

ANIMAL GENETICS AND BREEDING

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
AGB 601*	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1	I
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1	II
AGB 603*	POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING	2+1	I
AGB 604*	SELECTION METHODS AND BREEDING SYSTEMS	3+1	II
AGB 605*	BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING	3+1	I
AGB 606	CONSERVATION OF ANIMAL GENETIC RESOURCES	2+0	I
AGB 607	CATTLE AND BUFFALO BREEDING	2+1	II
AGB 608	SMALL FARM ANIMAL BREEDING	2+0	II
AGB 609	POULTRY BREEDING	2+1	I
AGB 610	LABORATORY ANIMAL BREEDING	1+0	II
AGB 691	MASTER'S SEMINAR	1	I, II
AGB 699	MASTER'S RESEARCH	20	I, II
AGB 701	RECENT ADVANCES IN ANIMAL GENETICS	2+0	I
AGB 702	RECENT TRENDS IN ANIMAL BREEDING	2+0	II
AGB 703	ADVANCES IN BIOMETRICAL GENETICS	2+1	II
AGB704**	ADVANCES IN SELECTION METHODOLOGY	2+1	I
AGB 705	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0	I
AGB 706	ADVANCES IN MOLECULAR CYTOGENETICS	2+0	II
AGB707**	UTILIZATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1	I
AGB 791	DOCTORAL SEMINAR I	1	I, II
AGB 792	DOCTORAL SEMINAR II	1	I, II
AGB 799	DOCTORAL RESEARCH	45	I, II

*Compulsory for Master's programme; **Compulsory for Doctoral programme

ANIMAL GENETICS AND BREEDING

Course Contents

AGB 601	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1	SEM - I
Objective			
To educate about basic principles of cytogenetics and immunogenetics and their applications in improving farm animals.			
Theory			
<u>UNIT-I:</u> Development in animal cytogenetics and immunogenetics of farm animals. Immunoglobulins and their types: antigen-antibody interactions, Immune response, ELISA.			
<u>UNIT-II:</u> Major histocompatibility complex; genetics of biochemical variants and their applications; Ir-genes and concepts of disease resistance including major genes; hybridoma and its significance; concept of immuno-fertility, BoLA, BuLA, TLRs, Interleukins.			
<u>UNIT-III:</u> Chromatin structure of eukaryotes; chromosome number and morphology in farm animals banding and karyotyping; chromosomal and genetic syndromes, DNA packing in chromosomes, Z+B DNA, FISH chromosome painting and PRINS. RH Panel Mapping.			
<u>UNIT-IV:</u> Mutation and assays of mutagenesis; sister chromatid exchanges; recombinant DNA technique and its application in animal improvement programme.			
Practical			
Polymorphism of haemoglobulins, transferrins, enzymes/proteins; preparation of monovalent blood reagent-isoimmunization, titre testing and absorption of polyvalent serum; identification of bar bodies; in vitro and in vivo preparation of somatic metaphase chromosomes; screening of chromosomal abnormalities; microphotography and karyotyping; banding procedures for comparing the chromosomal complement, FISH and PRINS.			
Suggested Readings			
Hare WCD & Elizabeth L Singh 1999. <i>Cytogenetics in Animal Reproduction</i> . CABI.			
Roitt I. 1997. <i>Essential Immunology</i> . Blackwell.			
Stine GJ. 1989. <i>The New Human Genetics</i> . Wm C Brown Publ.			
Summer AT & Chandley AC. 1993. <i>Chromosome Today</i> . Chapman & Hall.			
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1	SEM - II
Objective			
To educate about molecular techniques to identify molecular markers as an aid to selection.			
Theory			
<u>UNIT-I:</u> Basic concept: Genesis and importance of molecular techniques; Genome organization – physical and genetic map, current status of genome maps of livestock.			
<u>UNIT-II:</u> Molecular markers and their application; RFLP, RAPD, Microsatellite/Minisatellite markers, SNP marker, DNA fingerprinting.			
<u>UNIT-III:</u> DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer.			
<u>UNIT-IV:</u> Statistical techniques for analyzing molecular genetic data, Quantitative Trait Loci (QTL) mapping and its application in animal breeding, Genome scan, Candidate gene approach, Genomic selection, Marker Assisted Selection- basic concept.			
Practical			
Extraction and purification of genomic DNA, Gel electrophoresis, Restriction enzyme digestion of DNA and analysis, PCR, PCR-RFLP, PCR-SSCP, Bioinformatics tool for			

