Academic:

1. **Degree Offered :B.V.Sc.&A.H., M.V.Sc and Ph.D.**

   Title of degree : Bachelor of Veterinary Science and Animal Husbandry
   Duration : Five and Half Year
   Eligibility Criteria : NEET Qualified
   Intake Capacity :115
   Opportunities:

   Degree Offered : M.V.Sc.
   Title of degree : Master of Veterinary Science in Animal Genetics and Breeding
   Duration : 2 years
   Eligibility Criteria : ICAR -Entrance Exam Qualified
   Intake Capacity :03
   Opportunities:

   Degree Offered : Ph.D.
   Title of degree : Doctor of Philosophy in Animal Genetics and Breeding
   Duration : 3/4 years
   Eligibility Criteria : ICAR -Entrance Exam Qualified
   Intake Capacity :02
   Opportunities:

2. Academic Regulations:
   UG , PG, PhD (VCI, ICAR, IV, V Dean's and Corrigendum) – PDF Copies

3. Admissions:
UG, PG, PhD

List of Admitted Students – First Year to Final Year (Veterinary Year wise / Fishery and Dairy Semester wise) :

Sr. No.	Name of Student	Enrl. No.	Email Address	Name of Advisor

4. Course offered :: UG, PG , PhD - Semester / Year wise

   - List of UG Courses (B.V.Sc & AH) As per latest MSVE Guidelines) , B.Tech. (D.T.) and B.F.Sc as per ICAR – V Deans Committee – 2016.

Sr No	Course No.	Title	Credit	Course offered in the Year

1	UNIT-I,UNIT-II &UNIT-III	Animal Genetics and Breeding with Biostatistics	3+1	II nd year

- List of PG Courses (MVSc) and M.Tech. (Dairy Technology)

Sr No	Course No .	Title	Credit	Semester
1	AGB 601	Animal Cytogenetics and Immunogenetics	2 + 1 = 3	I
2	AGB 602	Molecular Genetics I	2 + 1 = 3	I
3	AGB 603	Population and Quantitative Genetics	2 + 1 = 3	I
4	AGB 604	Selection Method and Breeding System	2 + 1 = 3	I
5	AGB 605	Biometrical Genetics	2 + 1 = 3	II
6	AGB 606	Conservation of Animal Genetics Resources	2 + 0 = 2	II
7	AGB 607 Optional	Cattle and Buffalo Breeding	2 + 1 = 3	II
8	AGB 608 Optional	Sheep and Goat Breeding	2 + 0 = 2	II
9	AGB 609 Optional	Poultry Breeding	2 + 1 = 3	II
10	AGB 610 Optional	Laboratory Animal and Rabbit Breeding	2 + 0 = 2	II
11	AGB 611 Optional	Swine Breeding	1 + 0 = 1	II
12	AGB 612	Pet Animal Breeding (Dogs and Cats)	1 + 0 = 1	II
13	AGB 613 Optional	Wild Animal Genetics and Breeding	1 + 0 = 1	II
14	AGB 614 Optional	Equine Breeding	1 + 0 = 1	II
15	AGB 615 Optional	Camel Breeding	1 + 0 = 1	II
16	AGB 616 Optional	Yak and Mithun Breeding	1 + 0 = 1	II
17	AGB 617 Optional	Statistical Methods in Animal Breeding	2 + 1 = 3	II
18	AGB 691	Masters Seminar	1 + 0 = 1	III
19	AGB 699	Masters Research	0 + 10=10	III
20	AGB 699	Masters Research	0 + 20 = 20	IV

5. Lecture Schedule – UG, PG , PhD - Theory / Practical Schedule – Approved by BoS – Subject wise

ANIMAL GENETICSAND BREEDING **Credit Hours: 3+1**

THEORY

UNIT-1 (BIOSTATISTICS AND COMPUTER APPLICATION)

Biostatistics: Introduction and importance of statistics and biostatistics, Classification and tabulation of data. Parameters, observation, recording and graphical and diagrammatic representation of data. Measures of Central tendency (simple and

grouped data). Measures of Dispersion (simple and grouped data). Probability and probability distributions: binomial, Poisson and normal, moments and skewness to kurtosis. Correlation and regression. Introduction of sampling methods. Tests of hypothesis and t, Z- tests of significance. Chi-square and F-test of significance. Design of experiment, Analysis of variance. Completely randomized design (CRD). Randomized block design (RBD).

