.03			Unit-5: Cultivar options		
		Unit II	Unit-1: Domestication, Acclimatization and Introduction Unit-2: Centres of origin/diversity, components of Genetic advance Unit-3: Heritability and genetic advance Unit-4: Genetic basis and breeding methods in self-pollinated crops Unit-5: Mass and pure line selection Unit-6: hybridization techniques and handling of segregating population Unit-7 :Multiline concept	40-78	8 to 17
7.04		Unit III	Unit-1: Concepts of population genetics and Hardy-Weinberg Law Unit-2: Genetic basis and methods of breeding cross pollinated crops. modes of selection Unit-3: Population improvement Schemes- Ear to row method, modified ear to row, recurrent selection schemes Unit-4:Heterosis and inbreeding depression. development of inbred lines and hybrids Unit-5: Composite and synthetic varieties Unit-6: Breeding methods in asexually propagated crops, clonal selection and hybridization	79-136	17 to 23
7.05		Unit IV	Unit-1: Maintenance of breeding records and data collection Unit-2: Wide hybridization and pre-breeding Unit-3: Polyploidy in relation to plant breeding. mutation breeding- methods and uses Unit-4: Breeding for important biotic and abiotic stresses Unit-5: Biotechnological tools- DNA markers and marker assisted selection Unit-6: Participatory plant breeding: Intellectual property right, patenting, plant breeder right and farmer rights	137-189	23 to 28
8	Course Evaluation				
8.1	CA: 10%				
8.11	Attendance	25%			
8.12	Homework	2 Assignments-50%			
8.13	Quizzes	2 Quizzes-25%			
8.14	Projects				
8.15	Presentation				
8.16	Any other	Practical examination-30%			
8.2	MTE	10%			
8.3	End-term examination: 50%				
9	Text Books & References				

<b>9.1</b>	<b>Text book</b>	<ol style="list-style-type: none"> <li>1. Fundamental of Plant Breeding by Dr Anand Kumar and Dr S,P Singh</li> <li>2. Plant Breeding Principles and Methods by B.d. Singh</li> </ol>
<b>9.2</b>	<b>References</b>	<ol style="list-style-type: none"> <li>1. Hayes HK, Immer FR, Smith DC. Methods of plant breeding.</li> <li>2. McGraw-Hill Book Company, Inc.; New York; London; Toronto; 1955</li> <li>3. Borojević S. Principles and methods of plant breeding. Elsevier; 1990.</li> <li>4. Jennings DL, Iglesias C. Breeding for crop improvement. Cassava: Biology, production → and utilization; 2002</li> </ol>
<b>9.3</b>	<b>Video References</b>	<ol style="list-style-type: none"> <li>1. <a href="https://youtu.be/OGfuWsb9nFw">https://youtu.be/OGfuWsb9nFw</a></li> <li>2. <a href="https://youtu.be/D9E9SD9986Y">https://youtu.be/D9E9SD9986Y</a></li> <li>3. <a href="https://youtu.be/t3XoGs9KoF4">https://youtu.be/t3XoGs9KoF4</a></li> <li>4. <a href="https://youtu.be/mUsHbSFqilU">https://youtu.be/mUsHbSFqilU</a></li> <li>5. <a href="https://youtu.be/NYpQOIImG14c">https://youtu.be/NYpQOIImG14c</a></li> <li>6. <a href="https://youtu.be/E-v_BIqBMQQ">https://youtu.be/E-v_BIqBMQQ</a></li> <li>7. <a href="https://youtu.be/NYn77y7SSW4">https://youtu.be/NYn77y7SSW4</a></li> <li>8. <a href="https://youtu.be/dK9XrOQxxbU">https://youtu.be/dK9XrOQxxbU</a></li> <li>9. <a href="https://youtu.be/NEdpnkCOFJE">https://youtu.be/NEdpnkCOFJE</a></li> <li>10. <a href="https://youtu.be/_Slebp6yhZc">https://youtu.be/_Slebp6yhZc</a></li> </ol>

