



जननायक चन्द्रशेखर विश्वविद्यालय, बलिया-277001 (उ.प्र.)
Jananayak Chandrashekhar University, Ballia-277001 (U. P.)



FACULTY OF AGRICULTURE

Course structure and Syllabus

Ph.D. Course work system

GENETICS AND PLANT BREEDING
UNDER SEMESTER SYSTEM TO COME INTO FORCE FROM
ACADEMIC SESSION -2018-19



Ph.D. (Doctor of Philosophy)

GENETICS AND PLANT BREEDING
FACULTY OF AGRICULRE
SEMESTER SYSTEM

FACULTY OF AGRICULTURE

SEMESTER SYSTEM

Ph.D. course work and Syllabus for GENETICS AND PLANT BREEDING

In the area of Genetics & Plant Breeding an effort has been made to retain relevant core concepts and principles of Plant Breeding & Genetics as such. However, new topics and also new courses have been added to infuse new blood in the area.

- All the courses have been designed/redesigned/updated as per present and future needs.
- New courses have been introduced to keep pace with the latest developments.
- In order to help the students, Course objectives and Suggested readings have also been provided for each course.
- List of Journals has been provided to keep pace with latest developments in the area.
- Suggested Areas of Research have also been added for providing directions to future researches in the area

This programme also requires proper infrastructure, trained teachers, and Computers with internet connections. Industrial linkages, guest lectures, industry and farm visits will also be required to provide real life exposure.

Ph.D. Genetics and Plant Breeding

COURSE WORK SYSTEM FOR SIX-MONTH PRE-REGISTRATION COURSE WORK OF Ph.D. PROGRAMMES

COURSE STRUCTURE –

SYLLABUS/Ph.D. COURSE WORK

- | | |
|-------------------------------------------------------------------------------|--------------|
| 1. PAPER-P101- RESEARCH METHODOLOGY AND COMPUTER APPLICATION | M.M.-100 |
| 2. PAPER-P102- ADVANCED BIOMETRICAL AND QUANTITATIVE GENETICS | M.M.-100 |
| 3. PAPER-P103- ADVANCES IN PLANT BREEDING SYSTEMS AND BREEDING DESIGNER CROPS | M.M.-100 |
| 4. SYNOPSIS SEMINAR | Satisfactory |
| 5. COURSE SEMINAR | Satisfactory |
| 6. THESIS PRE SUBMISSION SEMINAR | Satisfactory |
| 7. THESIS (DOCTORAL RESEARCH WORK) | Satisfactory |

PROPOSED REGULATIONS

Semesters/Papers SEMESTER I	Title of the papers	Theory	
		Max. Marks	Min. Marks
Paper P101	(Theory Paper)	100	40
Paper P102	(Theory Paper)	100	40
Paper P103	(Theory Paper)	100	40
Total aggregate of First Semester will be 50 %		Max. Marks – 300 Min. Marks – 150	
SYNOPSIS SEMINAR		Satisfactory	
COURSE SEMINAR		Satisfactory	
THESIS PRE-SUBMISSION SEMINAR		Satisfactory	
THESIS (DOCTORAL RESEARCH WORK)		Satisfactory	
THESIS VIVA-VOCE		Satisfactory	

Note-

1. The research work may be initiated as per Ph.D. ordinance.
2. The evaluation of seminar presentation, written and oral comprehensive examination shall be done by the departmental committee which shall be constituted by the Head of Department /Principal of College.
3. The minimum passing marks of every paper will be 40 % in theory and total aggregate of the semester will be 50 % minimum.

PAPER-P101--RESEARCH METHODOLOGY AND COMPUTER APPLICATION**M.M.100****(Common course for all the discipline of Agriculture faculty)****UNIT I**

Importance and scope of research in agricultural. Introduction to Research Methodology: Meaning and objective of Research, Motivations in Research, Types, approaches and significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research. Defining the Research Problem: What is Research Problem?, Selecting the Problem, Necessity of and Techniques in defining the problem

UNIT II

Methods of Data Collection: Collection of Data through questionnaire and Schedules, Collection of Secondary Data, Selection of appropriate method for data collection questionnaire, successful interviewing. Survey v/s experiment. Classification and tabulation of data. Diagrammatic and Graphical representations of research results. Correlation, rank correlation, Regression analysis, partial and multiple correlation and regression, linear and nonlinear relationship. Analysis of variance, soil heterogeneity-choosing. Sampling distributions of sample mean and sample variance from Normal population, chi-Square, *t* and *F*, *Z* distributions and their properties and inter relationships.