Computer Application: Basics of computer. Introduction to computer languages. Data management using spread sheet (MS-Excel). Introduction of MS-Office, MS-Word, MS-PowerPoint. Concepts of computer networks, internet & e-mail.

UNIT-2 (PRINCIPLES OF ANIMAL AND POPULATION GENETICS)

Animal Genetics: History of Genetics. Mitosis v/s Meiosis. Chromosome numbers and types in livestock and poultry. Overview of Mendelian principles. Modified Mendelian inheritance, Pleiotropy, Penetrance and expressivity. Multiple alleles; lethals; sex-linked, sex limited and sex influenced inheritance. Sex determination. Linkage, crossing over and construction of linkage map. Mutation, Chromosomal aberrations. Cytogenetics, Extra-chromosomal inheritance. Molecular genetics, nucleic acids-structure and function. Gene concept, DNA and its replication. Introduction to molecular techniques.

Population Genetics: Introduction to population genetics; individual v/s population. Genetic structure of population: Gene and genotypic frequency. Hardy - Weinberg law and its application. Forces changing gene and genotypic frequencies (eg Mutation, migration, selection and drift). Quantitative v/s qualitative genetics; concept of average effect and breeding value. Components of Variance. Concept of correlation and interaction between Genotype and Environment. Heritability and Repeatability. Genetic and Phenotypic Correlations.

UNIT-3 (PRINCIPLES OF ANIMAL BREEDING)

Livestock and Poultry Breeding: History of Animal Breeding. Classification of breeds. Economic characters of livestock and poultry and their importance. Selection, types of selection, response to selection and factors affecting it. Bases of selection: individual, pedigree, family, sib, progeny and combined, indirect selection. Method of selection, Single and Multi trait. Classification of mating systems. Inbreeding coefficient and coefficient of relationship. Genetic and phenotypic consequences of inbreeding, inbreeding depression, application of inbreeding. Out breeding and its different forms. Genetic and phenotypic consequences of outbreeding, application of outbreeding, heterosis. Systems of utilization of heterosis; Selection for combining ability (RS & RRS). Breeding strategies for the improvement of dairy cattle and buffalo. Breeding strategies for the improvement of sheep, goat, swine and poultry. Sire evaluation. Open nucleus breeding system (ONBS). Development of new breeds/strains. Current livestock and poultry breeding policies and programmes in the state and country. Methods of conservation- livestock and poultry conservation programmes in the state and country. Application of reproductive and biotechnological tools for genetic improvement of livestock and poultry. Breeding for disease resistance.

Breeding of pet, zoo and wild animals: Classification of dog and cat breeds. Pedigree sheet, selection of breeds and major breed traits. Breeding management of dogs and cats. Common pet birds seen in India and their breeding management.
Population dynamics and effective population size of wild animals in captivity/zoo/natural habitats. Planned breeding of wild animals. Controlled breeding and assisted reproduction. Breeding for conservation of wild animals.

PRACTICAL
UNIT-1 (BIOSTATISTICS AND COMPUTER APPLICATION)
Collection, compilation and tabulation of data. Estimation of measures of central tendency (mean, median, mode) for simple and grouped data. Estimation of measures of dispersion (Range, standard deviation, standard error, variance, and coefficient of variation) for simple and grouped data. Graphical and diagrammatic representation of data. Estimation of correlation and regression. Simple probability problems, Normal distribution. Tests of significance: t-test, Z – test, Chi-square, F- tests. Completely randomized design (CRD). Randomized block design (RBD). Computer basics and components of computer. Simple operations: internet and e-mail, Entering and saving biological data through MS-Office (MS-Excel)

UNIT-2 (PRINCIPLES OF ANIMAL AND POPULATION GENETICS)
Monohybrid, Dihybrid cross and Multiple alleles. Modified Mendelian inheritance and sex linked inheritance. Linkage and crossing over. Demonstration of Karyotyping in farm animals. Demonstration of molecular techniques. Calculation of gene and genotypic frequencies, Testing a population for Hardy-Weinberg equilibrium. Calculation of effects of various forces that change gene frequencies. Computation of population mean, average effect of gene and gene substitution and breeding value. Estimation of repeatability, heritability, genetic and phenotypic correlations.
UNIT-3: (PRINCIPLES OF ANIMAL BREEDING)
Computation of selection differential and intensity of selection, Generation interval, expected genetic gain, correlated response, EPA and Most probable producing ability (MPPA). Estimation of inbreeding and relationship coefficient. Estimation of heterosis. Computation of sire indices. Computation of selection index.\

AGB 701 RECENT ADVANCES IN ANIMAL GENETICS (2+0)
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: Transprosons, RNA processing Transcuplion regulation of gene expression, selective gene amplification, post transceptional 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.