#### Mapping of Outcomes v. Topics

Outcome no. → Syllabus topic ↓	1	2	3	4	5
Paper Code. Unit I (1)	✓				
Paper Code. Unit I (2)		✓			
Paper Code. Unit I (3)		✓			
Paper Code. Unit I (4)		✓			
Paper Code. Unit I (5)		✓			
Paper Code. Unit II (1)	✓	✓			
Paper Code. Unit II (2)	✓	✓			
Paper Code. Unit II (3)	✓	✓			
Paper Code. Unit II (4)	✓	✓			
Paper Code. Unit II (5)			✓		
Paper Code. Unit II (6)			✓		
Paper Code. Unit II (7)			✓		
Paper Code. Unit III (1)	✓				
Paper Code. Unit III (2)				✓	
Paper Code. Unit III (3)				✓	
Paper Code. Unit III (4)				✓	
Paper Code. Unit III (5)				✓	
Paper Code. Unit III (6)				✓	
Paper Code. Unit IV (1)					✓
Paper Code. Unit IV (2)					✓
Paper Code. Unit IV (3)					✓
Paper Code. Unit IV (4)					✓
Paper Code. Unit IV (5)					✓
Paper Code. Unit IV (6)					✓

## Question Bank

## Unit-I

### A) Multiple choice questions

- 1) The process of bringing a wild species under human management is referred to a
  - a) Introduction
  - b) Domestication
  - c) Germplasm collection
  - d) Acclimatization
- 2) Name eminent sorghum breeder in india
  - a) M.S. Swaminathan
  - b) Pushkarnath
  - c) N.G.P. Rao
  - d) Ram Dhan Singh
- 3) Gametophytic incompatibility was first described by
  - a) East and Mangelsdorf
  - b) East and Shull
  - c) C.T. Patel
  - d) V. Santhanam
- 4) Condition in which the flowers are either staminate (male) or pistillate (female)
  - a) Dicliny
  - b) Monoecy
  - c) Dioecy
  - d) Protogyny
- 6) The first artificial interspecific plant hybrid was produced by
  - a) Thomas Fairchild
  - b) Mather
  - c) Johansen
  - d) Davenports

### B) Define the following terms

- 1) Plant breeding
- 2) Protandry
- 3) Protogyny
- 4) Sporogenesis
- 5) Gametogenesis

### C) Write short notes on the following

1. Explain genetic consequences of cross-pollination
2. Explain genetic consequences of self –pollination
3. What is male sterility? Write its type
4. Discuss the scope of plant breeding and future prospects
5. Discuss about the activities in Plant Breeding

### D) Descriptive question

1. Define Plant Breeding. Enlist any six objectives of plant breeding.
2. Define Hybridization. Enlist various steps involved in hybridization programme
3. Write in detail the concept, nature and role of Plant Breeding
4. Explain in detail about the historical development of plant breeding
5. Discuss in detail about activities involved in plant breeding

## Unit-II

### A) Multiple choice questions

1. The mass selection variety has a .... and ... than a pureline variety.
  - (a) Wider adaptation, greater stability
  - (b) Limited adaptation, lesser stability
  - (c) Wider adaptation but lesser stability
  - (d) Lesser adaptation but greater stability
2. In pedigree method individual plants are selected from .... generation?
  - (a) F1 generation
  - (b) F2 generation
  - (c) F3 generation
  - (d) F4 generation
3. The single seed descent method is a modification of..?
  - (a) Pedigree method
  - (b) Pureline selection method
  - (c) Mass selection method
  - (d) Bulk method
4. Which of the following processes is not related to hybridisation?
  - a) Emasculation
  - b) Selection of parents
  - c) Bagging
  - d) Crossing or artificial pollination
5. Which of the following statements is true for Emasculation?
  - a) Removal of stigma and anther from a plant
  - b) Removal of male parts from the future female plant
  - c) Removal of female parts from the future male plant
  - d) Removal of all parts of the plant

### B) Define the following term

- 1) Hybridization
- 2) Emasculation
- 3) Pureline
- 4) Germplasm
- 5) Backcross

### C) Write short notes on the following

1. Enlist breeding methods used in self pollinated crops.
2. Draw Schematic flow chart for pureline selection
3. Discuss the application of back crosses method in plant breeding.
4. Explain the procedure of mass selection in self-pollinated crop
5. Distinguish between mass selection and pure line selection.

