

**CURRICULUM**  
**OF**  
**PLANT BREEDING AND GENETICS**

**BS/B.Sc (Hons)**  
**MS/M.Sc (Hons)**

(Revised 2010)



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD**

# **CURRICULUM DIVISION, HEC**

Dr. Syed Sohail H. Naqvi	Executive Director
Prof. Dr. Altaf Ali G. Shaikh	Member (Acad)
Mr. Muhammad Javed Khan	Adviser (Academic)
<b>Ms. Ghayyur Fatima</b>	<b>Director (Curri)</b>
<b>Dr. M. Tahir Ali Shah</b>	<b>Deputy Director (Curri)</b>

Composed by: Ms. Pakeeza Yousuf, HEC, Islamabad

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## PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**” the erstwhile University Grants Commission was designated as competent authority to develop review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

To bring international compatibility to qualifications held from Pakistani universities/DAIs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semesters BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semesters, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS and MS (Plant Breeding and Genetics). The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

**PROF. DR. ALTAF ALI G. SHAIKH**  
**Member Academics**

**March 2010**

# CURRICULUM DEVELOPMENT

## INTRODUCTION

The final meeting of National Curriculum Revision Committee (NCRC) was held at HEC Regional Center Karachi from June 14-16, 2010 to review and finalize the revised draft curriculum. The following experts attended the meeting.

1. Prof. Dr. Hidayat-ur-Rahman                      Convener  
Conveners NCRC (PBG)  
NWFP Agriculture University  
Peshawar
2. Dr. Saif Ullah Ajmal                                  Secretary/Member  
Professor  
Deptt of Plant Breeding and Genetics  
Arid Agriculture University  
Rawalpindi
3. Dr. Muhammad Jurial Rind,                      Member  
Associate Professor  
Deptt of Plant Breeding & Genetics  
Sindh Agriculture University  
Tandojam
4. Dr. Faqir Muhammad Azhar                      Member  
Professor  
Department of Plant Breeding & Genetics  
University of Agriculture  
Faisalabad
5. Prof. Dr. Farhatullah                              Member  
Professor,  
Department of Plant breeding & Genetics  
NWFP Agriculture University  
Peshawar
6. Dr. Muhammad Fareed Khan                      Member  
Department of Plant Breeding & Genetics  
University AJK Agriculture  
Rawlakot
7. Dr. Naeem Akhtar                                  Member  
Assistant Professor  
Department of Plant Breeding & Genetics  
University of Sargodha,  
Sargodha

8. Mr. Ghulam Rasool Lashari                      Member  
Baluchistan Agriculture College  
Chaman Road Beleli Quetta
9. Dr. Muhammad Iqbal                      Member  
Associate Professor  
Deptt of Plant Breeding & Genetics  
Islamia University Bahawalpur  
Bahawalpur
10. Dr. Sher Muhammad Mangrio              Member  
Professor  
Institute of Plant Sciences  
University of Sindh,  
Jamshoro
11. Dr. Hamad Raza                      Member  
Assistant Professor  
Deptt of Botany  
GC University, Faisalabad

The meeting started with recitation from the Holy Quran by Dr. M.Tahir Ali Shah. After the recitation, Muhammad Javed Khan, Advisor Academics, HEC, welcomed the participants and highlighted the importance of curriculum development process at national level. Mr. Khan gave a quick rundown of efforts made by HEC to promote Higher Education in Pakistan with special reference to the development of curriculum and its accreditation and uniformity. Dr. Tahir Shah, Deputy Director (Curriculum) HEC, briefed the participants about the outcomes of the preliminary meeting. The technical proceedings of the meeting began with Prof. Dr. Hidayat-ur-Rahman as Convener and Dr. Saif Ullah Ajmal as Secretary who were unanimously elected in NCRC preliminary.

The participants reviewed each course keeping in view the comments of their colleagues at their respective universities/colleges. Accordingly, some courses were modified and some new courses were added to the curriculum in Plant Breeding & Genetics.

The Committee finalized the draft curriculum for Under-graduate and Post-graduate level for Plant Breeding and Genetics and suggested some recommendations to HEC. Finally, the meeting was concluded with the vote of thanks by the Chair.

# Template for 4-Year BS/B.Sc. (Hons) in Agricultural Disciplines

## 1. Compulsory Courses

	<b>Credits Hours</b>
Mathematics / Biology (2 courses)	6 (3-0) (2-1)
Statistics 1 & 2	6 (3-0) (3-0)
Computers / IT	3 (2-1)
Pakistan Studies	2 (2-0)
Islamic Studies	2 (2-0)
Communications Skills	3 (3-0)
English	3 (3-0)
Basic Agriculture	3 (2-1)

**Sub-Total 28**

## 2. Interdisciplinary Foundation Courses

Agronomy	3 (2-1)
Plant Breeding & Genetics	3 (2-1)
Entomology	3 (2-1)
Plant Pathology	3 (2-1)
Food Technology	3 (2-1)
Horticulture	3 (2-1)
Soil Sciences	3 (2-1)
Agriculture Economics	3 (2-1)

**Sub-Total 24**

## 3. Supporting Courses {6-8 courses (3 Cr. hr) amongst below}

Agriculture Extension  
Forestry & Range Management  
Animal Science  
Marketing & Agri Business  
Rural Development  
Human Nutrition  
Agriculture Chemistry  
Agriculture Engineering  
Water Management  
Any other discipline recommended by the university

**Sub-Total 18-24**

<b>Sub-Total during the first four semesters</b>	<b>70-76</b>
<b>Semester 5, 6, 7 &amp; 8</b>	<b>56-60</b>
<b>Project / Internship</b>	<b>04</b>
<b>Grand Total</b>	<b>130-140</b>

- 1 credit of theory = one contact hour per week for 16-18 weeks and 1 practical/Lab hour = 3 contact hours per week for 16-18 weeks.
- In case of non availability of department of supporting courses, courses from foundation courses can be opted.



## Scheme of Studies for BS/B.Sc. (Hons.) in Plant Breeding and Genetics

Course No.	Title	Credit Hours
PBG 401	Introductory Genetics	3(2-1)
PBG 402	Introductory Plant Breeding	3(2-1)
<b>5<sup>th</sup> Semester Courses</b>		
PBG 501	Principles of Genetics	3(2-1)
PBG 503	Breeding Field Crops	3(2-1)
PBG 505	Cytogenetics	3(2-1)
PBG 507	Morphology and Reproductive Systems of Crops	3(2-1)
PBG 509	Breeding Cereal Crops	3(2-1)
		<b>Total= 15</b>
<b>6th Semester Courses</b>		
PBG 502	Breeding Fibre Crops	3(2-1)
PBG 504	Breeding Sugar Crops	3(2-1)
PBG 506	Breeding Maize and Millets	3(2-1)
PBG 508	Biodiversity and Plant Genetic Resources	3(3-0)
PBG 510	Molecular Genetics	3(2-1)
		<b>Total= 15</b>
<b>7th Semester Courses</b>		
PBG 601	Breeding Oilseed Crops	3(2-1)
PBG 603	Breeding Pulse Crops	3(2-1)
PBG 605	Breeding Vegetable Crops	3(2-1)
PBG 607	Modern Techniques in Plant Breeding	3(2-1)
PBG 609	Fundamentals of Plant Biometry	3(3-0)
		<b>Total= 15</b>
<b>8th Semester Courses</b>		
PBG 602	Breeding Fodder and Forage Crops	3(2-1)
PBG 604	Breeding Minor Crops	3(2-1)
PBG 606	Intellectual Property Rights in Crop Varieties	3(3-0)
PBG 608	Internship or Research Project	4(0-4)
		<b>Total= 13</b>

# DETAIL OF COURSES FOR BS/B.Sc (HONS) PLANT BREEDING AND GENETICS

PBG 401	<b>Introductory Genetics</b>	3(2-1)
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## Objectives

To enable the students understand:

- Basic concepts of genetics
- Mechanism of heredity
- Effects of environment on organisms
- Chemical and molecular nature of gene

## Theory

Definition of genetics, concepts of heredity and variation, cell and cell divisions; Chromosome theory of heredity; Mendelian Genetics, Monohybrid, dihybrid phenotypic and genotypic ratios. Differences between allelic and non-allelic interactions (epistasis), illustration of epistasis with suitable examples, Pleiotropy and multiple allelism. Multiple factor hypothesis. Linkage and crossing over. Sex determination, Sex linked and sex influenced traits. Chromosomal aberrations. Physical, chemical and molecular nature of gene.

## Practical

Cell structure, cell cycle and gametogenesis. Calculation of monohybrid and dihybrid ratios. Numerical problems relating to gene interaction, multiple alleles and multiple factor inheritance. Calculation of linkage from test cross and  $F_2$  data.

## Books recommended

1. Singh, B.D. 2004. Genetics. Kalyani Publishers, New Delhi, India.
2. Klug, W. S. and M. R. Cummings. 2003. Concepts of Genetics. (7<sup>th</sup> ed.), Pearson Education, Singapore.
3. Singh, P. 2003. Elements of Genetics. (2<sup>nd</sup> ed.) Kalyani Publishers, Delhi, India.