AGB 702 RECENT TRENDS IN ANIMAL BREEDING (2+0)

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 programmesand 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.

AGB 703 ADVANCES IN BIOMETRICAL GENETICS (2+1)

Theory
UNIT-I:
Mating designs; genetic basis of tripple test cross analysis (TTC); triallel 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, D2 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).

AGB 704 ADVANCES IN SELECTION METHODOLOGY (2+1)

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 varaiance.

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.

AGB 705 BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING (2+0)

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 characterization, Use of bioinformatics tools for identifying QTL and selection of elite germplasm.

AGB 706 ADVANCES IN MOLECULAR CYTOGENETICS (2+0)

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.

AGB 707 UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS (2+1)

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.

6. Teaching Schedule :UG, PG , PhD - Prepared by – Course Teacher – Year wise / Course Wise

UG lecture schedule

Sr.No.	Unit No.	Lecture/No.	Topic to be covered
1.	I	1	Introduction and Importance of statistics and biostatistics: Elementary statistical definitions
2.		2	Classification and Tabulation of Data, Parameter, Statistic and Observation.
3.		3	Graphical (Histogram, Frequency polygon, Ogive)and diagrammatic (Bar diagram, Pie diagram) representation of data.
4.		4-5	Measure of central tendency(simple and grouped data) Concept: Mean, Median, Mode Weighted mean, Geometric mean, Harmonic mean.
5.		6	Measure of dispersion(Simple and grouped data)Concept: Range, Inter quartile range, Mean deviation
6.		7	Standard deviation, Variance, Standard Error, Coefficient of Variance
7.		8	Elements of Probability : definition and its laws
8.		9-10-11-	Probability distribution: Binomial, Poisson, Normal
9.		12	Moments, Skewness, Kurtosis
10.		13-14	Correlation: Introduction, Concept, types, Properties and its uses.Rank Correlation

11.		15	Regression : Introduction, Concept, Properties and its uses
12.		16-17	Introduction to sample methods: Simple Random Sampling (SRS), Stratified sampling, Systematic sampling, Cluster sampling, etc.
13.		18	Testing of hypothesis: Simple and composite hypothesis, Null hypothesis, types of error, one tailed and two tailed, test, confidence interval, Power test.
14.		19-20	Test of hypothesis: t – test for single mean, difference of mean and paired t – test, testing of correlation coefficient
15.		21-22	Z-test, Chi - Square test for goodness of fit and test of attributes.
16.		23	Analysis of variance : One way classification
17.		24	Analysis of variance : Two way classification
18.		25	Design of Experiments: Concept and Principles (Replication, Randomization, Local control)
19.		26	Complete Randomized Design (CRD)
20.		27	Randomized Block Design (RBD) ,F- TEST OF Significance
21.		28	Introduction to Non-parametric tests (Rank test, Median, Mann-Whitney)
22.		29	Computer Application : Introduction to Computer languages,
23.		30	Data Base Management
24.		31-32	Review of MS-Office and its components (Ms-Word, Excel, Power Point and Access)
After 30% course completion – FIRST INTERNAL ASSESSMENT			
25.		33.	Analysis of data using MS-Excel
26.	I	34.	Concept of computer networks, Internet and e-mail.
27.		35.	History of Genetics
28.		36.	Mitosis v/s Meiosis
29.		37.	Chromosome numbers and types in livestock and poultry
30.		38.	Overview of Mendelian principles
31.		39.	Overview of Mendelian principles
32.		40.	Modified Mendelian inheritance
33.		41.	Modified Mendelian inheritance
34.		42.	Pleiotropy, Penetrance and expressivity
35.		43.	Multiple alleles
36.		44.	lethals
37.	II	45.	sex-linked inheritance
38.		46.	sex limited inheritance and sex influenced inheritance
39.		47.	Sex determination
40.		48.	Linkage and construction of linkage map
41.		49.	Crossing over
42.		50.	Mutation
43.		51.	Cytogenetics
44.		52.	Chromosomal aberrations
45.		53.	Extra-chromosomal inheritance
46.		54.	Gene concept, Molecular genetics
47.		55.	Nucleic acids-structure and function
48.		56.	DNA and its replication
49.		57.	Introduction to molecular techniques
50.		58.	Introduction to population genetics

