



Department of Genetics & Plant Breeding, Institute of Agricultural Science, Calcutta University

Admission to the Ph.D. program in the Department of Genetics & Plant Breeding.

1. 5 (Five) vacancies exist in the Department for admission to Ph.D. considering the strength and availability of faculty members. Reservation policy in admission will be followed as per the West Bengal State Higher Educational Institutions (Reservation in Admission) rules, 2013.
2. A Ph.D. entrance test followed by an interview (**Research Eligibility Test**) for Ph.D. programme in Genetics & Plant Breeding will be held on 4th November , 2025 at 1 p.m. and same day at 4 p.m. respectively.
3. The last date for submission of application 3rd , November, 2025.
4. The entrance test will be of 50 marks. The question pattern will be of objective type or short answer type. The Duration of the entrance test will be one hour. (the qualifying marks for Entrance Test will be 50%)
5. An interview will be held on 4th November , 2025 **at 4 p.m.** for entrance test qualified candidates as well as candidates having NET,/GATE. Successful candidates will be eligible to register for their Ph.D. in Department of Genetics & Plant Breeding .
6. **Eligibility:** Candidates for admission to the Ph.D. programme shall have a M. Sc. (Agriculture) in Genetics & Plant Breeding or allied disciplines subject to endorsed by the concerned Ph.D. Researched Advisory Board with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) are eligible to apply. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently-abled and other categories of candidates as per UGC Ph.D. Regulation . **Those who have qualified in NET/GATE would be exempted from the Ph.D. entrance test. They may directly submit a statement of purpose or research in brief and appear in the interview.**
7. Candidates should apply to the Head, Department of Genetics & Plant Breeding , in the proforma mentioned below by paying Rs. 100/- through a challan obtainable in the College Street cash counter and Law College Cash Counter of the University of Calcutta or through online by
 - i) click <https://www.onlinesbi.com/sbicollect/icollecthome.htm>
 - ii) Check box; Proceed
 - iii) State of corporate/ institution- West Bengal ; Type of corporate/institution- Educational institutions
 - iv) Educational institute name- **CALCUTTA UNIVERSITY ONLINE PAYMENT**
 - v) Select payment category- Entrance fees for PhD program law vi) Remarks- Entrance fees for RET – 2024 GENETICS & PLANT BREEDING
8. The application form for admission is available below.
9. Documents to be submitted along with the application form: One passport photo and Self attested copies of testimonials (from Madhyamik (X) onwards), proof of age and certificate supporting reserve category)

HEAD

Department of Genetics and Plant Breeding

SYLLABUS FOR THE RESEARCH ELIGIBILITY TEST FOR Ph.D. PROGRAMME IN THE DEPARTMENT OF GENETICS & PLANT BREEDING

Principles of Genetics:

Historical perspective on genetics, Mendelian principles; concept of factors and Characters; dominance and recessive, genotype and phenotype, segregation, independent assortment, dihybrid and trihybrid ratios; gene interaction and its expression, modified dihybrid ratios; Multiple allelism- test of allelism, pseudoalleles, cis-trans position effect, inheritance of blood group in man. Theory of probability and its application in genetics, chi-square and its application in general problems; linkage detection and estimation, construction of chromosome map, sex linkage and sex determination; Non-nuclear inheritance; Qualitative and quantitative traits, multiple factor inheritance.

Principles of Cytogenetics:

History of cytogenetics; components of cell and their function and significance; chromosome structure: Prokaryotes and eukaryotes, function and replication . Karyotype analysis, chromosome banding pattern and fine structure, different forms of chromosomes and their functional significance, lampbrush chromosome, polytene chromosomes, B chromosomes, sex chromosomes and artificial chromosomes. Cell division. Mitotic cell cycle; behaviour of chromosomes during meiosis and its significance, mechanisms and theories of crossing over, re-combination models, cytogenetical basis and role of synaptonemal complex, Pachytene analysis and its importance in cytogenetics. Structural variation in chromosomes: deletion, duplication, inversion, translocation and their cytogenetical consequences, Numerical variation in chromosomes; sources and consequences, euploidy and aneuploidy- classification, cytogenetics; evolutionary significance and use in basic and applied research; synthesis of natural and new polyploids; haplontic and diplontic barriers and means to overcome them. Elements of molecular cytogenetics.

Principle of Plant Breeding:

Introduction to plant breeding- history, objectives, achievements in the pre Mendelian era, post-Mendelian plant breeding- potential and opportunities. Modes of reproduction- sexual, asexual, apomixis, apospory, apogamy, parthenogenesis, polyembryony. Floral biology in relation to self and cross pollinated groups of plants, heterostyly, protandry, protogyny, genetic consequences of self and cross fertilization. Sterility and incompatibility system, natural crossing, genetics of self incompatibility. Methods of breeding self-pollinated, Cross pollinated and asexually propagated crops; Land races, pureline selection and mass selection; Pedigree selection, bulk method and its modification; Backcross method; clonal selection; population improvement procedures- recurrent selection, synthetic and composite varieties. General outline of heterosis, polyploidy and mutation breeding. Collection maintenance, release and registration of varieties.