## World Wide Web

1. <http://en.wikipedia.org/wiki/Genetics>
2. [http://anthro.palomar.edu/mendel/mendel\\_1.htm](http://anthro.palomar.edu/mendel/mendel_1.htm)

## Objectives

To make the students know about:

- Basic concepts of plant breeding
- Reproductive mechanisms in major crops
- Application of genetic principles in crop improvement
- Breeding methods in self and cross pollinated crops

## Theory

Introduction to plant breeding and its role in crop improvement. Reproductive systems in major crop plants. Genetic variation and its exploitation, artificial creation of variation through genetic recombination, mutation and heteroploidy. Breeding self-pollinated crops: introduction, mass selection, pure line selection; hybridization, pedigree method, bulk method and backcross technique. Breeding cross-pollinated crops: introduction, mass selection, recurrent selection, development and evaluation of inbred lines, development of hybrids, synthetic and composite populations. Application of biotechnology in plant breeding.

## Practical

Descriptive study of floral biology, scientific names and chromosome number of important field crops. Selfing and crossing techniques in self and cross-pollinated crops.

## Books recommended

1. Khan, M. A. and M. Ahmad. 2008. Plant Breeding. Daya Publishing House, New Delhi, India.
2. Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. 5<sup>th</sup> ed. Iowa State University Press, Ames, USA.
3. Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House New Delhi India.
4. Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.
5. Singh, P. 2003. Essentials of Plant Breeding. Kalyani Publishers, New Delhi, India.
6. Khan, M. A (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad.

## Objectives

To enable students to understand:

- Chemical nature of genetic material
- Genetic control of protein synthesis
- Molecular basis of gene
- Mutation and its types

## Theory

Pleiotropy and various types of gene interaction, Multiple alleles, Polygenic inheritance. Sex determination, XO, XX/XY systems and sex-linkage inheritance, genic balance theory. Holandric genes. Extra chromosomal inheritance. Linkage and crossing over. Three-point and multipoint linkage tests and chromosome mapping. Properties of genetic material, DNA as genetic material, implications of Watson and Crick Model of DNA structure, Prokaryotic and eukaryotic chromosome structure, Genetic code, RNA and protein synthesis. Gene mutation, factors affecting mutation rate, transposable elements. Change in chromosome number and structure, polytene and lampbrush chromosomes.

## Practical

Solving problems on dihybrid and multihybrid segregating generations and backcrosses. Numerical problems relating to polygenic inheritance, sex linked inheritance, linkage and crossing over. Gene mapping.

## Books recommended

1. Klug, W. S. and M. R. Cummings. 2010. Concepts of Genetics. Dorling Kindersley, Pvt.(Ltd.) New Delhi, India.
2. Brooker, R. J. 2005. Genetics: Analysis and Principles. 2<sup>nd</sup> ed., McGraw-Hill Company, New York, USA.
3. Griffiths, A. J. F., J. H. Miller, D. T. Suzuki, R.C. Lewontin and W.M. Gelbart. 2005. An Introduction to Genetic Analysis. W.H. Freeman and Company, New York. USA.
4. Singh, B. D. 2004. Genetics. Kalyani Publishers, New Delhi, India.

## world wide web

1. <http://www.wiley.com/college/math/biol/genlink/snustad.html>

PBG 502	<b>Breeding Fiber Crops</b>	3(2-1)
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## Objectives

To enable students to understand:

- Developmental history of various fibre crops
- Breeding fibre crops for yield and quality characteristics
- Breeding methods for incorporating resistance against biotic and abiotic stresses

## Theory

Review of breeding work on cotton, jute and other fibre crops. Role of cotton in national and international economy. Cotton genetic resources: species grown in Pakistan. Objective of breeding fibre crops. Breeding methods. Concepts of ideotype breeding in cotton. Coloured cotton. Genetics of host-plant resistance. Fibre quality attributes and their relationship with morphological traits. Development of hybrid and transgenic cotton. Scope of *Bt* cotton in Pakistan.

## Practical

Selfing and crossing techniques in cotton and jute. Identification of different species of cotton. Testing of fibre traits in cotton. Collection of data on different quantitative characters of cotton. Data analysis and its interpretation.

## Books recommended

1. Sleper, D .A. and J.M. Poehlman. 2006. Breeding Field Crops. 5<sup>th</sup> Ed. Iowa State University Press Ames, USA.
2. Shiron, J. (Editor). 2004. Transgenic Cotton. Science press, 16 Donghuangchenggen North Street Beijing, China.
3. Singh, P. 2004. Cotton Breeding. Kalyani Publishers. New Delhi. India.
4. Johnie, N. J. and S. Saha. 2001. Genetic improvement of Cotton-emerging techniques. Oxford and IBH Publishing Co., New Delhi, India.

PBG 503	<b>Breeding Field Crops</b>	3(2-1)
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## Objectives

To enable students to understand

- Achievements made in plant breeding
- Strategies of plant breeding
- Various breeding methods in self and cross pollinated crops

## Theory

History, objectives, achievements and strategies of plant breeding. Genetic variability: basis of plant breeding; components of variability. Estimation of

heritability. Threshold characters: penetrance and expressivity. Breeding methods in self-, cross-pollinated and asexually propagated crops. Development of doubled haploids, mutation breeding, wide hybridization. Heterosis: genetic basis and exploitation. Male sterility and self-incompatibility. Breeding crops for biotic and abiotic stresses. Ideotype breeding and its limitations. Scope and importance of biotechnology in plant breeding.

## Practical

Selfing and crossing techniques in self- and cross-pollinated crops. Assessment of variability in crops for biotic and abiotic stresses.

## Books recommended

1. Singh, B. D. 2007. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.
2. Sleper, D.A. and J.M. Poehlman. 2006. Breeding Field Crops. 5<sup>th</sup> Ed. Iowa State University Press Ames, USA.
3. Singh, P. 2004. Essentials of Plant Breeding. Kalyani Publishers, New Delhi, India.
4. Chahal, G. S. and S. S. Gosal. 2002. Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches. Alpha Science International Ltd., Oxford, UK.
5. Simmonds, N.W. and J. Smartt. 1999. Principles of Crop Improvement. Blackwell Science. London, UK.
6. Khan, M. A. (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad, Pakistan.

PBG 504	<b>Breeding Sugar Crops</b>	3(2-1)
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## Objectives

To enable students to understand

- Constraints in sugarcane breeding
- Different genetic systems in sugar crops
- Breeding methods in sugar crops

## Theory

Origin, classification and botanical features of sugar crops. Genetics of *Saccharum officinarum* canes, evolution of nobel canes and present status, flowering: a breeding constraint; Artificial induction of flowering and hybridization techniques; Selection strategies and development of new varieties. Improvement through modern approaches, Co-products of sugarcane. Exploitation of somaclonal variation and micropropagation for

improvement of sugarcane. Sugarbeet: botany and genetics, induction of flowering. Seed production strategies.

## Practical

Identification of sugarcane species and varieties using morphogenetic features; Study of sugarcane flowering mechanisms. Morphogenetic features of sugar beet. Evaluation of sugarcane and sugar beet for quality parameters. Visit to sugar industries/research institutes.

## Books recommended

1. Henry, R. J. and C. Kole. 2010. Genetics, Genomics and Breeding of Sugarcane. Taylor and Francis, London, UK.
2. Malik, K. B. 2009. Cane and Sugar Production. Punjab Agriculture Research Board, Lahore, Pakistan.
3. Draycott, A. P. 2006. Sugar beet. Blackwell Publishing Ltd., Oxford, UK.
4. Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. 5<sup>th</sup> ed. Iowa State University Press, Ames, Iowa, USA.
5. James, G. 2004. Sugarcane. Blackwell Publishing Co., Ames, Iowa, USA.

## World Wide Web

1. <http://sugarcane-breeding.tn.nic.in/>
2. [http://en.wikipedia.org/wiki/Sugar\\_beet](http://en.wikipedia.org/wiki/Sugar_beet)
3. <http://khibreeding97.webs.com/sugarcropsresinst.htm>

PBG 505	<b>Cytogenetics</b>	3(2-1)
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## Objectives

To enable students to understand:

- Structure and functions of cell organelles
- Chromosomal structure, functions and their abnormalities

## Theory

Description of cell organelles and their role in inheritance. Gross morphology and functions of chromosomes. Fine structure of chromosomes. Heterochromatin and euchromatin; Cytological differences in mitosis and meiosis. Karyotype studies of plant species; construction of ideograms; arm ratio and centromere index. Structural changes and breakage of chromosome, changes in chromosome number. Cytological basis and proofs of crossing over; Factors affecting crossing over. Gene mapping.

## Practical

Preparation of different solutions, preservatives, fixatives and stains for cytological studies. Collection of suitable material. Observation of mitotic and meiotic chromosomes. Use of colchicine for chromosome duplication. Micrometry.

## Books recommended

1. Singh, R.J. 2003. Plant Cytogenetics. CRC Press, Baton Rudge, USA.
2. Ravindranath, N. H. 2002. Elements of Modern Cytology, Genetics and Evolution. Kalyani Publishers, New Delhi, India.
3. Clark, M. S. and W. J. Wall. 1996. Chromosomes: The Complex Code. Chapman and Hall Ltd., London, UK.
4. Jahier, J, A. M. Chevre, R. Delourme, F. Eber, and A. M. Tanguy. 1996. Techniques of Plant Cytogenetics. Science Publishers Inc, New York, USA.