51.		59.	Individual v/s population
52.		60.	Genetic structure of population: Gene and genotypic frequency
53.		61.	Hardy - Weinberg law and its application
54.		62.	Forces changing gene and genotypic frequencies (eg. Mutation, migration)
55.		63.	Forces changing gene and genotypic frequencies (eg.Selection and drift)
After 60% course completion – SECOND INTERNAL ASSESSMENT			
56.	II	64.	Quantitative v/s qualitative genetics
57.		65.	Concept of average effect and breeding value
58.		66.	Components of Variance
59.		67.	Concept of correlation and interaction between Genotype and Environment
60.		68.	Heritability
61.		69.	Repeatability
62.		70.	Genetic and Phenotypic Correlations
63.	III	71.	History of Animal Breeding
64.		72.	Classification of breeds
65.		73.	Economic characters of cattle,buffalo,sheep,goat and their importance
66.		74.	Economic characters of pig, poultry and their importance
67.		75.	Selection, types of selection
68.		76.	response to selection and factors affecting it
69.		77.	Bases of selection: individual, pedigree
70.		78.	Bases of selection: family, sib,
71.		79.	Bases of selection: progeny and combined, indirect selection
72.		80.	Method of selection, Single and Multi trait
73.		81.	Classification of mating systems
74.		82.	Inbreeding coefficient
75.		83.	Coefficient of relationship
76.		84.	Genetic and phenotypic consequences of inbreeding, inbreeding depression, application of inbreeding
77.		85.	Out breeding and its different forms
78.		86.	Genetic and phenotypic consequences of outbreeding, application of outbreeding,
79.		87.	Heterosis
80.		88.	Systems of utilization of heterosis; Selection for combining ability (RS and RRS)
81.		89.	Breeding strategies for the improvement of dairy cattle and buffalo
82.		90.	Breeding strategies for the improvement of sheep, goat, swine and poultry
83.		91.	Sire evaluation
84.		92.	Open nucleus breeding system (ONBS)
85.		93.	Development of new breeds or strains
86.		94.	Current livestock and poultry breeding policies and programmes in the state and country
87.		95.	Methods of conservation- livestock and poultry conservation programmes in the state and country

After 90% course completion- THIRD INTERNAL ASSESSMENT			
88.	III	96.	Application of reproductive and biotechnological tools for genetic improvement of livestock and poultry
89.		97.	Breeding for disease resistance
90.		98.	Classification of dog and cat breeds
91.		99.	Pedigree sheet, selection of breeds and major breed traits
92.		100.	Breeding management of dogs and cats
93.		101.	Common pet birds seen in India and their breeding management
94.		102.	Population dynamics and effective population size of wild animals in captivity or zoo or natural habitats
95.		103.	Planned breeding of wild animals
96.		104.	Controlled breeding and assisted reproduction
97.		105.	Breeding for conservation of wild animals

Lecture Schedule of M. V. Sc. (Animal Genetics and Breeding) courses

Course Title : Animal Cytogenetics and Immunogenetics I
Course Code : AGB 601
Credit Hours : 2+1=3

Unit No.	Lecture No.	Name of Topic
I	1	Physical and chemical basis of heredity
	2	Development of animal cytogenetics and animal immunogenetics in farm animals.
	3	Inborn errors of metabolism and inherited disorders
	4	Immunoglobulin and their types
	5	Immunoglobulin and their types
	6	Antigen – Antibody interactions
	7	Immune response
	8	ELISA
II	9	Chromatin structure of eukaryotes
	10	Chromosome number and morphology in farm animals
	11	Karyotyping
	12	Chromosomal and genetic syndromes
	13	Chromosomal and genetic syndromes
	14	DNA packing in chromosomes
	15	DNA packing in chromosomes
	16	Types of DNA
	17	FISH chromosome panting and PRINS
	18	FISH chromosome panting and PRINS
	19	SCH and RH Panel mapping
	20	SCH and RH Panel mapping
III	21	Genetic variants in blood group systems of farm animals
	22	Major Histocompatability Complex

