

**FACULTY OF AGRICULTURAL SCIENCES**  
UNIVERSITY OF THE PUNJAB, LAHORE

<b>Program</b>	B.Sc.(Hons.)Agriculture	<b>Course Code</b>	<b>PBG-201</b>	<b>Credit Hours</b>	3(2-1)
<b>Course Title</b>	<b>ELEMENTARY GENETICS &amp; PLANT BREEDING</b>				
<b>Course Introduction</b>					
<p>Plant breeding is the art and science of changing the genetics of plants in order to produce desired characteristics. Plant breeding can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques. Plant breeding has been practiced for thousands of years, since near the beginning of human civilization. It is now practiced worldwide by individuals such as gardeners and farmers, or by professional plant breeders employed by organizations such as government institutions, universities, crop specific industry associations or research centers.</p> <p>Elementary genetics &amp; plants breeding is a course designed for undergraduate. The course will provide the information to the students about basic concepts of plant breeding and genetics.</p>					
<b>Learning Outcomes</b>					
<p>The course aims to equip students with a comprehensive understanding of various aspects related to the plant breeding and genetics. By the end of the course, students are expected to achieve the following learning outcomes:</p> <ol style="list-style-type: none"> <li>1. <b>Terminology and Management Principles:</b> Acquire knowledge of common terminology used in genetics and plant breeding.</li> <li>2. <b>Genetics and Breeding:</b> Introduce basic genetic concepts and their application in plant breeding to improve desirable traits in crops.</li> <li>3. <b>Basic concepts of genetics,</b> mechanism of heredity, basis of plant breeding, Reproductive mechanisms in major crops and application of genetic principles in crop improvement.</li> </ol>					
<b>Course Content</b>			<b>Assignments/Readings</b>		
<b>Week 1</b>	<p><b><u>THEORY</u></b></p> <p><b>Unit-I:</b></p> <p>1.1 Definition of genetics, 1.2 Concepts of heredity and variation.</p>		<ul style="list-style-type: none"> <li>• Singh, B.D. 2004. Genetics. Kalyani Publishers, New Delhi, India.</li> <li><input type="checkbox"/> Internet</li> <li><input type="checkbox"/> PowerPoint slides</li> <li><input type="checkbox"/> Research articles</li> </ul>		

	<p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ Study of cell divisions and gametogenesis.</li> </ul>	<ul style="list-style-type: none"> <li>• Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India</li> </ul>
Week 2	<p><b><u>THEORY</u></b></p> <p><b>Unit-II:</b></p> <p>2.1 Cell and cell divisions.</p> <p>2.2 Mendelian genetics:</p>	<ul style="list-style-type: none"> <li>○ Acquaah, G. 2009. Principles of Plant Genetics and Breeding. John Wiley &amp; Sons, UK.</li> </ul> <p>□ Related research articles</p>
	<p><b><u>PRACTICAL</u></b></p> <p>Calculation of monohybrid and dihybrid ratios.</p>	
Week 3	<p><b><u>THEORY</u></b></p> <p><b>Unit-III:</b></p> <p>3.1 Mendelian genetics: chromosome theory of heredity.</p> <p>3.2 Various, genotypic and phenotypic ratios and their modifications.</p>	<ul style="list-style-type: none"> <li>○ Khan, M.A (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad</li> <li>○ Khan I.A. F.M. Azhar, Z. Ali and A.A. Khan. 2008. Solving Numerical Genetic Problems. Dept. Plant Breed. Genet. Uni. Agri. Faisalabad.</li> <li>○</li> </ul>
	<p><b><u>PRACTICAL</u></b></p> <p>Numerical examples relating to gene interaction</p>	
Week 4	<p><b><u>THEORY</u></b></p> <p><b>Unit-IV:</b></p> <p>4.1 Differences between allelic and non-allelic interactions (epistasis),</p> <p>4.2I illustration of epistasis with suitable examples.</p>	<ul style="list-style-type: none"> <li>○ Klug, W.S. and M. R. Cummings. 2003. Concepts of Genetics. (7<sup>th</sup> ed.), Pearson Education, Singapore.</li> </ul> <p>□ Related research articles.</p>
	<p><b><u>PRACTICAL</u></b></p>	