UNIT III

Analysis of variance; Basic principles of design of experiments, size and shape of plots and blocks. Basic designs-completely randomized design, randomized complete block design and Latin square design. Factorial experiments, confounding. Split plot and Strip plot design; sampling in field experiments.

UNIT IV

Computer: fundamental, programming language, data representation, application. Systems concepts -definitions, general characteristics; general systems theory; systems thinking, systems dynamics, systems behavior and systems study.

UNIT V

Scientific Communications. Importance of publishing research papers, Publishing Research paper: (a) Preliminaries, Format, Choosing Journal, (b) Title, Running Title (c) Authors: Single and Multi authorship (d) Writing Abstract (e) Introduction section (f) Materials and Methods Section (g) Results and discussion (h) Figures: Design Principles, Legends, Table components, Graphs: Types, Style, Tables v/s Graph (i) Acknowledgements (j) References: Different Styles (k) Selecting Keywords (l) Communication with the Editor, Handling Referees' Comments, Galey Proofs 5. Writing Review Articles 6. Preparing and Delivering of Oral and Poster Presentations 7. Avoiding Plagiarism 8. Preparing documents for MoUs, Confidentiality Agreements. 9. Standard Abbreviations and Symbols

Suggested Readings

1. Agresti A. 2002. *Categorical Data Analysis*. 2nd Ed. John Wiley.
2. Arnold BC, Balakrishnan N & Nagaraja HN. 1992. *A First Course in Order Statistics*. John Wiley.
3. Huber PJ. 1981. *Robust Statistics*. John Wiley.
4. Johnson NL, Kotz S & Balakrishnan N. 2000. *Continuous Univariate Distributions*. John Wiley.
5. Marek F. 1963. *Probability Theory and Mathematical Statistics*. John Wiley.
6. Rohatgi VK & Saleh AK Md. E. 2005. *An Introduction to Probability and Statistics*. 2nd Ed. John Wiley.
7. Chakrabarti MC. 1962. *Mathematics of Design and Analysis of Experiments*. Asia Publ. House.
8. Cochran WG & Cox DR. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
9. Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
10. Dey A & Mukerjee R. 1999. *Fractional Factorial Plans*. John Wiley.
11. John JA & Quenouille MH. 1977. *Experiments: Design and Analysis*. Charles & Griffin.
12. Kempthorne, O. 1976. *Design and Analysis of Experiments*. John Wiley.
13. Khuri AI & Cornell JA. 1996. *Response Surface Designs and Analysis*. 2nd Ed. Marcel Dekker.
14. Montgomery DC. 2005. *Design and Analysis of Experiments*. John Wiley.
15. Raghavarao D. 1971. *Construction and Combinatorial Problems in Design of Experiments*. John Wiley.
16. Design Resources Server. *Indian Agricultural Statistics Research Institute (ICAR), New Delhi-110012, India*. www.iasri.res.in/design.
17. Gomez, K.A. and Gomez, A.A. (1984) *Statistical Procedure for Agricultural Research*, John Wiley and Sons
18. Panse, V.G. and Sukhatme, P.V. (1985) *Statistical Methods for Agricultural Workers*, ICAR Pub.

PAPER-P102--ADVANCED BIOMETRICAL AND QUANTITATIVE GENETICS
M.M.100

UNIT I

Basic principles of Biometrical Genetics; Selection of parents; Advanced biometrical models for combining ability analysis; Simultaneous selection models; Use of Multiple regression analysis in selection of genotypes; Designs and Systems; Selection of stable genotypes.

UNIT II

Models in stability analysis - Pattern analysis - Additive Main Effect and Multiplicative Interaction (AMMI) analysis and other related models; Principal Component Analysis.