Plant Genetic Resources:

Historical perspective; Speciation ,domestication,introduction,centres of origin and diversity of crop plants ; gene pool: primary, secondary and tertiary ; collection,characterization,evaluation and cataloguing PGR.Genetic diversity conservation, strategies and methodologies, in situ ,ex situ and on farm ; use of genetic diversity in crop improvement. Policies related to the management and use of genetic diversity: FAO International Undertaking of Plant Genetic Resources (IUPGR), Convention on Biological Diversity (CBD), International Union for the Protection of New varieties of plants (UPOV); Agreement on Trade –Related Aspects of Intellectual property Rights (TRIPS), Farmer's Right, Intellectual Property Rights (IPR), Plant Breeders Rights (PBR).Taxonomical classification of cultivated plants; study of economically important families of field / horticultural crops; modes of reproduction in crop plants – sexual, asexual, apomixis. Origin, Classification and economic importance of field / horticultural crops.

Methods of Plant Breeding:

Heterosis and genetic basis of heterosis; Prediction of heterosis; Hybrid breeding : hybrid in self and cross pollinated crops , development and evaluation of inbred lines and hybrids; production of hybrid seed – use of male sterility and its restoration mechanisms and genetic manipulation in hybrid breeding, apomixis in fixing heterosis ; Polyploidy breeding –induction of polyploidy and its utilization in plant improvement ,induced auto and allopolyploids ,alien substitution, origin of some polyploid crops, Mutation breeding: utilization of different types of mutagens, identification of mutants and their handling in breeding population. Distant hybridization: barriers in distant hybridization ,methods to overcome the barriers, embryo rescue, embryo culture ,Methods used for hybridization – protoplast fusion, advanced techniques in plant breeding - anther culture ,tissue culture ,somaclonal variation ;Breeding for biotic stresses – definition and history ,nature of resistance, methods of breeding for disease and insect resistance, scope and application ,multiline approach. Breeding for abiotic stress: general consideration, nature of temperature and moisture stresses Nutritional stresses, screening technique and breeding approaches; biometrical technique in crop improvement programme-genotype-environmental interaction, yield component analysis, combining ability analysis, selection indices and genetic divergence; molecular marker assisted selection (MAS):RAPD,RFLP,AFLP.

Improvement of field crops:

Eminent plant breeders and their achievements, breeding methods of cereals, pulses, oilseeds, fibre crops, forage crops, sugar crops, tea, potato and asexually propagated crops.

National and international institute for crop improvement.

Quantitative Genetics:

Quantitative inheritance: Historical background, qualitative and quantitative characters and quantitative inheritance; Probability laws, expectation, fixed and random effect models, probability distribution; Elementary concept of matrix theory and its use in estimating genetic parameters, estimation of components of gene action, single locus diallel models; Genetic components of continuous variation, additive, dominance and epistatic components of genetic variance, role of genotype and environment in continuous variation, heritability, genetic advance under selection, estimation of different hereditary parameters; Linkage, epistasis, components of epistasis and their estimation; Selection differential and response to selection correlated response, genotype $\times$ environment interaction and stability analysis, selection indices, divergence test.

Molecular Genetics:

Classical and modern concept of gene, DNA as hereditary material, transformation, transduction: chemistry and structure of DNA and RNA; genome organization- euchromatin and heterochromatin; DNA content variation, types of DNA sequences – unique and repetitive sequences VNTRs, minisatellite and microsatellites, DNA organization in Eukaryotic chromosomes; mechanism of DNA replications and recombinations in prokaryotes and eukaryotes; DNA sequencing, split genes, alternative splicing, trans-splicing, pseudo gene, overlapping genes, DNA amplification and rearrangement; transcription and its regulation mechanism in prokaryote and eukaryotes, enhancers, suppressors, transcription factors and their role, post transcriptional regulation, mRNA processing, SnRNAs ; regulation of protein synthesis in prokaryotes and eukaryotes, genetic code and translation factors, post translation modification, DNA damage and repair, gene regulation in prokaryotes and eukaryotes, operon concept, positive and negative control of gene regulation, attenuation, methylation; Structural and functional genomics; proteomics and protein- protein interaction; signal transduction, genes in development mechanisms and regulation of cell division. Biochemistry and molecular biology of cancer, genetic and metabolic disorder, genetic load and genetic counseling.

Genetic Engineering and Biotechnology:

Introduction of plant genetic engineering and biotechnology, gene identification, gene isolation, synthesis of genes and gene cloning, restriction enzyme and vectors, gene transfer system, vector mediated gene transfer, microinjection, electrophoration, direct DNA uptake, gene gun technique selectable markers and reporter systems.

Application of plant genetic engineering: transgenic crop, application of recombinant DNA technology, current status and future prospect; regulation mechanism for genetically modified crops; bio safety issues of transgenic crops. Molecular breeding- morphological, biochemical and DNA based markers (RFLP, RAPD, AFLP, SSLP etc); mapping populations (F₂, back crosses, RILs, NILs, and DHs); molecular mapping and tagging of agronomically important traits; QTL analysis, marker assisted selection for qualitative and quantitative traits.

HEAD

DEPARTMENT OF GENETICS & PLANT BREEDING

UNIVERSITY OF CALCUTTA



Application Form for the Admission Test of the Ph.D. Programme

Department / Centre .

Name (in block letters) :

Date of Birth :

Father's Name :

Marital Status :

Whether SC/ST/OBC/
Physically Challenged :

Nationality :

Address for Communication : :

Phone No. :

E-mail ID :

Academic Qualifications :

Name of the Examinations	Year	Board /University	Subjects taken	Div./Class	% of Marks

Whether qualified in NET/GATE/equivalent examination :

Signature of the applicant with date:

*Candidates are requested to deposit application fee of Rs.100/- either by cash or DD through duly filled in C.U. Challan, endorsed by the Head of the Department.

** Original documents may be asked for as and when required by the appropriate authority.