## World Wide Web

1. [en.wikipedia.org/wiki/Cytogenetics](http://en.wikipedia.org/wiki/Cytogenetics)
2. [www.molecularcytogenetics.org/](http://www.molecularcytogenetics.org/)

PBG 506	<b>Breeding Maize and Millets</b>	3(2-1)
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## Objectives

To enable students to understand

- Evolutionary pathways of maize and millet
- Breeding methods in maize and millet
- Hybrid maize production and its scope

## Theory

Economic importance and origin of maize and millets. Types of maize and their significance. Breeding methods, various selection procedures; recurrent selection, Development of inbred line. Heterosis, its significance, genetic basis and exploitation. General and specific combining ability. Hybrid seed production of maize and millets and use of male sterility. Population improvement and handling segregating generations. Breeding for forage yield and quality. Quality protein maize. (QPM). Maize and millet improvement through modern biotechnological techniques. Breeding for various stresses. Current scenario and future prospects

## Practical

Handling of inbred lines and hybrid material in maize. Development of various crosses, populations in maize and millets. Layout of experiments and



recording of data on various plant parameters. Visit to maize and millets research institutes and industry.

### **Books recommended**

1. Dana. S. 2001. Plant Breeding. Partha Sankar Basu Publishing Co. Kolkata, India.
2. Sprague, G. F. and J. V. Dudley (ed.). 1988. Corn and Corn Improvement. 3rd ed. ASA, CSSA and SSSA. Agronomy Monograph 18, Amer-Soc. Agron., Madison, Wisconsin, USA.
3. Chaudhry, A. R. 1983. Maize in Pakistan. Punjab Agric. Res. Coordination Board, Univ. of Agric., Faisalabad, Pakistan.
4. Hallauer, A. R. and J. B. Miranda. 1981. Quantitative Genetics in Maize Breeding. 1st ed. Iowa State University Press, Ames, Iowa.
5. FAO. 1980. Improvement and production of Maize, Sorghum and Millet. Vol. 2, Food and Agric. Org. of the United Nations, Home, Italy.

PBG 507	<b>Morphology and Reproductive Systems of Crops</b>	3(2-1)
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### **Objectives**

To enable students to understand:

- Floral morphology in various self and cross pollinated crops
- Reproductive systems of major crops
- Familiarize the students regarding hybridization techniques

### **Theory**

Morphology and anatomy of root, stem and leaf in major crops. Description of growth and reproductive stages. Floral biology and pollination behavior, sexual reproduction, self sterility, incompatibility and factors responsible. Heteromorphy, dicliny, dichogamy, asexual reproduction in different crops. Economic traits commonly measured in crop plants.

### **Practical**

Study of root, stem, leaf and other plant parts of major crops. Study of floral morphology, various techniques employed to emasculate and pollinate flowers.

### **Books recommended**

1. Gupta, S.K. 2006. Plant Breeding: Theories and Techniques. Agrobios, Jodhpur, India.
2. Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. 5th ed. Iowa State University Press, Ames, USA.

3. Mishra, S.R. 2005. Plant Reproduction. Discovery Publishing House, New Delhi, India.
4. Richards, A.J. 1997. Plant Breeding Systems. 2nd ed. Chapman and Hall, London, UK.

PBG 508	<b>Biodiversity and Plant Genetic Resources</b>	3(2-1)
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## Objectives

To enable students to understand:

- Importance of biodiversity in plant breeding
- Strategies of germplasm collection and conservation
- Role of biotechnology in identification and preservation

## Theory

Importance of plant biodiversity, characteristics of wild and domesticated plant species, Origin and distribution patterns of crop species. Centres of origin. Wild relatives of crops, Exploration of genetic resources. Principles and strategies of germplasm collection, seed banks. Mechanism of gene banking, maintenance, evaluation and conservation. Utilization of genetic resources in crop research and plant breeding. Introduction to national and international germplasm centres.

## Books recommended

1. Sleper, D.A. and J.M. Poehlman. 2006. Breeding Field Crops. 5<sup>th</sup> Ed., Iowa State University Press, Ames, USA.
2. Dhillon, B.S., R.K. Tyagi and A. Lal. 2004. Plant Genetic Resource Management. Narosa, New Delhi, India.
3. Brown, A. H. D., O. H. Frankel, D. R. Marshall and J. T. Williams. 1989. The Use of Plant Genetic Resources. Cambridge University Press, Cambridge, UK.

PBG 509	<b>Breeding Cereal Crops</b>	3(2-1)
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## Objectives

To enable students to understand:

- Application of genetic principles in cereal breeding
- Various reproductive systems in cereals
- Variety development and release procedures

## Theory

Importance of food cereals; wheat, rice, barley and oats. Status of cereals; global and local perspective. Evolution, origin, and phenology of cereal crops.

Objectives and application of breeding techniques. Procedure for variety development under stress environments. Genetic improvement using novel techniques. Development of commercial hybrids, exploitation of male sterility systems for hybrid development in cereals.

### **Practical**

Development of genetic material using appropriate techniques. Data collection on various stages of cereal crops. Assessment of genetic material. Handling of segregating populations. Data recording on various plant attributes and their statistical interpretation.

### **Books recommended**

1. Sleper, D.A. and J.M. Poehlman. 2006. Breeding Field Crops. 5<sup>th</sup> Ed., Iowa State University Press, Ames, USA.
2. Morris, P. C. and J. H. Bryce. (ed.). 2000. Cereal Biotechnology. Woodhead, New York, USA.
3. Nanda, J. S. 2000. Rice Breeding and Genetics: Research Priorities and Challenges. Pak Book Corporation, Lahore, Pakistan.
4. Heyne, E. G. (ed.). 1987. Wheat and Wheat Improvement. 2<sup>nd</sup> ed., ASA, CSSA and SSSA. Agronomy Monograph 13, Amer. Soc. Agron., Madison, Wisconsin, USA.

PBG 510	<b>Molecular Genetics</b>	3(2-1)
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### **Objectives**

To enable students to understand:

- Concept of genetic codes and gene function
- Basics of genetic engineering and biotechnology

### **Theory**

DNA as genetic material, chemistry of nucleic acids; DNA replication; types of RNA, Recombinant DNA technique, DNA transcription and translation. Transposable elements, Construction of genetic linkages map. Genetic Transformation, various techniques of developing transgenic plants. Marker assisted analysis and QTL mapping. Features of the genetic code, split gene and redundant DNA. Gene mutation, molecular basis of gene mutation, factors affecting mutation rate.

### **Practical**

DNA extraction, isolation and quantification. Gel electrophoresis, DNA amplification.

## Books Recommended

1. Klug, W. S. and M. R. Cummings. 2010. Concepts of Genetics. Dorling Kindersley, Pvt.(Ltd.) New Delhi, India.
2. Rothwell, V. N. 1993. Understanding Genetics: A Molecular Approach. 2<sup>nd</sup> ed., John Wiley and Sons New York, USA.
3. Bilgrami, K. S. and A. K. Pandey. 1992. Introduction of Biotechnology. CBS Publishers & Distributers, New Delhi, India.
4. Maniatis, T., E. F. Fritsch and J. Sambrook, 1989. Molecular Cloning. A Laboratory Manual. Cold Spring Harbour, USA.

PBG 601	<b>Breeding Oil Seed Crops</b>	3(2-1)
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## Objectives

To enable students to understand:

- Status and situation of oilseeds in Pakistan
- Significance of conventional and non-conventional oilseed crops
- Breeding methodology in oilseeds

## Theory

Origin and classification of oilseeds. Role of edible oilseeds in national economy, edible oil scenario in Pakistan and strategies. Introduction to conventional and non-conventional oilseed crops. Significance of cotton as oilseed crop, factors responsible for yield constraints. Breeding objectives and methodologies; Genetics of male sterility and its use. Hybrid seed production in sunflower and other oilseed crops. Development of double low varieties in rapeseed mustard crops.

## Practical

Identification of oilseeds, their reproductive biology, estimation of oil quality. Development of hybrid populations of oilseed crops, selection practices in segregating populations.

## Books recommended

1. Nagata, T. and S. Tabata (ed).2003. Brassica and Legumes: From Genome Structure to Breeding. Springer Verlag, New York, USA.
2. Verma, D. P. S. 1996. Soybean: Genetics, Molecular Biology and Biotechnology. Biotechnology in Agriculture Series, No 14. CABI Publishing Co. USA.
3. Kimber, D. and D.I. McGregor. 1995. Brassica Oilseeds: Production and Utilization. Cambridge, UK.

4. Robbelen, G. and R. K. Downey. 1990. Oil Crops of the World: their Breeding and Utilization, McGraw-Hill Publishing Company, New York, USA.

## **World Wide Web**

1. <http://www.parc.gov.pk/1SubDivisions/NARCCSI/CSI/rapeseed.html>
2. [http://archive.idrc.ca/library/document/091017/chap3\\_e.html](http://archive.idrc.ca/library/document/091017/chap3_e.html)

PBG 602	<b>Breeding Fodder and Forage Crops</b>	3(2-1)
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## **Objectives**

To enable students to understand:

- Significance of fodder and forages in livestock
- Genetic and cytoplasmic basis of reproductive systems
- Various breeding methods in fodder and forages
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## **Theory**

Introduction to major fodder and forage crops of Pakistan. Reproductive systems in fodder and forage crops. Apomixis and its role in fodder crops. Male sterility and self-incompatibility: genetic and cytogenetic basis. Breeding objectives and methods for improvement, hay and silage production, fodder quality components in fodder crops, anti-quality agents and remedies. Application of biotechnology in fodder and forage crops.

## **Practical**

Pollination, fertilization and seed setting in fodder and forage crops. Handling of apomictic, self and cross-pollinated fodder and forage species. Determination of nutritive quality; nutritive value. Visit to research organizations, livestock farms and feed industry.