### D) Descriptive question

1. Write a note on different devices adopted for maintaining the germplasm.
2. Draw Schematic flow chart for backcross method for transfer of dominant gene
3. Draw Schematic flow chart for backcross method for transfer of recessive gene
4. Discuss the general procedure for evolving a variety by single seed descent
5. Explain the procedure of bulk method in self-pollinated crop

### Unit-III

#### A) Multiple choice questions

1. Who used the term heterosis for the first time?
  - (a) Shull.
  - (b) Keith Downey.
  - (c) Thomas Andrew Knight.
  - (d) Niels Ebbesen Hans
2. What is dominance of linked gene hypothesis?
  - (a) Where quantitative characters are governed by few genes.
  - (b) Where qualitative characters are governed by many genes.
  - (c) Where quantitative characters are governed by many genes.
  - (d) Where qualitative characters are governed by few genes.
3. A sampled "a" population has 36% of homozygous recessive genotype (aa). Then the frequency of allele "a" is
  - (a) 0%
  - (b) 20%
  - (c) 60%
  - (d) 70%
4. This condition is essential for a population to be in the Hardy-Weinberg equilibrium
  - (a) Random mating
  - (b) No mutations
  - (c) Large population
  - (d) all of these
5. This statement describes the Hardy-Weinberg law the best
  - (a) It is impossible to predict expected allele frequencies mathematically
  - (b) In large populations, dominant alleles become more prevalent
  - (c) Allele frequency changes over a period of time in a large population
  - (d) Mechanism of inheritance in a large population does not change allele frequency

#### B) Define the following terms

- 1) Heterosis
- 2) Recurrent selection
- 3) General combining ability
- 4) Specific combining ability
- 5) Inbreeding

#### C) Write short notes on the following

- 1) Explain about different mechanisms of disease resistance
- 2) Explain genetic basis of heterosis
- 3) Different mechanisms of insect resistance
- 4) Discuss dominance hypothesis
- 5) Explain different measures of conservation of heterosis

- 6) Differentiate between synthetics and composites
- 7) Explain about different mechanisms of disease resistance
- 8) Explain genetic basis of heterosis

**D) Descriptive question**

1. Explain Hardy-Weinberg Law and factors affecting it
2. Briefly describe the procedure of mutation breeding
3. Explain about different mechanisms of drought resistance
4. Write down steps for identifying suitable clone and hybridisation of the same
5. Classify mutation on different basis of classification
6. What is mutagen and Classify elaborately about physical and chemical mutagen?
7. Explain polyploidy breeding with suitable examples
8. Explain regarding Modified Ear to Row method in Maize

**Unit-IV**

**A) Multiple choice questions**

- 1) The set of DNAs generated by using random primers in a PCR reaction is called
  - a) RAPD
  - b) RFLP
  - c) AFLP
  - d) in situ hybridization
- 2) All the statements are true regarding RFLP and RAPD except
  - a) RAPD is a quick method compared to RFLP
  - b) RFLP is more reliable than RAPD
  - c) Species specific primers are required for RAPD
  - d) Radioactive probes are not required in RAPD
- 3) Molecular markers are used to construct
  - a) chromosome maps
  - b) cytogenetic maps
  - c) physical maps
  - d) all of these
- 4) The variation in the restriction DNA fragment lengths between individuals of a species is called
  - a) restriction Fragment Length Polymorphism (RFLP)
  - b) Random amplified Polymorphic DNA (RAPD)
  - c) Amplified Fragment Length Polymorphism (AFLP)
  - d) Simple Sequence repeats (SSR)
- 5) Locations of quantitative genes on chromosomes are called
  - a) Qualitative trait loci
  - b) Quantitative trait loci
  - c) both a and b
  - d) none of these
- 6) The set of DNAs generated by using random primers in a PCR reaction is called
  - a) RAPD
  - b) RFLP

- c) AFLP
- d) in situ hybridization

**B) Define the following terms**

- 1) Quantitative traits loci
- 2) Allopolyploid
- 3) Autopolyploid
- 4) Molecular marker
- 5) DNA marker

**C) Write short notes on the following**

- 1) Define molecular marker? Enlist different type of DNA marker
- 2) What is interspecific hybridization? Explain with suitable example
- 3) Define crop ideotype and discuss its objective in plant breeding
- 4) What is the barrier in distant hybridization?
- 5) Explain the characteristics of an ideal DNA marker

**D) Descriptive question**

- 1. Explain in details about the steps involved in RAPD
- 2. With the help of suitable example discuss the applications and limitations of allopolyploidy
- 3. Explain in detailed marker assisted selection in plant breeding
- 4. Explain the role of allopolyploidy in crop improvement with suitable example
- 5. Explain the role of autopolyploidy in crop improvement with suitable example