UNIT III

Additive and multiplicative model - Shifted multiplicative model; Analysis and selection of genotypes; Methods and steps to select the best model - Biplots and mapping genotypes.

UNIT IV

Genetic architecture of quantitative traits; Conventional analyses to detect gene actions- Partitioning of phenotypic/genotypic variance – Construction of saturated linkage maps, concept of framework map development; QTL mapping- Strategies for QTL mapping- desired populations, statistical methods; Marker Assisted Selection (MAS) - Approaches to apply MAS in Plant breeding - selection based on markers - simultaneous selection based on marker and phenotype - Factors influencing MAS; Heritability of the trait, proportion of genetic variance, linkage disequilibrium between markers and traits and selection methods.

Suggested Readings

1. Bos I & P Caligari. 1995. *Selection Methods in Plant Breeding*. Chapman & Hall.
2. Falconer DS & Mackay J. 1996. *Introduction to Quantitative Genetics*. Longman.
3. Mather K & Jinks L. 1983. *Introduction to Biometrical Genetics*. Chapman & Hall.
4. Nadarajan N & Gunasekaran M. 2005. *Quantitative Genetics and Biometrical Techniques in Plant Breeding*. Kalyani.
5. Singh P & Narayanan SS. 1993. *Biometrical Techniques in Plant Breeding*. Kalyani.
6. Singh RK & Choudhary BD. 1987. *Biometrical Methods in Quantitative Genetics*. Kalyani.
7. Weir DS. 1990. *Genetic Data Analysis. Methods for Discrete Population Genetic Data*. Sinauer Associates.
8. Wricke G & Weber WE. 1986. *Quantitative Genetics and Selection in Plant Breeding*. Walter de Gruyter.
9. Singh R k .Biometrical Genetics.Kalyani Publication

PAPER- P103--ADVANCES IN PLANT BREEDING SYSTEMS AND BREEDING DESIGNER CROPS
MM:100

UNIT I

Thrust area of Research, Scope, Application and current and future prospect of research.

Facts about plant breeding before the discovery of Mendelism; Evolutionary concepts of genetics and plant breeding - Flower development and its importance; genes governing the whorls formation and various models proposed; Mating systems and their exploitation in crop breeding; Types of pollination, mechanisms promoting cross pollination.

UNIT II

Breeding of crop ideotypes; Genetic manipulations through recombination breeding, genomics and transgenics for physiological efficiency, nutritional enhancement, special compounds-proteins, vaccines, gums, starch and fats.

UNIT III

Designer crops. Breeding for special traits viz. oil, protein, vitamins, amino acids etc.; Concept of biopharming and development of varieties producing targeted compounds, nutraceuticals and industrial products;

UNIT IV

Intellectual property right (IPR), Plant Genetic Resources (PGR) .Breeding of crop ideotypes; Genetic manipulations through recombination breeding, genomics and transgenics for physiological efficiency, nutritional enhancement etc.

UNIT V

Genetically modified crops (Bt cotton, Golden rice, Flavr savr, Bt. maize etc.). Biosafety management, molecular markers

Suggested Readings

1. Agarwal RL. 1996. *Fundamentals of Plant Breeding and Hybrid Seed Production*. Oxford & IBH.
2. Allard RW. 1966. *Principles of Plant Breeding*. John Wiley & Sons.
3. Briggs FN & Knowles PF. 1967. *Introduction to Plant Breeding*. Reinhold.
4. Fehr WR. 1987. *Principles of Cultivar Development: Theory and Technique*. Vol I. Macmillan.
5. Hayes HK, Immer FR & Smith DC. 1955. *Methods of Plant Breeding*. McGraw-Hill.
6. Mandal AK, Ganguli PK & Banerji SP. 1995. *Advances in Plant Breeding*. Vol. I, II. CBS.
7. Richards AJ. 1986. *Plant Breeding Systems*. George Allen & Unwin.
8. Sharma JR. 1994. *Principles and Practice of Plant Breeding*. Tata McGraw-Hill.
9. Simmonds NW. 1979. *Principles of Crop Improvement*. Longman.
10. Singh BD. 1997. *Plant Breeding: Principles and Methods*. 5th Ed., Kalyani. Singh P. 1996. *Essentials of Plant Breeding*. Kalyani.
11. Welsh JR. 1981. *Fundamentals of Plant Genetic and Breeding*. John Wiley.
12. Williams W. 1964. *Genetical Principles and Plant Breeding*.
13. Blackwell. Balint A. 1984. *Physiological Genetics of Agricultural Crops*. AK Ademiaikiado.
14. Hay RK. 2006. *Physiology of Crop Yield*. 2nd Ed. Blackwell.
15. Pessaraki, M. 1995. *Handbook of Plant and Crop Physiology*. Marcel Dekker. Taiz L & Zeiger E. 2006. *Plant Physiology*. 4th Ed. Sinauer Associates.