## **Books recommended**

1. Sleper, D. A. and J. M. Poehlman. 2006. Breeding Field Crops. Iowa State University Press, Ames, Iowa, USA.
2. Poehlman, J.M. 1995. Breeding Field Crops. Iowa State University Press, Ames, Iowa, USA.
3. Rognli, O.A., E.T. Solberg, I. Schjelderup. (eds.). 1994. Breeding Fodder Crops for Marginal Conditions. Series: Developments in Plant Breeding, SpringerLink, USA.
4. Chatterjee, B. N, 1989. Forage Crop Production: Principles and Practices. Oxford and IBH Publishing Co. Ltd., New Delhi, India.

- Sleper, D. A., K. H. Asay and J.F. Pedersen, (eds.) 1989. Contributions from Breeding Forage and Turf Grasses. CSSA Special Publication 15, Amer. Soc. Agron., Madison, Wisconsin, USA.

PBG 603	<b>Breeding Pulse Crops</b>	3(2-1)
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## Objectives

To enable students to understand:

- Significance and status of pulses
- Biotic and abiotic stresses
- Constraints in pulse breeding

## Theory

Significance of pulses in human diet. Present status of pulses in Pakistan: an overview; reasons of low yield in pulse crops. Botanical description and breeding methods in pulse crops. Breeding for biotic and abiotic stresses. Limitations in hybridization. Role of mutation breeding in pulses. Use of biotechnological tools for pulses improvement. Genetic mechanism of nitrogen fixation in pulses.

## Practical

Reproductive biology of important pulses, Crossing and hybridization techniques in major pulses. Study of rhizobium nodulation and nitrogen fixation in various pulse crops. Visit to research stations.

## Books recommended

- Ali, M. 2006. Drought Management Strategies for Pulse crops. Agrotech. Publishing Academy, Udaipur, India.
- Nagata, T. and S. Tabata (ed). 2003. Brassica and Legumes - From Genome Structure to Breeding. Springer Verlag, New York, USA.
- Singh, D.P. (ed). 2001. Genetics and Breeding of Pulse Crops. Kalyani Publishers New Delhi, India.
- Poehlman, J.M. 1995. Breeding Field Crops. Iowa State University Press, Ames, USA.
- Persley, G. J. (ed.). 1984. Tropical Legume Improvement. Biotech Anutech Pvt. Ltd., Canberra, Australia.

PBG 604	<b>Breeding Minor Crops</b>	3(2-1)
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## Objectives

To enable students to understand

- Significance and status of minor crops

- Breeding methods in minor crops

## Theory

Importance of minor crops: guar, sesame, linseed, sorghum, tobacco. Breeding objectives, methodologies and selection procedures; recurrent selection, general and specific combining ability. Use of male sterility in hybrid seed production. Breeding for biotic and abiotic stresses.

## Practical

Handling of inbred lines and hybrid materials. Layout of experiments, recording and analysis of data on various plant parameters, visit to research Institutes and industry.

## Books recommended

1. Ed., Iowa State University Press, Ames, USA
2. Douglas, C. A. 2005. Evaluation of Guar Cultivars in Central and Southern Queensland. RIRDC Publications, Australia.
3. Goodman, J. (Editor). 2004. Tobacco in History and Culture: An Encyclopedia. Charles Scribner's Sons.
4. Ram, H.H. and H. G. Singh. 2003. Crop Breeding and Genetics. Kalyani Publishers, New Delhi, India.

PBG 605	<b>Breeding Vegetable Crops</b>	3(2-1)
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## Objectives

To enable students to understand:

- Significance and classification of vegetables
- Reproductive mechanisms in various vegetables
- Role of biotechnology in vegetable improvement

## Theory

Introduction, classification and importance of vegetable crops. Reproductive systems of important vegetables. Breeding objectives of important vegetable crops. Breeding and hybridization constraints of vegetables and possible improvement strategies. Hybrid seed production in vegetables. Breeding for quality, biotic and abiotic stresses and shelf- life. Role of biotechnology in improvement of vegetable crops.

## Practical

Study of reproductive biology of important vegetables. Selfing and crossing techniques in major vegetables. Layout of field experiments and data recording for various genetic parameters. Visit to research stations.

## Books recommended

1. Arya, P.S. 2003. Vegetable Breeding, Production and Seed Production. Kalyani Publisher, New Delhi, India.
2. Kalloo, G. and B. O. Bergh. (Eds) 1999. Genetic Improvement of Vegetable Crops. Pergoman Press, New York. USA.
3. Swiader, J. M., G. W. Ware and J. M. McCollum. 1992. Producing Vegetable Crops. 4<sup>th</sup> ed. Interstate. Publisher, Inc, Danville, Illinois, U.S.A.
4. Bassett, M. J. (ed.) 1986. Breeding Vegetable Crops. Avi Publishing Co., Inc. Westport, Connecticut, U.S.A.

PBG 606	<b>Intellectual Property Rights in Crop Varieties</b>	3(2-1)
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## Objectives

To make the students abreast about:

- Intellectual property rights
- Registration of crop varieties and seed certification

## Theory

Intellectual Property Rights (IPR): introduction and implementation; IPR; issues and challenges. Strategies to maximize benefits from IPR. Plant Variety Protection (PVP) and farmer's rights. Biological diversity and utilization of germplasm resources. Plant Breeder's Rights Act: background, requirements; advantages and disadvantages. Patenting biological material. International harmonization of patent laws. Plant variety registration and seed certification. A critical review of "WTO, TRIPS and seed industry in Pakistan".

## Books recommended

1. Helfer, L.R. 2004. Intellectual Property Rights in Plant Varieties: International legal regimes and policy options for national governments. FAO Legislative Study 85, Food and Agriculture Organization, Rome, Italy.
2. Erbisch, F.U. and K.M. Maredia (eds). 2003. Intellectual Property Rights in Agricultural Biotechnology. CABI Publishing Company, USA.
3. Helfer, L.R. 2002. Intellectual Property Rights in Plant Varieties: an overview with options for national governments. FAO Legal Papers, Online #31, Food and Agriculture Organization, Rome, Italy.
4. Evenson, R.E. 1999. Intellectual Property Rights; access to plant germplasm and crop production scenarios in 2020. Crop Sci., 39:1630-1635.



## Objectives

To enable students to understand:

- Modern breeding tools and techniques in crop improvement.
- Application of new techniques in plant breeding.

## Theory

Introduction to genetic engineering and plant biotechnology. In vitro culture techniques : callus culture, cell suspension culture, protoplast culture, embryo rescue, soma clonal variations. Basics of molecular biology, DNA amplification, Polymerase Chain Reaction, DNA fingerprinting, molecular markers and marker assisted selection in plant breeding. Biotechnological approaches to drought tolerance, salt tolerance and protein quality in various field crops. Scope of transgenic plants in plant breeding.

## Practical

Safety measures in the biotech laboratory. Introduction to aseptic techniques, autoclaving, sterilization, use of laminar flow and fume hoods. Storage and weighing of chemicals, preparation of stock-solutions, adjusting pH, making dilutions. Media preparation. Callus formation and regeneration from plant material. Isolation, handling and quantification of DNA.

## Books recommended

1. Loodish, H. 2004. Molecular Cell Biology. 5th Ed., John Wiley and Sons, New York, USA.
2. Paul, C and K. Harry. 2004. Handbook of Plant Biotechnology. John Willy and Sons, New York, USA.
3. Muglani, G. S. 2003. Advanced Genetics. Narosa Publishing House, New Delhi, India.
4. Razdan, M. K. (Ed) 2003. Introduction to Plant Tissue Culture. 2nd Ed., Intercept, New York, USA.
5. Brown, T. A. 2000. Essential Molecular Biology: A Practical Approach. Oxford University Press, New York, USA.

## World Wide Web

1. [en.wikipedia.org/wiki/Tissue\\_culture](http://en.wikipedia.org/wiki/Tissue_culture)
2. [www.accessexcellence.org/LC/ST/st2bgplant.html](http://www.accessexcellence.org/LC/ST/st2bgplant.html) -

PBG 608	<b>Internship or Research Project</b>	4(0-4)
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## Objectives

To enable students to understand:

- Importance of planning and conducting research project
- Data collection, analysing and interpretation
- Logical presentation of results

## Practical

Students will be required to undertake internship at various agricultural research organizations, private companies, extension/adaptive farms and private farms **or**

undertake a research project at university fields/laboratories aimed at their practical training. Upon completion of internship/research project, students are required to submit a report and give presentation of internship/research experiment.

## Books recommended

1. Khalil, S. K. and P. Shah. 2007. Scientific Writing and Presentation. Higher Education Commission, Islamabad, Pakistan.

PBG 609	<b>Fundamentals of Plant Biometry</b>	3(3-0)
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## Objectives

To enable students to understand

- Application of biometrical techniques in genetics and breeding
- Recording data on qualitative and quantitative traits
- Various statistical techniques used in plant breeding

## Theory

Concept of quantitative, qualitative traits and their analysis. Chi-square test. Variance and covariance: components of variance and covariance. Heritability types and estimation, selection pressure, selection differential, response to selection and genetic advance. Introduction to different genetic models.

## Books recommended

1. Singh, R. K. and B. D. Chaudhary. 2004. Biometrical Methods in Quantitative Genetics Analysis. Kalyani Publishers, New Delhi, India.

2. Kang, M. S. and M. Kang (ed). 2003. Handbook of Formulae and Software for Plant Geneticists and Breeders. Harworth Press Inc, Los Angelous, USA.
3. Singh, P. 2000. Biometrical Techniques in Plant Breeding. 2<sup>nd</sup> ed., Kalyani Publishers, New Delhi, India.
4. Baker, W. A. 1992. Manual of Quantitative Genetics. 5th ed. Academic enterprises, Pullman, USA.