	23	Major Histocompatability Complex
	24	BoLA
	25	BuLA
	26	Genetics of Biochemical variants and their applications
	27	Genetics of Biochemical variants and their applications
	28	Immune response genes and concepts of disease resistance including major genes
	29	Immune response genes and concepts of disease resistance including major genes
	30	Hybridoma and its significance
	31	Hybridoma and its significance
	32	Concept of immuno-fertility
	33	TLRs and interleukins
IV	34	Mutation and assays of mutagenesis
	35	Mutation and assays of mutagenesis
	36	Sister chromatid exchanges

Practical

Practical No.	**Name of Topic**
1	Identification of Barr bodies
2	Identification of Barr bodies
3	In-vitro and in-vivo preparation of somatic metaphase chromosome
4	In-vitro and in-vivo preparation of somatic metaphase chromosome
5	Screening of chromosomal abnormalities
6	Screening of chromosomal abnormalities
7	Microphotography and Karyotyping
8	Microphotography and Karyotyping
9	Microphotography and Karyotyping
10	Banding procedures for comparing the chromosomal complement
11	Banding procedures for comparing the chromosomal complement
12	Banding procedures for comparing the chromosomal complement
13	FISH and PRINS
14	FISH and PRINS
15	ELISA
16	ELISA
17	Immunocompetence tests
18	Immunocompetence tests

Course Title : Molecular Genetics I
Course Code : AGB 602
Credit Hours : 2+1=3

Unit No.	Lecture No.	Name of Topic
I	1	Basic concept of Molecular genetics
	2	Concepts of proteomics and genomics
	3	Genesis and importance of molecular techniques
	4	Genesis and importance of molecular techniques
	5	Genome organization-Physical and genetic map
	6	Genome organization-Physical and genetic map
	7	Current status of genome map in livestock
	8	Gene expression and control
	9	Gene expression and control
II	10	Molecular markers and their applications
	11	Molecular markers and their applications
	12	RFLP Marker
	13	RAPD Marker
	14	Microsatellite marker
	15	Microsatellite marker
	16	Minisatellite marker
	17	SNP Marker
	18	DNA Fingerprinting
	19	DNA Fingerprinting
III	20	DNA Sequencing
	21	Genome sequencing
	22	Genomic Library
	23	Polymerase Chain Reaction (PCR) and its types (PCR-RFLP, AS-PCR, etc.)
	24	Polymerase Chain Reaction (PCR) and its types (PCR-RFLP, AS-PCR, etc.)
	25	Applications of PCR
	26	Transgenesis and methods of gene transfer
	27	Transgenesis and methods of gene transfer
	28	Recombinant DNA technology and application
IV	29	Analysis of molecular genetic data
	30	Analysis of molecular genetic data
	31	Quantitative Trait Loci (QTL)
	32	QTL mapping and its application in animal breeding
	33	QTL mapping and its application in animal breeding
	34	Genome scan
	35	Candidate gene approach
	36	Candidate gene approach

Practical

Practical No.	Name of Topic
1	Extraction and purification of genomic DNA
2	Extraction and purification of genomic DNA
3	Extraction and purification of genomic DNA
4	Gel electrophoresis
5	Gel electrophoresis
6	Restriction enzyme digestion of DNA and analysis
7	Restriction enzyme digestion of DNA and analysis
8	PCR-RFLP
9	PCR-RFLP
10	PCR-SSCP
11	Bioinformatics tool for DNA sequence analysis
12	Bioinformatics tool for DNA sequence analysis
13	Isolation of RNA
14	Isolation of RNA
15	cDNA synthesis
16	cDNA synthesis
17	Statistical methods for analyzing molecular genetic data
18	Statistical methods for analyzing molecular genetic data

Course Title : Population and Quantitative Genetics
Course Code : AGB 603
Credit Hours : 2+1

Theory

Unit No.	Lecture No.	Name of Topic
I	1.	Genetic structure of population
	2.	Hardy Weinberg Law
	3.	Idealized population
	4.	Factors affecting changes in gene and genotypic frequencies
	5.	Systematic processes
	6.	Approach to equilibrium under different situations
	7.	Single autosomal locus with two alleles
	8.	Single X-linked locus
	9.	Two pairs of autosomal linked and unlinked loci
	10.	Linkage equilibrium and disequilibrium
	11.	Combined effect of all forces changing gene frequency
II	12.	Dispersive process: Small population
	13.	Random genetic drift
	14.	Effective population size
	15.	Regular and irregular inbreeding systems
	16.	Regular and irregular inbreeding systems