DNA sequence analysis, Design of primer, Isolation of RNA, cDNA synthesis, Statistical methods for analyzing molecular genetic data.

Suggested Readings

Akano IE 1992. *DNA Technology*. IAP Academic Press.
Micklos DA, Fryer GA & Crotty DA. 2003. *DNA Science*. Cold Spring Harbour.
Setlow JK. 2006. *Genetic Engineering – Principles and Methods*. Springer.

AGB 603	POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING	2+1	SEM - I
----------------	--	------------	----------------

Objective

To study genetic structure of animal population and importance of genetic variation and covariation among traits.

Theory

UNIT-I: Individual versus population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal populations. Approach to equilibrium under different situations: Viz: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci.

UNIT-II: Small population: random genetic drift, effective population size, pedigreed populations, regular and irregular inbreeding systems.

UNIT-III: Quantitative genetics-gene effects, population mean and variance and its partitioning, biometric relations between relatives.

UNIT-IV : Genetic and phenotypic parameters-their methods of estimation, uses, possible biases and precision. Scale effects and threshold traits.

Practical

Problems relating to gene and genotypic frequencies under different conditions. Estimation of inbreeding in regular and irregular systems. Estimation of effective population size. Computation of quantitative genetic effects. Estimation of variance components. Computation of heritability, repeatability, genetic, environmental and phenotypic correlations and their standard errors.

Suggested Readings

Bulmer MG. 1980. *The Mathematical Theory of Quantitative Genetics*. Clarendon Press.
Crow JF & Kimura M. 1970. *An Introduction to Population Genetics. Theory*. Harper & Row.
Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
Pirchner F. 1981. *Population Genetics in Animal Breeding*. S. Chand.

AGB 604	SELECTION METHODS AND BREEDING SYSTEMS	3+1	SEM - II
----------------	---	------------	-----------------

Objective

To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.

Theory

UNIT-I: Type of selection and their genetic consequences. Response to selection and its prediction and improvement of response to selection.

UNIT-II: Theoretical aspects of accuracy and efficiency of different base of selection. Prediction of breeding value using different criteria. Combined Selection. Correlated response to selection and efficiency of indirect selection.

UNIT-III: Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateau and limit.

UNIT-IV: Genetic aspects and consequences of various mating systems. Effects of mating systems on mean and variance. Application of various mating system in animal improvement. Selection for general and specific combining ability. Genetic polymorphism and its application in genetic improvement.

Practical

Estimation of breeding values from different sources of information. Prediction of direct and correlated response to different bases of selection. Computation of breeding values using different sources of information for female and male selection. Computation of

realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits. Estimation of heterosis for different types of crosses. Estimation of GCA and SCA.

Suggested Readings

Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
Tomar SS 1996. *Text Book of Population Genetics*. Vol. I. *Qualitative Inheritance*; Vol. II. *Quantitative Inheritance*. Universal Publ.

AGB 605	BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING	3+1	SEM - I
----------------	--	------------	----------------

Objective

To educate about the various biometrical techniques for data analysis and their applications in animal breeding research.

Theory

UNIT-I: Review of basic concepts in statistical inference and balanced experimental designs. Nature of structure of animal breeding data and sources of variation.

UNIT-II: Introduction to matrix algebra, types of matrices and matrix operations. Determinants and their properties, methods of finding inverse of a matrix and their application.