# SCHEME OF STUDIES FOR MS/M.Sc (HONS) IN PLANT BREEDING & GENETICS

PBG 701	Advanced Methods in Plant Breeding	3(2-1)
PBG 702	Cytogenetics in Crop Plants	3(2-1)
PBG 703	Advanced Genetics	3(3-0)
PBG 719	Seminar	1(1-0)
PBG 720	Thesis	10(0-10)

## General Courses for Post Graduate Students

PBG-704	Principles of Plant Breeding	3(2-1)
PBG-705	Breeding Fodder Crops	3(2-1)
PBG-706	Breeding for Stress Environments	3(2-1)
PBG-707	Mutation Breeding	3(2-1)
PBG-708	Population Genetics	3(3-0)
PBG-709	Cereal Genetics	3(2-1)
PBG-710	Cotton Genetics	3(2-1)
PBG-711	Genetics of Oilseed Crops	3(2-1)
PBG-712	Genetics of Sugar Crops	3(2-1)
PBG-713	Genetic Engineering in Plants	3(2-1)
PBG-718	Special Problems	1(1-0)
PBG-721	Evolution of Field Crops	3(3-0)
PBG-722	Genetics of Plant Disease and Insect Resistance	3(2-1)
PBG-723	Advanced Cytogenetics	3(2-1)
PBG-724	Hybrid Seed Production.	3(2-1)
PBG-725	Biometrical Techniques in Plant Breeding	3(2-1)
PBG-726	Special Problems	1(1-0)
PBG-728	Seminar-I	1(1-0)
PBG-729	Seminar-II	1(1-0)
PBG-730	Dissertation	20(0-20)

## **DETAIL OF COURSES**

### **FOR MS/M.Sc (HONS) IN PLANT BREEDING & GENETICS**

PBG 701	<b>Advanced Methods in Plant Breeding</b>	3(2-1)
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#### **Theory**

Ideotype concept; its genetic and physiological basis, identification and construction of an ideotype. Components of variation, estimation of additive and non-additive variances. Testing GxE; Stability analysis; Enhancement of genetic gain in plant breeding. Mating designs: Diallel, North Carolina design I, II and III. Uses of mating designs in plant breeding. Selection indices and their uses. Marker assisted selection and its application in plant breeding. Significance and utilization of wider crosses. QTLs application in plant breeding. Current scenario and future concerns. Participatory plant breeding.

#### **Practical**

Expected mean squares and their use in plant breeding. Response to selection, Estimation of variance components and heritability from the mating designs. Application of various mating designs and selection indices. Use of computer software.

#### **Books Recommended**

1. Singh, R.K. and B. D. Chaudhary, 2004. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi, India.
2. Falconer, D.S. 2003. Introduction to Quantitative Genetics. Textbook Publisher, London, U.K.
3. Kang, M.S. (ed). 2003. Handbook of Formulas and Software for Plant Geneticists and Breeders. Harworth Press Inc, LA, USA.
4. Kang, M.S. (Ed) 2002. Quantitative Genetics, Genomics and Plant Breeding. CABI, Sussex, UK.
5. Kang, M.S. and H.G. Gauch. 1996. Genotype by Environment Interaction. CRC Press, New York, USA.
6. Kearsey, M.J. and H.S. Pooni. 1996. The Genetical Analysis of Quantitative Traits. Chapman and Hall, Ltd. London, U.K.

PBG 702	<b>Cytogenetics of Crop Plants</b>	3(2-1)
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#### **Theory**

Cytogenetics and its importance in crop improvement. Ultra fine structure of cell and its contents. Overview of cell cycle. Cytological evidences of crossing over. Chromosomal aberrations; deficiencies and duplications, their phenotypic effects, genetic and cytological tests, use of translocations and

inversions in genetic studies and evolution. Methods of locating break points. Genetic studies in translocations and inversions in different crops. Heteroploidy, genetic and cytological behavior.

## Practical

Slide preparation of mitotic and meiotic cell divisions from different plant material. Karyotype study of different crop plants: Banding techniques. Study of chromosomal structural changes.

## Books Recommended

1. Bass, H. W. and J. A. Brichler. 2010. Plant Cytogenetics: Genome Structure and Chromosome Function. Springer Publishers, New York, USA Gupta, R.K. 1999. Cytogenetics. Rastogi Publishers, Meerut, India..
2. Singh, R. J. 2003. Plant Cytogenetics. CRC Press, London, UK.
3. Prasad, G. 1998. Introduction to Cytogenetics. Kalyani Publishers, New Delhi, India.
4. Sinha, U, and S. Sinha. 1998. Cytogenetics, Plant Breeding and Evolution. Vikas Publishing House Pvt Ltd, New Delhi, India.

PBG 703	<b>Advanced Genetics</b>	3(3-0)
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## Theory

Classical versus modern concepts of gene. Genetic material: a brief review: structure, function, organization, replication and properties of genetic material. Gene interaction: control, basis and importance. Gene expression and regulation in prokaryotes and eukaryotes. Gene, genetic code, one gene-one polypeptide concept, protein synthesis. Mutation: classification, biochemical basis, factors affecting the rate of mutation and repair mechanism. Transposable genetic elements. Genetic recombination: mechanisms of recombination. Cytoplasmic inheritance: Origin and biological implications, genetics of killer traits. Introduction to non-conventional gene manipulation techniques.

## Books Recommended

1. Klug, W. S. and M. R. Cummings. 2010. Concepts of Genetics. Dorling Kindersley, Pvt.(Ltd.) New Delhi, India.
2. Snustad, D.P. and M. J. Simmons. 2009. Principles of Genetics. John Wiley and Sons, Inc., New York, USA.
3. Hartl, D. L. 2005. Genetic Analysis of Genes and Genomes. 6th ed. John and Bartlett Publishers, NY, USA.
4. Lewin, B. 2004. Genes VIII. John Wiley and Sons, NY, USA.

5. Reece, R. J. 2004. Analysis of Genes and Genomes. John Wiley & Sons, NY, USA.

PBG 704	<b>Principles of Plant Breeding</b>	3(2-1)
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### **Theory**

Role of Plant Breeding in crop improvement. Variability in natural populations and its exploitation. Creation of genetic variation using conventional and non-conventional techniques. Breeding methods in self- pollinated crops. Breeding methods in cross pollinated crops, Heterosis and its exploitation in crop improvement. Development, evaluation and improvement of inbred lines. A, B and R lines in hybrid seed production. Novelty and DUS characteristics in varietal registration. Varietal Evaluation Committee. Specific objectives in various self and cross pollinated crops. Seed production system of approved true breeding and hybrid varieties.

### **Practical**

Hybridization techniques used in self pollinated and cross pollinated crops. Handling of segregating and inbred generations. Layout of experiments and collection of experimental data, its tabulation and interpretation. Estimating effective population and sample size. Visits to various research institutes.

### **Books Recommended**

1. Sleper D.A. and J. M. Poehlman. 2006. Breeding Field Crops. Blackwell Publishers, Iowa Sate University Press, Ames, USA.
2. Singh, B.D. 2004. Plant Breeding, Principles and Methods. Kalyani Publishers, New Delhi, India
3. Khan, M.A., E. Bashir, and R. Bantel (Editors). 1994. Plant Breeding. National Book Foundation, Islamabad.
4. Fehr, W.R. 1987. Principles of Cultivar Development. Volume I. Theory and Technique. MacMillan Publishing Co., New York.
5. Allard, R. W. 1999. Principles of Plant Breeding. John Wiley and Sons, New York, USA.

PBG 705	<b>Breeding Fodder Crops</b>	3(2-1)
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### **Theory**

Reproductive mechanisms in various fodder crops. Male sterility and self-incompatibility factors and their consequences. Breeding objectives in fodders. Breeding procedures and techniques, introduction, selection and evolution of new varieties/species. Testing of inbred lines; Production of hybrid fodder. Interspecific and intergeneric crosses in fodder species such as sorghum-sudangrass hybrid, bajra-napier hybrid. Use of polycross methods in fodders. Developing synthetic varieties. Evaluation for quality; proteins, carbohydrates

and digestibility. Breeding for greater seedling vigour, persistence of stand and disease and insect resistance.

### **Practical**

Classification of various rabi and kharif fodders. Study of floral structure in different fodder crops. Selfing and crossing techniques for various fodders; handling breeding material and its evaluation.

### **Books Recommended**

1. Sleper, D. A. and J. M. Poehlman. 2006. Breeding Field Crops. Iowa State University Press, Ames, Iowa, USA.
2. Bhatti, M.B. and S. Khan (Eds.) 1996. Fodder production in Pakistan. Proceedings of the National Conference on the Improvement, Production and Utilization of Fodder Crops in Pakistan, held on March 25-27, 1996 at NARC, Pakistan Agricultural Research Council, Islamabad.
3. Poehlman, J.M. 1995. Breeding Field Crops. Iowa State University Press, Ames, Iowa, USA.
4. Rognli, O.A., E.T. Solberg, I. Schjelderup. (eds.). 1994. Breeding Fodder Crops for Marginal Conditions. Series: Developments in Plant Breeding, SpringerLink, USA.

PBG 706	<b>Breeding for Stress Environment</b>	3(2-1)
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### **Theory**

Importance of stress breeding in Pakistan. Definition and types of stresses: environmental, soil and physiological stresses. Plant parameters related to salinity, drought, low and high temperature. Induction of stress tolerance, adaptive mechanisms. Genetic variability for stress tolerance and its evaluation for improvement. Identification of genetic resources for tolerant genes and their transfer to indigenous varieties. Screening and micro-screening techniques; breeding and selection strategies for stress tolerance. Molecular basis of stress tolerance.