List of Journals

- Australian Journal of Biological Sciences, Australia
- Australian Journal of Agricultural Research, Australia
- Biometrics, UK
- BioTechniques
- Cereal Research Communication, Hungary
- Cotton Research and Development, Hisar, India
- Crop Improvement, Ludhiana
- Crop Science, USA
- Current Science, Bangalore
- Critical Reviews in Plant Sciences
- Czech Journal of Plant Breeding Genetics, Prague,
- Electronic Journal of Biotechnology
- Euphytica, The Netherlands
- FABIS Newsletter
- Forage Research, Hisar, India
- Genetics, USA
- Genome, Canada
- Genetic resources and crop evolution, Netherlands
- Haryana Agricultural University Journal of Research, Hisar, India
- Heredity
- Hilgardia, Sweden,
- Indian Journal of Agricultural Research, New Delhi
- Indian Journal of Genetics and Plant Breeding, New Delhi
- Indian Journal of Plant Genetic Resources, New Delhi
- International Chickpea, Newsletter, ICRISAT
- International Rice Research Notes, IRRI, Philippines
- Journal of Agricultural Research, U.K.
- Journal of Biochemistry and Biotechnology, New Delhi
- Journal of Genetics and Breeding, Italy
- Journal of Heredity
- Journal of Pulses Research, Kanpur
- Legume Research, Karnal
- MILWAI Newsletter
- Madras Agricultural Journal, Coimbatore, India
- Molecular Breeding, USA
- Mutation Research
- National Journal of Plant Sciences, Hisar, India
- Nucleic Acids Research, USA
- Oryza, Cuttack, India
- PGR Newsletter, Syria
- Plant Breeding, Germany
- Plant Molecular Biology, The Netherlands
- Rachis, Syria
- Sorghum and Millet Newsletter, ICRISAT
- Theoretical and Applied Genetics, Germany
- Wheat Research, Japan

e-Resources

Name of the Journal URL

Agronomy Research <http://www.eau.ee/~agronomy/>

Asian Journal of Plant Sciences <http://ansijournals.com/3/c4p.php?id=1&theme=3&jid=ajps>

Breeding Science <http://www.jstage.jst.go.jp/browse/jsbbs>

Current Science <http://www.ias.ac.in/currsci/index.html>

International Journal of Botany <http://ansijournals.com/3/c4p.php?id=1&theme=3&jid=ijb>
 International Journal of Sociology
 of Agriculture and Food <http://www.csafe.org.nz/ij saf/>
 Japan Agricultural Research
 Quarterly
<http://ss.jircas.affrc.go.jp/english/publication/jarq/index.htm>
 Japanese Journal of Crop Sc. <http://www.jstage.jst.go.jp/browse/jcs>
 Journal of Agronomy <http://ansijournals.com/3/c4p.php?id=1&theme=3&jid=ja>
 Journal of Biosciences <http://www.ias.ac.in/jbiosci/index.html>
 Journal of Cotton Science <http://www.cotton.org/journal/>
 Journal of Genetics <http://www.ias.ac.in/jgenet/index.html>
 Plant Biotechnology <http://www.jstage.jst.go.jp/browse/plantbiotechnology>
 Plant Production Science <http://www.jstage.jst.go.jp/browse/pps>
 Scientia Agraria <http://calvados.c3sl.ufpr.br/ojs2/index.php/agraria>
 Tropicultura <http://www.bib.fsagx.ac.be/tropicultura/>
 Turkish Journal of Agriculture and
 Forestry Sciences <http://journals.tubitak.gov.tr/agriculture/index.php>