UNIT-III: ANOVA, Regression and Correlations, Henderson's methods for estimation of variance components, Basic concepts of linear models, Least-squares analysis, maximum likelihood; Method of estimation; Generalized LS and weighted LS. Fisher's discriminant function and its application, D^2 - Statistics in divergent analysis.

UNIT-IV: Linear models in animal breeding, Methods of analysis of unbalanced animal breeding data. Adjustment of data. Data base management and use of software packages in animal breeding.

Practical

Matrix applications, determinant and inverse of matrices; Building of models for various types of data; Estimation of variance components; Least squares method for analysis of research data; Collection, compilation, coding, transformation and analysis of animal breeding data by using above biometrical techniques with computer application.

Suggested Readings

Henderson CR. 1984. *Application of Linear Models in Animal Breeding*. Univ. of Guelph.
Kaps M & Lamberson WR. 2004. *Biostatistics for Animal Science*. CABI.
Mather K & Jinks JL. 1977. *Introduction to Biometrical Genetics*. Chapman & Hall.
Searle Sr. 1971. *Linear Models*. John Wiley & Sons.
Singh RK & Choudhary BD. 1977. *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani.

AGB 606	CONSERVATION OF ANIMAL GENETIC RESOURCES	2+0	SEM - I
----------------	---	------------	----------------

Objective

To educate about the concept of conservation of Animal Genetic Resources and their sustainable utilization.

Theory

UNIT-I: Domestic Animal Diversity in India, its origin, history and utilization. Present status and flow of Animal Genetic Resources and its contribution to livelihood security. Methodology for genotypic characterization of livestock and poultry breeds through systematic surveys. Fodder availability; management of breed; physical, biochemical and performance traits and uniqueness of animals of a breed; social, cultural and economic aspects of their owners/communities rearing the breed.

UNIT-II: Methodology for molecular genetic characterization, diversity analysis and relationship among the breeds. Concept of conservation, *In-situ* and *ex-situ* (*in-vivo* and *in-vitro*); models of conservation; prioritization of breeds for conservation. National and international strategies for conservation of Animal Genetic Resources.

UNIT-III: Status, opportunities and challenges in conservation of AnGR. IPR issues pertaining to animal genetic resources/animal products or by-products. Registration of livestock breeds and protection of livestock owner's rights in India.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH.
Nicholas FW. 1987. *Veterinary Genetics*. Claredon Press.
Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 607 CATTLE AND BUFFALO BREEDING 2+1 SEM - II**Objective**

To educate about the concept of cattle and buffalo breeding.

Theory

UNIT-I: History of dairy cattle and buffalo breeding. Breeds of cattle and buffalo and their Characterisation. Inheritance of important economic traits. Recording and handling of breeding data. Standardization of records. Computation of correction factors for the adjustment of the data. Estimation of breeding values of the cows and bulls.

UNIT-II: Sire evaluation methods using single trait and multiple traits: construction of Sire indices, Sire evaluation under animal model, sire mode; and maternal grand sire model. Open nucleus breeding systems with MOET.

UNIT-III: Methods of cross breeding. Breeding of type, milk quality and production efficiency. Plans for developing new breeds of dairy cattle. History of development of important breeds of dairy cattle.

UNIT-IV: Considerations in the import of exotic germplasm for breeding cattle in the tropics. Appraisal of buffalo and cattle breeding programme. Role of breed associations in dairy improvement.

Practical

Performance recording – milk recording - Estimation of economic traits – Standardization of records – Index cards – Sire evaluation – Comparison of latest methods - Computation of genetic parameters – Genetic gain – Estimation of heterosis – Culling and replacement.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH.
Nicholas FW. 1987. *Veterinary Genetics*. Claredon Press.
Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 608 SMALL FARM ANIMAL BREEDING 2+0 SEM - II
(Sheep, Goat, Swine and Rabbit)**Objective**

To educate about the small farm animal breeding concepts.