	Multiple alleles and multiple factor inheritance.	
Week 5	<p><b><u>THEORY</u></b></p> <p><b>Unit-V:</b></p> <p>5.1 Pleiotropy and multiple allelism. 5.2 Multiple factor hypothesis. Linkage and crossing over.</p>	Acquaah, G. 2009. Principles of Plant Genetics and Breeding. John Wiley & Sons, UK.
	<p><b><u>PRACTICAL</u></b></p> <p>Calculation of linkage from test cross and F2 data.</p>	
Week 6	<p><b><u>THEORY</u></b></p> <p><b>Unit-VI:</b></p> <p>6.1 Sex determination: sex linked and sex influenced traits. 6.2 Chromosomal aberrations.</p>	<ul style="list-style-type: none"> <li>• Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.</li> <li>• Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.</li> </ul> <p><input type="checkbox"/> PowerPoint slides <input type="checkbox"/> Related research articles</p>
	<p><b><u>PRACTICAL</u></b></p> <p>Descriptive study of floral biology,</p>	
Week 7	<p><b><u>THEORY</u></b></p> <p><b>Unit-VII:</b></p> <p>Nucleic acids: nature, structure and function.</p>	<ul style="list-style-type: none"> <li>• Stansfield, W.D. 1988 Theory and Problems of Genetics. 4<sup>th</sup> ed. McGraw-Hill Book Co, NY.</li> </ul> <p><input type="checkbox"/> Related research articles.</p>
	<p><b><u>PRACTICAL</u></b></p> <p>Descriptive study of floral biology of field crops</p>	
Week 8	<p><b><u>THEORY</u></b></p> <p><b>Unit-VIII:</b></p> <p>8.1 Classical vs modern concepts of gene.</p>	<ul style="list-style-type: none"> <li>○ Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant</li> </ul>

	8.2 Introduction to plant breeding and its role in crop improvement.	<p>Breeding. Narosa Publishing House, New Delhi, India.</p> <ul style="list-style-type: none"> <li>○ Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.</li> <li>○ <input type="checkbox"/> Internet</li> <li><input type="checkbox"/> PowerPoint slides</li> <li><input type="checkbox"/> Research articles</li> </ul>
	<p><b><u>PRACTICAL</u></b></p> <p>Descriptive study of floral biology of vegetables</p>	
<b>Week 9</b>	<b>MID TERM EXAMS</b>	
<b>Week 10</b>	<p><b><u>THEORY</u></b></p> <p><b>Unit-IX:</b></p> <p>9.1 Reproductive systems in major crop plants. 9.2 Genetic variation and its exploitation</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Internet</li> <li><input type="checkbox"/> PowerPoint slides</li> <li><input type="checkbox"/> Research articles</li> <li>• Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. (5<sup>th</sup> ed.) Iowa State University Press, Ames, USA.</li> <li>• Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.</li> </ul>
	<p><b><u>PRACTICAL</u></b></p> <p>Scientific names, Field visit</p>	
<b>Week 11</b>	<p><b><u>THEORY</u></b></p> <p><b>Unit-X:</b></p> <p>10.1 Creation of variation through genetic recombination, mutation and heteroploidy. 10.2 Breeding self-pollinated crops</p>	<p>Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.</p>
	<p><b><u>PRACTICAL</u></b></p> <p>Chromosome number and ploidy level of important field crops</p>	

<p><b>Week 12</b></p>	<p><b><u>THEORY</u></b></p> <p><b>Unit-XI:</b></p> <p>11.1 Introduction, mass selection, pure line selection; 11.2 Hybridization, pedigree method, bulk method and backcross techniques.</p> <hr/> <p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ Selfing Techniques and practical demonstration</li> </ul>	<ul style="list-style-type: none"> <li>• Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.</li> <li>• Singh, P. 2003. Essentials of Plant Breeding. Kalyani Publishers, New Delhi, India.</li> <li>• Khan, M.A (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad.</li> </ul>
<p><b>Week 13</b></p>	<p><b><u>THEORY</u></b></p> <p><b>Unit-XII:</b></p> <p>12.1 Breeding cross-pollinated crops</p> <hr/> <p><b><u>PRACTICAL</u></b></p> <p>Crossing techniques in major crops</p>	<ul style="list-style-type: none"> <li>• Stansfield, W.D. 1988 Theory and Problems of Genetics. 4<sup>th</sup> ed. McGraw-Hill Book Co, NY.</li> <li>• Khan I.A. F.M. Azhar, Z. Ali and A.A. Khan. 2008. Solving Numerical Genetic Problems. Dept. Plant Breed. Genet. Uni. Agri. Faisalabad.</li> </ul> <p>□ Related research articles</p>
<p><b>Week 14</b></p>	<p><b><u>THEORY</u></b></p> <p><b>Unit-XIII:</b></p> <p>13.1 introduction, mass selection, recurrent selection, development and evaluation of inbred lines</p> <hr/> <p><b><u>PRACTICAL</u></b></p> <p>Germplasm storage techniques</p>	<ul style="list-style-type: none"> <li>• Singh, B.D. 2004. Genetics. Kalyani Publishers, New Delhi, India.</li> <li>• Klug, W.S. and M. R. Cummings. 2003. Concepts of Genetics. (7<sup>th</sup> ed.), Pearson Education, Singapore.</li> <li>• Singh, P. 2003. Elements of Genetics. (2<sup>nd</sup> ed.) Kalyani Publishers, Delhi, India.</li> </ul>