Other Major Portals for Genetics and Plant Breeding

<http://www.icrisat.org/>
<http://121.244.161.11/Search/QuickSearch.asp>
<http://www.plantstress.com/WRFiles/literaturewr.htm> (portal for several sites)
http://www2.unil.ch/lpc/docs/index_plants.htm (portal for several sites)
<http://www.dnaftb.org/dnaftb/> (portal for several sites)

Suggested Broad Areas for Doctoral Research

1. Studies on introgressions, gene transfers, gene identification, location and
2. localization with the application of technologies such as, *in situ* hybridization,
3. chromosome identification like FISH (Fluorescent *In Situ* Hybridization), GISH
4. (Genomic *In Situ* Hybridization), Spectral Karyotyping (SKY) and Multiplex
5. Fluorescence *In Situ* Hybridization (M-FISH) etc.
6. Studies on stay-green traits in relation to genes affecting efficiency of
7. photosynthesis, biotic/abiotic stress tolerance
8. Genetics of AGP system for better photosynthesis and translocation
9. Identification of genes/QTLs for NUE and WUE
10. Molecular markers tagged to genes/QTLs identified for improvement of nutrient
11. use efficiency, water use efficiency
12. MAS based mobilization of transgenes for tolerance to biotic and abiotic stresses
13. into desirable agronomic backgrounds
14. Breeding methodologies to enhance selection efficiency
15. Component approaches and development of selection criteria for quantitative trait
16. improvement
17. Stability analyses and methods to estimate the G X E components in breeding
18. materials
19. Relative efficiency analyses of genetic component estimation for reliable use in
20. developing selection criteria in crop plants
21. Distance and divergence statistics for identification of similarity assessment among
22. genetic stocks and parental genetic material
23. Linear and quadratic distance measures to identify relative contribution of
24. component traits for complex traits
25. Studies on genetic and molecular bases of stress tolerance to develop molecular
26. diagnostics for screening/identification of stress tolerant genotypes

27. Use of aneuploids for gene location and source for transfer through wild species
28. Development and trisomic and monosomic series in diploids and polyploids
29. Dependable marker systems for detection of introgression in wide crosses with
30. minimized linkage drag
31. Analysis of Resistance Gene analogues and their use in MAS with enhanced
32. disease resistance
33. Analysis of Gene analogues and expression synteny and their use in MAS with
34. enhanced quality and trait expression
35. Refinements in embryo rescue and consequent diploidization for production of
36. double haploids
37. Use of molecular markers in phylogenetic analysis
38. Breeding through distant hybridization route for New Plant Type for breaking yield
39. barriers
40. Genetics of durable, quantitative resistance and adult plant resistance in major
41. crops against known pathogens
42. Development of tools and methodologies for identification of genes responsible for
43. resistance against polyphagous insects
44. Development of alien addition lines and telocentric lines in crops
45. Microarray technique and robotics for identification of useful genes in crops
46. Characterization of germplasm through molecular and serological techniques
47. Induction of novel variation through mutagenesis tools and identify novel genes for
48. different traits
49. Development of heterotic pools for maximized heterosis in cross and self pollinated
50. crops where hybrid seed production tools are available
51. Genetics and traits responsible for terminal and initial heat tolerance in wheat,
52. maize and mustard
53. Genetics of cold tolerance related traits in maize, rice and pigeonpea
54. Widening the QPM base in maize and prebreeding to add value to the genetic
55. stocks of QPM
56. Comparison of relative efficiency of different softwares in analysis of quantitative
57. trait loci and linkages
58. Biochemical and molecular bases of signal transduction in host-pathogen
59. interactions
60. Metal binding proteins for identification of phytoremediators
61. Crop improvement for biomass energy and industrial use
62. Development of cytogenetic stocks through varietal/alien chromosome