Theory

UNIT-I: Breeds–Economic traits–Prolificacy–Breeding records and standardization.

UNIT-II: Genetic parameters – Selection of males and females – Breeding systems. Development of new breeds.

UNIT-III: Breeding policy – Breeding research – Conservation of breeds.

UNIT-IV: Culling and replacement – EADR.

Suggested Readings

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Turner HN & Young SSY. 1969. *Quantitative Genetics in Sheep Breeding*. MacMillan.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 609 POULTRY BREEDING 2+1 SEM - I**Objective**

To educate about the advances in poultry breeding practices.

Theory

UNIT-I: Origin and history of poultry species: Chicken, turkey, duck and quail – Important qualitative traits in poultry including lethals – Economic traits of egg-type chicken and their standardization – Selection criteria – Aids to selection: Index selection and Osborne index – Restricted selection index – Economic traits of meat – type chicken and their standardization.

UNIT-II: Selection criteria and selection indices – Response to selection – Genetic controls – Genotype and environment interaction – Inbreeding, and its effects on production traits in egg and meat-type chickens – Inbred lines – Strain development – Crossing : strain and line crosses – Introduction to diallel cross – Utilisation of heterosis and reciprocal effect – Reciprocal recurrent selection and recurrent selection.

UNIT-III: Industrial breeding – Artificial insemination in chicken – Autosexing – Random Sample Test.

UNIT-IV: Biochemical variants and immunogenetics of poultry – Use of molecular genetics in poultry breeding – Quantitative trait loci and marker-assisted selection – Conservation of poultry genetic resources.

Practical

Inheritance of qualitative traits – Economic traits of egg-type and meat-type chicken – Procedures of standardization – Estimations of heritability, correlation between various production traits, inbreeding co-efficient and heterosis – Selection of sires and dams – Osborne index – Restricted selection index – Collection and evaluation of semen and insemination – Diallel cross.

Suggested Readings

Crawford RD.1990. *Poultry Breeding and Genetics*. Elsevier.

Hutt FB. 2003. *Genetics of Fowl*. Norton Greek Press.

Singh RP & KumarJ. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani.

AGB 610 LABORATORY ANIMAL BREEDING 1+0 SEM - II

Objective

To educate about the laboratory animal breeding principles.

Theory

UNIT-I: Introduction to laboratory animal genetics – Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits.

UNIT-II: Selection and mating methods/systems – mongamous, polygamous and others.

UNIT-III: Development of genetically controlled laboratory animals – Rules for nomenclature, inbred strains, outbred stocks, mutant stocks, recombinant inbred strains, transgenic strains, gene targeting and production of ‘gene knock-out’ animals.

UNIT-IV: Genetic control and monitoring – Record keeping – Ethics of laboratory animal use.

Suggested Readings

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 701 RECENT ADVANCES IN ANIMAL GENETICS 2+0 SEM - I

Objective

To impart knowledge about the latest tools and techniques of animal genetics and their uses in animal sciences.

Theory

UNIT-I: Eukaryotic genome: Gene families, Pseudogenes SnRNPs, Gene conversion, tandemly repeated genes, Nuclear Organiser region, mRNA splicing, Minisatellites, Microsatellites and its usage.

UNIT-II: Transposons, RNA processing Transcuplion regulation of gene expression, selective gene amplification, post transeptional regulation. The proteasome and longevity of proteins.

UNIT-III: Transgenic animals their benefits in livestock production, somatic cell nuclear transfer, transgenic animals in biomedical research, ethical consideration of transgenic animals; gene therapy and transgenic animal production. Pharming of Pharmaceutical.

UNIT-IV: Radiation hybrid panels and their usage in livestock, microdissection of chromosomes, *In-situ* hybridization, chromosome painting, meiotic crossing over, genome selection; Structure and functions of major histocompatibility complex, T Cell receptor, CD4, Toll Like Receptors and their functions.

Suggested Readings

Selected articles from journals.

