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

ACADEMIC SESSION -2019-20

Ph.D. (Doctor of Philosophy)

GENETICS AND PLANT BREEDING

FACULTY OF AGRICULRE

SEMESTER SYSTEM

FACULTY OF AGRICULRE

SEMESTER SYSTEM

Ph.D. course work and Syllabusfor

GENETICS AND PLANT BREEDING

In the area of Genetics &Plant Breeding an effort has been made to retainrelevant 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 andfuture needs.
• New courses have been introduced to keep pace with the latest developments.
• In order to help the students, Course objectives and Suggested readings havealso been provided for each course.
• List of Journals has been provided to keep pace with latest developments inthe area.
• Suggested Areas of Research have also been added for providing directions tofuture researches in the area

This programme also requires proper infrastructure, trained teachers, and
Computers with internet connections. Industrial linkages, guest lectures, industry andfarm 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-1:RESEARCH METHODOLOGY AND COMPUTER APPLICATION 4 credit, M.M.-100
2. PAPER-2: RESEARCH AND PUBLICATION ETHICS Credits-2, M.M.-100
3. PAPER-3:ADVANCED BIOMETRICAL AND QUANTITATIVE GENETICS 4 credit, M.M.-100
4. PAPER-4 :ADVANCES IN PLANT BREEDING SYSTEMS AND BREEDING DESIGNER CROPS 4credit,M.M.-100
5. SYNOPSIS SEMINAR Satisfactory
6. ORAL COMPREHENSIVE Satisfactory
7. COURSE SEMINAR Satisfactory
8. THESIS PRE SUBMISSION SEMINAR Satisfactory

9. THESIS (DOCTORAL RESEARCH WORK) Satisfactory
10. THESIS VIVA-VOCE Satisfactory

PROPOSED REGULATIONS

Semesters/Papers	Title of the papers	**Theory**

PROPOSED REGULATIONS

Semesters/Papers **SEMESTER I**	Title of the papers	**Theory**	
		Credit/Max. Marks	Min. Marks
Paper P1	(Theory/Practical Paper)	4/100	40
Paper P2	(Theory/Practical Paper)	4/100	40
Paper P3	(Theory/Practical Paper)	4/100	40
Paper P4	(Theory/Practical Paper)	2/100	40

Total aggregate of First Semester will be50 %	Max. Marks – 400 Min.Marks – 200
SYNOPSIS SEMINAR	Satisfactory
COURSE SEMINAR	Satisfactory
Oral Comprehensive	
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 be40 % in theory and total aggregate of the semester will be50 % minimum.

PAPER-I--RESEARCH METHODOLOGY AND COMPUTER APPLICATION
4 Credits, M.M.100

PAPER-II: RESEARCH AND PUBLICATION ETHICS CREDITS-2, M.M.-100
(Common Syllabus)

PAPER-III--ADVANCED BIOMETRICAL AND QUANTITATIVE GENETICS
Credit 4, M.M.:100

UNIT I

Basic principles of Biometrical Genetics; Selection of parents; Advancedbiometrical models for combining ability analysis; Simultaneous selectionmodels; 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 andMultiplicative Interaction (AMMI) analysis and other related models;Principal Component Analysis.

UNIT III

Additive and multiplicative model - Shifted multiplicative model; Analysisand 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 detectgene actions-Partitioning of phenotypic/genotypic variance – Constructionof saturated linkage maps, concept of framework map development; QTLmapping- Strategies for QTL mapping- desired populations, statisticalmethods; Marker Assisted Selection (MAS) - Approaches to apply MAS inPlant breeding - selection based on markers - simultaneous selection based on marker and phenotype - Factors influencing MAS; Heritability of thetrait, proportion of genetic variance, linkage disequilibrium betweenmarkers 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 andBiometrical 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 QuantitativeGenetics*. Kalyani.
7. Weir DS. 1990. *Genetic Data Analysis. Methods for Discrete PopulationGenetic Data*. Sinauer Associates.
8. Wricke G & Weber WE. 1986. *Quantitative Genetics and Selection inPlant Breeding*. Walter de Gruyter.
9. Singh R k .Biometrical Genetics.Kalyani Publication

PAPER- IV--ADVANCES IN PLANT BREEDING SYSTEMS AND BREEDING DESIGNER CROPS 4 credit, 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 developmentand its importance; genes governing the whorls formation and variousmodels 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 recombinationbreeding, genomics and transgenics for physiological efficiency, nutritionalenhancement, 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 rite (IPR), Plant Genetic Resources (PGR) .Breeding of crop ideotypes; Genetic manipulations through recombination breeding, genomics and transgenics for physiological efficiency, nutritional enhancement etc.Genetically modified crops (Bt cotton, Golden rice, Flavrsavr, Bt. maize etc.). Biosafety management, molecular markers

Suggested Readings

1. Agarwal RL. 1996. *Fundamentals of Plant Breeding and Hybrid SeedProduction*. 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 andTechnique*. 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*. TataMcGraw-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. Pessarakli, 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 BiologicalSciences, Australia
- Australian Journal of AgriculturalResearch, 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 BreedingGenetics, 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 Journalof Research, Hisar, India
• Heredity
• Hilgardia, Sweden,
• Indian Journal of Agricultural Research,New Delhi
• Indian Journal of Genetics and PlantBreeding, New Delhi
• Indian Journal of Plant GeneticResources, New Delhi
• International Chickpea, Newsletter, ICRISAT
• International Rice ResearchNotes, IRRI, Philippines
• Journal of AgriculturalResearch, U.K.
• Journal of Biochemistry andBiotechnology, New Delhi
• Journal of Genetics andBreeding, 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 PlantSciences, Hisar, India
• Nucleic Acids Research, USA
• Oryza, Cuttack, India
• PGR Newsletter, Syria
• Plant Breeding, Germany
• Plant Molecular Biology, TheNetherlands
• Rachis, Syria
• Sorghum and Millet Newsletter,ICRISAT
• Theoretical and AppliedGenetics, 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/ijsaf/
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
ScientiaAgraria 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. photosynthethesis, 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 methologies to enhance selection efficiency
15. Component approaches and development of selection criteria for quantitiative 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 diplodization 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 polyphagus 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