### **Practical**

Field and laboratory study of stress parameters; screening under simulated conditions; genetic analysis of tolerance related traits.

### **Books Recommended**

1. Goyal, S. S., S. K. Sharma and D. W. Rains (Ed) 2003. Crop Production in Saline Environments: Global and Integrative Perspectives. Haworth Press, London UK.



2. Hall, A. E. 2001. Crop Responses to Environment. CRC Press LLC, Boca Raton, Florida, UK.
3. Gupta, U. S. 1997. Crop Improvement Vol. 2 Stress Tolerance. Oxford and IBH Publishing Co. (Pvt) Ltd., New Delhi, India.
4. Pessaraki, M. (ed.) 1994. Handbook of Plant and Crop Stress. Marcel Dekker Inc., New York. USA.
5. Mooney, H. A., W. E. Winner, and E. J. Pell. 1991. Response of Plants to Multiple Stresses. Academic Press, San Diego, California, USA.

PBG 707	<b>Mutation Breeding</b>	3(2-1)
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## **Theory**

Mutation: importance and achievements in plant breeding. Classes of mutagens. Induction of mutation, detection, evaluation and utilization of induced mutants. Factors modifying the effectiveness of irradiation in seed treatment. Determination of LD50. Effectiveness and efficiency for inducing cytological changes. Gamma garden. Molecular basis of Mutation: Targeting Induced Local Lesions in Genomes (TILLING); making Kill Curve, development and handling of TILLING populations, high throughput screening of point mutations. Observations in M1, procedure for selection in later generations, use of mutants in hybridization programme. Improvement of specific characters through induced mutation. Mutation breeding research in some vegetatively propagated plants.

## **Practical**

Radiation treatment techniques; Radio sensitivity of field crops; Cytological analysis of mutants; Field observations and selection procedure of irradiated material.

## **Books Recommended**

1. Purohit, S.S. 2010. Mutation Breeding. Agrobios, India.
2. Datta, S.K. 2005. Role of Classical Mutation Breeding in Crop Improvement. Daya, New Delhi, India
3. Van Harten, A.M. 1998. Mutation breeding. Theory and Practical Applications. Cambridge University Press, Cambridge, U.K.
4. Amir, M. and R.C. Borstel. 1985. Basic and Applied Mutagens. Plenum Press, New York, USA.

## **World Wide Web**

[http://tilling.fhcrc.org:9366/files/Welcome\\_to\\_ATP.html](http://tilling.fhcrc.org:9366/files/Welcome_to_ATP.html)  
[http://www.licor.com/bio/applications/4300\\_applications/tilling.jsp](http://www.licor.com/bio/applications/4300_applications/tilling.jsp)

PBG 708	<b>Population Genetics</b>	3(3-0)
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### **Theory**

Definition and scope of quantitative genetics; Allele frequency and polymorphism. Organization of genetic diversity, Hardy-Weinberg law and factors affecting population structure. Mating systems: random mating, assortative and disassortative matings. Population models; consequences of genetic drift. Genetic differentiation of populations. Inbreeding in small populations, effective population size. Wahlund's principle, patterns of migration; natural selection; over-dominance, heterozygote inferiority. Mutation, selection balance; shifting balance.

### **Books Recommended**

1. Hamilton, M. B. 2009. Population Genetics. Wiley and Blackwell. Sussex, UK.
2. Harri, D. L. 2007. Principles of Population Genetics. Sinauer Associates, Sunderland, Massachusetts, USA.
3. Neal, D. 2003. Introduction to Population Biology. Cambridge University Press, Cambridge, UK.
4. Falconer, D. S. and T. E. C. Mackay. 1996. Introduction to Quantitative Genetics. Longman, London.
5. Brown, A. G. D., M. T. Clegg, A. L. Kahler and B. S. Weir. 1990. Population Genetics, Breeding and Genetic Resources. Sinauer Associates, Sunderland, Massachusetts, USA.

PBG 709	<b>Cereal Genetics</b>	3(2-1)
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### **Theory**

Role of cereals in human food. Genomic relationship among various species of cereal crops: wheat, rice, maize and barley. Genetics of morphological, physiological and grain quality characters in cereals. Genetics of disease and insect resistance. Genetic basis of resistance/tolerance against abiotic stresses. Genetics of qualitative and quantitative traits. Strategies for improvement of cereal crops for specific traits.

### **Practical**

Problems relating to genetic analysis in wheat, rice, maize and barley. Estimation of grain quality. Identification of cereal diseases, screening of cereal cultivars for drought resistance and salt tolerance in lab and field conditions.

## **Books Recommended**

1. Datta, S. K. 2008. Rice improvement in the genomics era. CRC Press, New York, USA.
2. Sleper D.A. and J. M. Poehlman. 2006. Breeding Field Crops. Blackwell Publishers, Iowa State University Press, Ames, USA.
3. Nevo, E., A. B. Korol, A. Beiles and T. Fahima. 2002. Evolution of wild emmer and wheat improvement. Springer-Verlag, Germany.
4. Slafer, G. A., J. L. Molina-Cano, J. L. Araus and I. Romagosa (eds.). 2002. Barley science: recent advances from molecular biology to agronomy of yield. Food Product Press, New York, USA.
5. Hallauer, A. R. (ed.). 2001. Specialty Corns. CRC press, Florida, USA.

PBG 710	<b>Cotton Genetics</b>	3(2-1)
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## **Theory**

Importance of cotton in national and global economy. Description of various species of cotton. Evolutionary history and cultivated species of cotton. Genetic analysis of morphological, physiological, yield components, lint percentage and fibre quality traits. Genetic basis of heterosis and its exploitation in global perspective. Genetic basis of insect pests and disease resistance/tolerance. Identification and utilization of genetic resources for biotic, abiotic stress and fibre traits. Role of biotechnology in cotton improvement.

## **Practical**

Study of various physiological and morphological parameters. Collection of data on different plant and fibre characters and their genetic analysis.

## **Books Recommended**

1. Sleper, D .A. and J.M. Poehlman. 2006. Breeding Field Crops. 5th Ed. Iowa State University Press Ames, USA.
2. Rafiq, M. 2004. Cotton: An Introduction. ICAC Washington DC, USA.
3. Shiron, J. (Editor). 2004. Transgenic Cotton. Science press, 16 Donghuangchenggen North Street Beijing, China.
4. Singh, P. 2004. Cotton Breeding. Kalyani Publishers. New Delhi. India.
5. Johnie, N. J. and S. Saha. 2001. Genetic improvement of Cotton-emerging techniques. Oxford and IBH Publishing Co., New Delhi, India.

## **World Wide Web:**

<http://www.cotton.org/journal/archive.cfm>

PBG 711	<b>Genetics of Oilseed Crops</b>	3(2-1)
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### **Theory**

Significance of edible oil in the economy of Pakistan. Achievements and major issues of oilseed crops: conventional and non-conventional. Genetic relationship among different Brassica species. Genetic diversity and its exploitation in oilseed crops. Genetic basis of physiological and morphological characteristics of oilseed crops. Genetics of quantitative and qualitative traits. Genetics of double low traits and its utilization. Genetic basis of oil composition. Genetics of male sterility and its use in sunflower and canola hybrid seed production. Strategies for genetic improvement of oilseeds.

### **Practical**

Specification and characteristics of edible oil, oil content, fatty acid, iodine number. Genetic evaluation of different fatty acids in oilseeds.

### **Books Recommended**

1. Ramanath, T. 2004. Applied Genetics of Oilseed Crops. Daya, New Delhi, India
2. Nagata, T. and S. Tabata (ed).2003. Brassica and Legumes: From Genome Structure to Breeding. Springer Verlag, New York, USA.
3. Kimber, D. and D.I. McGregor. 1995. Brassica Oilseeds: Production and Utilization. Cambridge, UK.
4. Verma, D. P. S. 1996. Soybean: Genetics, Molecular Biology and Biotechnology. Biotechnology in Agriculture Series, No 14. CABI Publishing Co. USA.
5. Robbelen, G. and R. K. Downey. 1990. Oil Crops of the World: their Breeding and Utilization, McGraw-Hill Publishing Company, New York, USA.

### **World Wide Web**

1. <http://www.parc.gov.pk/1SubDivisions/NARCCSI/CSI/rapeseed.html>
2. [http://archive.idrc.ca/library/document/091017/chap3\\_e.html](http://archive.idrc.ca/library/document/091017/chap3_e.html)
3. <http://www.soygenetics.org/>

PBG 712	<b>Genetics of Sugar Crops</b>	3(2-1)
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### **Theory**

Evolutionary history of sugarcane and sugar beet. Constraints of sugarcane flowering, fuzz growing and production. Genetic barriers in sugarcane flowering and their possible solutions. Genetics of different parameters in sugarcane and sugar beet. Role of polyploidy in sugar beet. Genetic

relationship between cane yield and sugar recovery. Strategies for genetic improvement in sugar crops. Genetic determination of quality parameters and their utilization. Role of biotechnology in sugar crops improvement.

### **Practical**

Estimation of brix value of sugarcane plant. Collection of data for various plant traits in sugar crops and their genetic analysis. Visit to research institutes and sugar industries.