AGB 702 RECENT TRENDS IN ANIMAL BREEDING 2+0 SEM - II**Objective**

To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

Theory

UNIT-I: Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding.

UNIT-II: Formulation of detailed breeding plans ongoing breed improvement programmes and their impact analysis in various species of livestock under different situations.

UNIT-III: Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

Suggested Readings

Selected articles from journals.

AGB 703 ADVANCES IN BIOMETRICAL GENETICS 2+1 SEM - II**Objective**

To impart knowledge about recent advances in population genetic theory and application in animal breeding.

Theory

UNIT-I: Mating designs; genetic basis of tripple test cross analysis (TTC); trialallel analysis, partial diallel crosses and mating design for studying reciprocal and maternal differences.

UNIT-II: Models for studying the inheritance of endosperm characters; classificatory problems; discriminant function, D^2 analysis; principal component analysis.

UNIT-III: Use of genetic parameters for prediction of recombinant inbred lines; advances in studies of genotype environment interaction and selection indices.

UNIT-IV: Generation matrix and its use in population genetics; gene mapping of QTL (quantitative trait loci).

Practical

Estimation of genetic parameters – Diallel analysis – Trialallel analysis – D^2 analysis – Problems in Matrix.

Suggested Readings

Selected articles from journals.

AGB 704 ADVANCES IN SELECTION 2+1 SEM - I
METHODOLOGY**Objective**

To educate about the latest advances in selection theory and their application in animal breeding.

Theory

UNIT-I: Fundamental theorem of natural selection; Selection in finite populations effect on genetic structure and variance. Optimum designs for the estimation of genetic parameters. Design of selection experiments for testing selection theory.

UNIT-II: Methods of measurement of genetic and environmental trends. Advances in selection indices Multistage, Restricted and retrospective selection indices.

UNIT-III: Multi-information, Empirical evaluation of selection theory: genetic slippage, limits to selection, asymmetry of response, selection experiments, effect of selection on variance.

UNIT-IV: Selection for threshold traits; single and multiple trait best linear unbiased estimation (BLUE) and prediction (BLUP); selection under single and multiple trait animal models; direct and correlated response through various selection indices, relationship between BLUP and selection index; fundamentals of marker assisted selections.

Practical

Estimation of relative economic values; determination of culling levels and selection intensity; construction of various indices; estimation of direct and correlated response; QTL analysis using LDMAS & LEMAS.

Suggested Readings

Selected articles from journals.

AGB 705	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0	SEM - I
----------------	---	------------	----------------

Objective

To educate about basic concepts of bioinformatics and their applications in Animal Genetics and Breeding.

Theory

UNIT-I: Overview of bioinformatics, Database concepts, Algorithms, Information resources for protein and genome databases: Gene Bank, EMBL, SWISSPROT, PROSITE.

UNIT-II: Nucleotide and protein sequence analysis, Pair-wise and multiple sequence alignments, Phylogeny, Micro-array processing, Clustering, Analysis software, Secondary database search.

UNIT-III: Genetic characterisation, Use of bioinformatics tools for identifying QTL and selection of elite germplasm.

Suggested Readings

Selected articles from journals.

AGB 706	ADVANCES IN MOLECULAR CYTOGENETICS	2+0	SEM - II
----------------	---	------------	-----------------

Objective

To educate about the advances in cytogenetics and their application in animal genetic and breeding

Theory

UNIT-I: Structure of eukaryotic chromosomes – Evolution of karyotype – Various in vitro cell culture techniques – Cell lines and utility – Genotoxicity.

UNIT-II: Somatic cell genetics – Stem cell genetics – Molecular cytogenetics and gene mapping – ISH, FISH, Radiation hybrid mapping, Fibre-FISH, PRINS.

UNIT-III: Positional cloning – Spectral karyotyping.

UNIT-IV: Image analysis – Chromosome walking – Chromosome painting.

Suggested Readings

Selected articles from journals.