<b>Week 15</b>	<b><u>THEORY</u></b>  <b>Unit-XIV:</b> 14.1 Development of hybrids 14.2 synthetic and composite populations.	<ul style="list-style-type: none"> <li>• Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.</li> <li>• Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.</li> </ul>
	<b><u>PRACTICAL</u></b>  List of approved varieties in major field crops.	
<b>Week 16</b>	<b><u>THEORY</u></b>  <b>Unit-XV:</b> 15.1 New trends in plant breeding. 15.2 Course discussion and overview	<ul style="list-style-type: none"> <li>• Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. (5<sup>th</sup> ed.) Iowa State University Press, Ames, USA.</li> </ul> <input type="checkbox"/> Internet <input type="checkbox"/> PowerPoint slides <input type="checkbox"/> Research articles
	<b><u>PRACTICAL</u></b>  Course overview and class discussion	
<b>Week 17</b>	<b>FINAL TERM EXAM</b>	
<b>Textbooks and Reading Material</b>		
<ul style="list-style-type: none"> <li>○ <b><u>Recommended books</u></b></li> </ul> <p><b>Textbooks.</b></p> <ul style="list-style-type: none"> <li>• Singh, B.D. 2004. Genetics. Kalyani Publishers, New Delhi, India.</li> <li>• Klug, W.S. and M. R. Cummings. 2003. Concepts of Genetics. (7<sup>th</sup> ed.), Pearson Education, Singapore.</li> <li>• Singh, P. 2003. Elements of Genetics. (2<sup>nd</sup> ed.) Kalyani Publishers, Delhi, India.</li> <li>• Stansfield, W.D. 1988 Theory and Problems of Genetics. 4<sup>th</sup> ed. McGraw-Hill Book Co, NY.</li> </ul>		

- Khan I.A. F.M. Azhar, Z. Ali and A.A. Khan. 2008. Solving Numerical Genetic Problems. Dept. Plant Breed. Genet. Uni. Agri. Faisalabad.
- Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. (5<sup>th</sup> ed.) Iowa State University Press, Ames, USA.
- Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.
- Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.
- Singh, P. 2003. Essentials of Plant Breeding. Kalyani Publishers, New Delhi, India.
- Khan, M.A (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad.
- Acquaaah, G. 2009. Principles of Plant Genetics and Breeding. John Wiley & Sons, UK.

In the detail course outline, one may mention chapters of the textbook with the content topics.

### **Journal Articles/ Reports available in library and on internet**

#### **Teaching Learning Strategies**

Teaching-learning strategies for the course aim to provide students with a comprehensive understanding of the subject:

1. **Lectures and Readings:**

- **Purpose:** Introduce key concepts, theories, and practices.
- **Approach:** Use multimedia presentations, textbooks, and scholarly articles to deliver content.

2. **Practical Demonstrations:**

- **Purpose:** Provide hands-on experience

3. **Interactive Discussions and Q&A Sessions:**

- **Purpose:** Foster critical thinking and deeper understanding.
- **Approach:** Encourage student participation through discussions, debates, and question-and-answer sessions.

4. **Group Projects and Collaborative Learning:**

- **Purpose:** Promote teamwork and collective problem-solving.
- **Approach:** Assign group projects on topics like farm design, sustainable practices, and breeding programs.

5. **Guest Lectures and Expert Panels:**

- **Purpose:** Provide industry insights and professional perspectives.
- **Approach:** Invite experts from the field to share their experiences and knowledge.

6. **Field Trips and Farm Visits:**

Expose students to real-world farming environments.

7. **Online Resources and E-learning:**

- **Purpose:** Supplement in-class learning with digital content.
- **Approach:** Utilize online courses, videos, and interactive modules for additional

learning support.

**8. Assessment and Feedback:**

- **Purpose:** Evaluate understanding and provide constructive feedback.
- **Approach:** Use quizzes, exams, practical assessments, and reflective journals to assess student progress.

**9. Simulation and Role-Playing:**

- **Purpose:** Simulate real-life scenarios and decision-making processes.
- **Approach:** Use software simulations and role-playing exercises to mimic farm management situations and problem-solving.

By incorporating these diverse strategies, the course can effectively cover both theoretical and practical aspects of Breeding, ensuring a well-rounded education for students.

**Assignments: Types and Number with Calendar**

**Mentioned in course content**

**Assessment**

<b>Sr. No.</b>	<b>Elements</b>	<b>Weightage</b>	<b>Details</b>
1.	Midterm Assessment	35%	Written assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.