### **Books Recommended**

1. Henry, R. J. and C. Kole. 2010. Genetics, Genomics and Breeding of Sugarcane. Taylor and Francis, London, UK.
2. Malik, K. B. 2009. Cane and Sugar Production. Punjab Agriculture Research Board, Lahore, Pakistan.
3. Draycott, A. P. 2006. Sugar beet. Blackwell Publishing Ltd., Oxford, UK.
4. Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. 5th ed. Iowa State University Press, Ames, Iowa, USA.

### **World Wide Web**

1. [http://www.amazon.com/Sugarcane-World-Agriculture-GlynJames/dp/063205476X/ref=pd\\_bxgy\\_b\\_img\\_b](http://www.amazon.com/Sugarcane-World-Agriculture-GlynJames/dp/063205476X/ref=pd_bxgy_b_img_b)

PBG 713	<b>Genetic Engineering in Plants</b>	3(2-1)
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### **Theory**

Molecular approaches in gene manipulation. Techniques for locating gene. Importance of gene cloning in research and industry. Cloning vehicle. Plasmids and bacteriophages, extraction and purification of DNA. Restriction endonucleases and ligases. DNA Probing, Southern and Northern blotting, PCR-amplification of DNA; cDNA- synthesis. Introduction of DNA into living cells. Selection for Recombinants; Cloning Vectors for E. coli and higher plants. Identification and selection of cloned gene. Formation of transgenic plants. Benefits and problems related with transgenic plants. Genetically modified plants and bioethical concerns. Bioinformatics.

### **Practical**

Extraction of genomic DNA, purification of DNA, restriction mapping. Genetic transformation of bacteria and plants. Electrophoresis. Visit to National Institutions working in Genetic Engineering and Biotechnology.

### **Books Recommended**

1. Slater, A., N. W. Scott and M. R. Fowler. 2008. Plant Biotechnology: the genetic manipulation of plants. Oxford University Press, Oxford, UK.

2. Liang, G. H. and D. Z. Skinner. 2005. Transgenic Crops. Haworth Press. Inc., NY, USA.
3. Chawla, H. S. 2004. Introduction to Plant Biotechnology. Science Publishers, New Hampshire, USA.
4. Watson, J, D., T. A. Baker, S. P. Bell, A. Gann, M. Levine and R. Losick. 2004. Molecular Biology of the Gene. Pearson Education, London, UK  
Jackson, J,F, and Linskens. 2002 (Ed) Testing for Genetics Manipulation in plants (Molcular Methods of plant analysis Vol 22) Springer-Verlag, Berlin, Germany.
5. Old, R. W. and S. B. P. Primose. 2000. Principles of Gene Manipulation: an introduction to genetic engineering. Blackwell, London, UK.

PBG 718	<b>Special Problem</b>	1(1-0)
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Student will be assigned a special topic for searching literature relevant to a particular problem or conducting an experiment or any other appropriate activity. Student has to compile a comprehensive report on the title assigned.

PBG 719	<b>Seminar</b>	1(1-0)
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Student will be given a topic on a particular problem in the field of plant breeding and genetics. Student has to deliver a presentation in an open house gathering on the title assigned.

PBG 720	<b>Thesis</b>	10(0-10)
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PBG 721	<b>Evolution of Field Crops</b>	3(3-0)
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## Theory

Evolution and its theories. Hybridization: role of natural hybridization in evolution, hybridization as a source of variation for adaptation to new environments. Role of reproductive isolating mechanisms; Introgression in crop species. Species and speciation: Significance of polyploidy in evolution. Evolution and species relationship in important crop plants. Evolutionary history of major crop plants, Genetic polymorphism.

## Books Recommended

1. Hancock, J. 2004. Plant Evolution and the Origin of Crop Species. (2nd ed) Oxford University Press, USA
2. Willis, K.J. and J.C. McElwain. 2002. Evolution of Plants. Oxford University Press, Oxford, UK.
3. Strickberger, M.W. 2000. Evolution. Jones and Bartlett, New York, USA.

4. Ladizinsky, G. 1998. Plant evolution under domestication. Kluwer Academic Publishers New York, USA.
5. Smartt, J. and N.W. Simmonds (eds.) 1995. Evolution of Crop Plants. (2nd ed.). Longman Scientific and Technical, Essex, England.

PBG 722	<b>Genetics of Plant Disease and Insect Resistance</b>	3(2-1)
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## **Theory**

Nature of parasitism, pathogenicity and expression of disease resistance. Mendelian, quantitative and cytoplasmic resistance in host. Genetics of host-pathogen interaction and various models; Horizontal and vertical resistance. Identification of disease resistance sources. Host/non-host resistance. Nature and genetic mechanism of resistance. Transfer of genetic resistance. Pyramiding genes for resistance. Evaluation of plant resistance to insect and diseases. Molecular approaches to insect and disease resistance.

## **Practical**

Inoculation techniques for various plant diseases. Study of differentiation among disease susceptibility, disease escape, tolerance, resistance and immunity. Measurement of resistance by using different scoring scales and their statistical analysis. Visit to specialized research institutes.

## **Books Recommended**

1. Agrios, G. N. 2005. Plant pathology. Elsevier Academic Press. Burlington, USA.
2. Singh, D. P. and A. Singh. 2005. Disease and Insect Resistance in Plants. Science Publishers, New Hampshire, USA.
3. Sadasivam, S., and B. Thayumanavan (Ed). 2003. Molecular Host Plant Resistance to Pests. Marcel Dekker, New York, USA.
4. Kranz, J. (Ed) 2002. Comparative Epidemiology of Plant Diseases. Springer, NY, USA
5. Gunasekaran, M. and D. J. Weber (Ed). 1995. Molecular Biology of the Biological Control of Pests and Diseases of Plants. Department of Botany and Range Science, Brigham Young University, Provo, Utah.
6. Johnson, R. 1992. Breeding for Disease Resistance. Kluwer Academic Publishers Group, Dordrecht. The Netherlands.
7. Vanderplank, J. E. 1984. Disease Resistance in Plants. 2<sup>nd</sup> ed. Academic Press, Inc., Orlando, Florida, USA.

PBG 723	<b>Advanced Cytogenetics</b>	3(3-0)
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### **Theory**

Heteroploidy; Autopolyploidy: occurrence and general characteristics. Haploids vs monoploids, artificial production of haploids and dihaploids. Theoretical genetic ratios for single gene locus, genetic data, linkages in autopolyploids. Allopolyploidy: origin, evidences of homology between chromosomes. Aneuploidy, trisomics, monosomics, nullisomics, their transmission and factors influencing transmission. Substitution lines and their use in crop improvement. Cytogenetics of apomixes.

### **Books Recommended**

1. Puertas, M. J. and T. Naranjo. 2005. Plant Cytogenetics: Cytogenetic and Genome Research. S. Karger Publishers,
2. Schulz-Schaeffer, J. 1981. Cytogenetics. Plants, animal, humans. Springer-Verlag, New York. USA.
3. Singh, R. J. 2005. Plant Cytogenetics. CRC Press, London, UK.
4. Swanson, C. P., T. Merz and W. J. Young. 1981. Cytogenetics. 2nd ed. Prentice Hall international Inc., Englewood Cliff, New Jersey, USA.

PBG 724	<b>Hybrid Seed Production</b>	3(2-1)
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### **Theory**

Background and basic requisites for hybrid seed production. Development and maintenance of parental lines (A, B and R lines). Estimation of general and specific combining ability. Production technology for hybrid seed in field crops and vegetables. Isolation, planting ratios and synchronization of male and female parents. Commercial use of hybrid vigor. Field standards, genetic purity, harvesting and handling of hybrid seed. Economic aspects of hybrid seed production.

### **Practical**

Development of inbred lines. Estimation of GCA and SCA. Selection and maintenance of A, B and R lines under field conditions. Use of gametocides, induction of male sterility and evaluation of hybrids.

### **Books Recommended**

1. Sleper D.A. and J. M. Poehlman. 2006. Breeding Field Crops. Blackwell Publishers, Iowa Sate University Press, Ames, USA.
2. Singal, W.C. 2004. Hybrid Seed Production. Kalyani Publishers, New Delhi, India.



3. Basra, A. S. 2000. Hybrid Seed Production in Vegetables: Rationale and Methods in selected crops. Food Product Press. New York, USA.
4. Feistritzer, W.P. and A.F. Kelly (eds.) 1987. Hybrid Seed Production of Selected Cereal, Oil and Vegetable Crops. FAO Plant Production and Protection Paper 82, FAO, Rome, Italy.

PBG 725	<b>Biometrical Techniques in Plant Breeding</b>	3(2-1)
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### **Theory**

Importance of biometry in plant improvement. Selection indices; Diallel cross system. Genetic analysis of additive-dominance model, adequacy tests, limitations and assumptions for additive-dominance model, combining ability analysis, line x tester analysis and generation mean analysis; Regression and correlation analysis; Genotypic and phenotypic correlation analysis; Path coefficient analysis. Multivariate analysis. Principal Component Analysis.

### **Practical**

Numerical examples regarding genetic analysis. Assessment of genotypic and phenotypic correlations, and partitioning of genotypic correlation into direct and indirect path ways. Use of software for biometrical analysis.

### **Books Recommended**

1. Singh, R.K. and B.D. Chaudhary. 2004. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi, India.
2. Mead, R., R.N. Curnow and A.M. Hasted. 2003. Statistical Methods in Agriculture and Experimental Biology. Chapman and Hall, London, UK.
3. Townend, J. 2002. Practical Statistics for Environmental and Biological Statistics. John Wiley, New York, USA.
4. Becker, W.L. 1993. Manual of Quantitative Genetics. Washington State University Press, Pullman, Washington, USA.