AGB 707	UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1	SEM - I
----------------	---	------------	----------------

Objective

To educate about the recent advances in estimation of non-additive genetic variation and possible use in developing synthetic population of livestock and poultry.

Theory

UNIT-I: Heterosis – forms and genetic basis; detection and estimation of non-additive genetic variance – average dominance, overdominance.

UNIT-II: Partitioning of between cross variance – general combining ability, specific combining ability and reciprocal effects; methods of analyzing diallel crosses; utilization of non-additive genetic variance.

UNIT-III: Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

UNIT-IV: Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.

Practical

Computation of degree of dominance using NC Plans; analysis of partial and complete diallel cross data; estimation of crossbreeding effects; estimation of genetic correlation among paternal purebred and crossbred half sibs; computation of response through RS and RRS.

Suggested Readings

Selected articles from journals.

ANIMAL GENETICS AND BREEDING

List of Journals

- Animal Breeding Abstract
- Animal Science
- Asian – Australasian Journal of Animal Science
- Biometrics
- Data Agricultural Scandinavica
- Genetics
- Heredity
- Hoard's Dairyman
- Indian Buffalo Journal
- Indian Journal of Animal Breeding & Genetics
- Indian Journal of Animal Production & Management
- Indian Journal of Animal Science
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of Dairy Science
- Indian Journal of Poultry Science
- Indian Journal of Small Ruminant
- Indian Veterinary Journal
- Journal of Animal Science
- Journal of Dairy Science
- Journal of Indian Society of Agriculture Statistics
- Livestock Production Science
- Newzealand Journal of Agri. Research
- The Cell
- Theoretical and Applied Genetics
- Veterinary Record
- World Animal Review
- World Poultry Science Journal
- World Rev. Animal Production.

e-Resources

- <http://www.ncbi.nlm.nih.gov/>
- <http://www.genome.gov>
- <http://www.hgsc.bcm.tmc.edu/projects/bovine>
- <http://www.animalgenome.org>
- <http://www.blackwell-synergy.com>
- <http://www.genomics.liv.ac.uk>
- <http://www.biomedcentral.com>
- <http://www.genomealliance.org.au>
- <http://www.csiro.au>
- <http://www.isag.org.uk>
- <http://www.ebi.ac.uk/imgt/>
- <http://www.csrees.usda.gov>

Broad Topics for Master's and Doctoral Research

- Characterization and cataloging of chromosomal profiles of different species of livestock and poultry.
- Studies on Major Histo-compatibility Complex in reference to traits of economic importance.
- To study mutagenic and cytogenic effects of pesticides and agro-chemicals on the genome of domestic animals.
- Molecular characterization of milk proteins/DGATI gene in cattle and buffalo.
- Comparative gene mapping of indigenous vs exotic livestock species including poultry.
- Studies on crossbreeding parameters for evolving synthetic germplasm of livestock and poultry.
- Designing of selection strategies and breeding systems for improving market-based commercial traits.
- Optimization of breeding strategies for genetic improvement of indigenous livestock and poultry based on field data.
- Evaluation of breeding strategies for conservation of indigenous livestock and poultry breeds.
- Development of synthetic germplasm suitable for rural husbandry with low inputs.
- Genetic studies of nutraceutical animal products of livestock and poultry.
- Genetic-economic evaluation and multiplication of superior germplasm of livestock and poultry.
- Selection strategies for traits of economic importance incorporating molecular markers.
- Evaluation of models for evolving field recording systems.
- Genetic studies on disease resistance in livestock and poultry
- Animal Genetic Resources characterization and evaluation using field survey and molecular markers.
- Animal Genetic Resource enhancement through selection/crossbreeding/reproductive biotechnology/molecular biology.
- Identification of molecular markers for economic traits.
- Genetic basis for improvement in quantitative traits.
- Breeding tools for Sire evaluation.
- Appropriate models for evaluating animal breeding values.
- Transgenesis and gene transfer.