**DETAILS OF COMPULSORY COURSES  
COMPULSORY COURSES IN ENGLISH FOR  
Undergraduate Level**

**English I (Functional English)**

**Credit Hrs. 3**

**Objectives:** Enhance language skills and develop critical thinking.

**Course Contents**

Basics of Grammar  
Parts of speech and use of articles  
Sentence structure, active and passive voice  
Practice in unified sentence  
Analysis of phrase, clause and sentence structure  
Transitive and intransitive verbs  
Punctuation and spelling

**Comprehension**

Answers to questions on a given text

**Discussion**

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

**Listening**

To be improved by showing documentaries/films carefully selected by subject teachers

**Translation skills**

**Urdu to English**

**Paragraph writing**

Topics to be chosen at the discretion of the teacher

**Presentation skills**

Introduction

*Note: Extensive reading is required for vocabulary building*

**Recommended books:**

1. **Functional English**
  - a) Grammar
    1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
    2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

- b) Writing
  - 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- c) Reading/Comprehension
  - 1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- d) Speaking

**Objectives:** Enable the students to meet their real life communication needs.

**Course Contents****Paragraph writing**

Practice in writing a good, unified and coherent paragraph

**Essay writing**

Introduction

**CV and job application**

Translation skills

Urdu to English

**Study skills**

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

**Academic skills**

Letter/memo writing, minutes of meetings, use of library and internet

**Presentation skills**

Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*

**Recommended books:****Communication Skills**

## a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

## b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

## c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard Yorky.

# English III (Technical Writing and Presentation Skills)

Credit Hrh. 3

**Objectives:** Enhance language skills and develop critical thinking

## Course Contents

### Presentation skills

### Essay writing

Descriptive, narrative, discursive, argumentative

### Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

### Technical Report writing

### Progress report writing

*Note: Extensive reading is required for vocabulary building*

## Recommended books:

### Technical Writing and Presentation Skills

#### a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4<sup>th</sup> edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

#### b) Presentation Skills

#### c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

## **ISLAMIC STUDIES (Compulsory)**

### **Objectives:**

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

### **Detail of Courses**

#### **Introduction to Quranic Studies**

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

#### **Study of Selected Text of Holly Quran**

- 1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

#### **Study of Selected Text of Holly Quran**

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

#### **Seerat of Holy Prophet (S.A.W) I**

- 1) Life of Muhammad Bin Abdullah ( Before Prophet Hood)
- 2) Life of Holy Prophet (S.A.W) in Makkah
- 3) Important Lessons Derived from the life of Holy Prophet in Makkah

#### **Seerat of Holy Prophet (S.A.W) II**

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina

- 3) Important Lessons Derived from the life of Holy Prophet in Madina

## **Introduction To Sunnah**

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith
- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

## **Selected Study from Text of Hadith**

### **Introduction To Islamic Law & Jurisprudence**

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

### **Islamic Culture & Civilization**

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

### **Islam & Science**

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quranic & Science

### **Islamic Economic System**

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

### **Political System of Islam**

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

### **Islamic History**

- 1) Period of Khlaft-E-Rashida
- 2) Period of Umayyads
- 3) Period of Abbasids

### **Social System of Islam**

- 1) Basic Concepts of Social System of Islam

- 2) Elements of Family
- 3) Ethical Values of Islam

### **Reference Books:**

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, 'Introduction to Islam
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)



## Pakistan Studies (Compulsory)

### Introduction/Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

### Course Outline

#### 1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
  - i. Indus Civilization
  - ii. Muslim advent
  - iii. Location and geo-physical features.

#### 2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

#### 3. Contemporary Pakistan

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

### Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.

5. Wilcox, Wayne. *The Emergence of Bangladesh.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

COMPULSORY MATHEMATICS  
COURSES FOR B.Sc (Hons) AGRICULTURE

### 1. MATHEMATICS I (ALGEBRA)

**Prerequisite(s):** Mathematics at secondary level

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

#### **Course Outline:**

*Preliminaries:* Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

*Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

*Quadratic Equations:* Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

*Sequences and Series:* Arithmetic progression, geometric progression, harmonic progression.

*Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices.

*Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

#### **Recommended Books:**

Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

##### **Boston (suggested text)**

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

## 2. MATHEMATICS II (CALCULUS)

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

### **Course Outline:**

*Preliminaries:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

*Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

*Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

*Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

### **Recommended Books:**

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8<sup>th</sup> edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3<sup>rd</sup> edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11<sup>th</sup> edition), 2005, Addison-Wesley, Reading, Ma, USA

## 3. MATHEMATICS III (GEOMETRY)

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

### **Course Outline:**

*Geometry in Two Dimensions:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

*Circle:* Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

*Conic Sections:* Parabola, ellipse, hyperbola, the general-second-degree equation

### **Recommended Books:**

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

### **Note:**

- 1. Two courses will be selected from the following three courses of Mathematics.**
- 2. Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.**

**Statistics-I**

**Credit 3 (2-1)**

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

**Practicals**

- a. Frequency Distribution
- b. Stem-and-Leaf diagram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kurtosis

**Book Recommended**

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2<sup>nd</sup> Ed. (1986) Fran II. Dietrich-II and Thomas J. Keans

## Statistics-II

**Credit 3 (2-1)**

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Inference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using  $\chi^2$  (chi-square) Testing hypothesis about variance.

### Practicals

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

### Book Recommended

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-meterial approach, 2<sup>nd</sup> Edition, 1980 by R.G.D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2<sup>nd</sup> Edition (1980) by K.A. Gomez and A.A. Gomez

**Note:** *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*

Course Name: **Introduction to Information and Communication Technologies**

**Course Structure:** Lectures: 2 Labs: 1 **Credit Hours: 3**

**Pre-requisite: None** **Semester: 1**

**Course Description:**

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

**Course Contents:**

- : Basic Definitions & Concepts
- : Hardware: Computer Systems & Components
- : Storage Devices, Number Systems
- : Software: Operating Systems, Programming and Application Software
- : Introduction to Programming, Databases and Information Systems
- : Networks
- : Data Communication
- : The Internet, Browsers and Search Engines
- : The Internet: Email, Collaborative Computing and Social Networking
- : The Internet: E-Commerce
- : IT Security and other issues
- : Project Week
- : Review Week

**Text Books/Reference Books:**

Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)

Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition (McGraw HILL)

Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer



Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon  
Press.

# Functional Biology-I

**Credit Hours 3+0**

## **Biological Methods**

Principles of Cellular Life

Chemical Basis

Structure and Function

Principles of Metabolism

Energy Acquisition

## Principles of Inheritance

Mitosis and Meiosis

Chromosomes

Observable Inheritance Patterns

DNA Structure and Function

RNA and Proteins

Genes

Genetic Engineering and Biotechnology

## Biodiversity

Fundamental Concept of Biodiversity

One or two examples of each of the following from commonly found organism

Prions

Viruses

Bacteria

Protistans

Algae

Fungi

Plants

Crops

Animals

Invertebrates

Vertebrates

## **Reading**

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

# Functional Biology-II

**Credit Hours 3+0**

Myths and Realities of Evolution

Microevolution

Speciation

Macroevolution

Level of Organization

Plants

Tissues

Nutrition and Transport

Reproduction

Growth and Development

Animals

Tissue, Organ System and Homeostasis

Information Flow and Neuron

Nervous System

Circulation and Immunity

Nutrition and Respiration

Reproduction and Development

Ecology and Behavior

Ecosystems

Biosphere

Social Interactions

Community Interactions

Human Impact on Biosphere

Environment Conservation

## ***Reading***

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

***Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.***

## RECOMMENDATIONS

1. In under-graduate scheme of studies, PBG-501, PBG-503, PBG-505, PBG-508, PBG 607 and PBG-609 were declared as core courses for students majoring in Plant Breeding and Genetics which will be taught at all agricultural universities and colleges. However, other courses on different crops may be changed according to regional specific agricultural requirements.
2. All agricultural universities and colleges have adopted semester system except the Faculty of Agriculture, Gomal University, D.I. Khan and Balochistan Agricultural College, Quetta. The Committee showed serious concern about this matter and again recommended them for the adoption of semester system as was recommended during the meeting of the NCRC held 2005 at HEC/UGC Regional Center, Karachi.
3. Representatives of Agriculture College, Quetta proclaimed about the deficiency of course related books, laboratory facilities and teaching faculty. They were advised to take the advantage of the projects launched by HEC. The information and details of these projects are available on HEC website ([www.hec.gov.pk](http://www.hec.gov.pk))
4. At post-graduate level, all the universities and colleges have been following the scheme of studies approved by the HEC with minor differences due to site/regional requirements. The committee discussed the course contents in detail and made improvements wherever necessary.
5. The courses PBG-701, PBG-702 and PBG-703 were decided as core courses in the scheme of studies of Plant Breeding and Genetics at post-graduate level and these courses will be taught in every agricultural university/college of the country.
6. Members of the committee showed concern about the change in the nomenclature of the degree being offered by Faculty of Agriculture Rawalakot, University of AJK. Muzaffarabad. The members after thorough discussion recommended that uniformity in nomenclature of the degree must be ensured and maintained.
7. Exchange of softwares between universities was recommended for strengthening collaboration and interaction among universities.
8. Workshop sponsored by HEC/Training of Trainers were strongly recommended to ensure regular updating of young teaching faculty about new developments in their area of expertise.
9. Visit to Institutes to National Research Institutes (NIFA/NIAB/CEMB) were emphasized so that Plant Breeding students are kept abreast of newly emerging techniques in plant Breeding and Genetics.