	17.	Founder effect and bottleneck
	18.	Effective number of founders and ancestors
III	19.	Quantitative genetics: Gene effects
	20.	Population mean
	21.	Breeding value
	22.	Variance and its partitioning
	23.	Genotype-environment interaction and correlation
	24.	Resemblance between relatives
	25.	Resemblance between relatives
IV	26.	Genetic and phenotypic parameters- heritability
	27.	Methods of estimation heritability
	28.	Methods of estimation heritability
	29.	Genetic and phenotypic parameters- repeatability
	30.	Methods of estimation repeatability
	31.	Genetic and phenotypic parameters- correlations
	32.	Methods of estimation – correlations
	33.	Uses, possible biases, precision
	34.	Optimal designs
	35.	Scale effects
	36.	Threshold traits

Practical

Practical No.	**Name of Topic**
1.	Estimation of gene and genotypic frequencies under different conditions
2.	Estimation of gene and genotypic frequencies under different conditions
3.	Estimation of inbreeding in regular and irregular systems
4.	Estimation of inbreeding in regular and irregular systems
5.	Estimation of effective population size
6.	Computation of quantitative genetic effects
7.	Estimation of variance components
8.	Estimation of variance components
9.	Computation of heritability
10.	Computation of heritability
11.	Computation of heritability
12.	Computation repeatability
13.	Computation repeatability
14.	Computation genetic, phenotypic and environmental correlations and their standard errors
15.	Computation genetic, phenotypic and environmental correlations and their standard errors

16.	Computation genetic, phenotypic and environmental correlations and their standard errors
17.	Computation genetic, phenotypic and environmental correlations and their standard errors
18.	Computation genetic, phenotypic and environmental correlations and their standard errors

Course Title : Selection Methods and Breeding System
Course No : AGB 604
Credit Hours : 2+1

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Selection, its concept and different types of selection
	2	Genetic consequences of selection
	3	Response to selection
	4	Prediction of selection response
	5	Improvement of selection response
II	6	Accuracy of selection
	7	Efficiency different bases of selection
	8	Prediction of Breeding value- Individual selection
	9	Prediction of Breeding value- Pedigree selection
	10	Prediction of Breeding value- Family selection
	11	Progeny testing
	12	Progeny testing
	13	Combined selection
	14	Correlated response and efficiency of indirect selection
III	15	Selection for several traits
	16	Different types of selection indices
	17	Evaluation of short term selection experiments
	18	Evaluation of long term selection experiments
	19	Bidirectional selection
	20	Asymmetry of response
	21	Asymmetry of response
	22	Selection limit
IV	23	Importance and classification of mating system
	24	Assortative mating
	25	Inbreeding and its genetic and phenotypic consequences
	26	Application of inbreeding for genetic improvement of animals
	27	Out breeding and its genetic and phenotypic consequences
	28	Application of out breeding for genetic improvement of animals
	29	Heterosis: Definition and concept along with its applications

	30	Heterosis: Definition and concept along with its applications
	31	Specific Combining Ability
	32	General Combining Ability
	33	Genetic polymorphism and its applications
	34	Marker Assisted Selection
	35	Marker Assisted Selection
	36	Genomic selection

Practical

Practical No.	Name of Topic
1	Prediction of direct response to selection
2	Prediction of correlated response to selection
3	Estimation of realized heritability
4	Estimation of genetic correlation
5	Estimation of genetic correlation
6	Computation of selection index
7	Computation of selection index
8	Estimation of breeding value – Individual selection
9	Estimation of breeding value – pedigree selection
10	Estimation of breeding value – Family selection
11	Determination of accuracy of selection
12	Determination of accuracy of selection
13	Estimation of heterosis for different types of crosses
14	Estimation of heterosis for different types of crosses
15	Estimation of GCA
16	Estimation of GCA
17	Estimation of SCA
18	Estimation of SCA

Course Title : Biometrical Genetics I
Course Code : AGB 605
Course credits : 2+1

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Nature and structure of animal breeding data
	2	Source of variation
	3	Adjustment of data
	4	Outliers and their removal
	5	Basic concepts in statistical inference

II	6	Introduction to matrix algebra
	7	Types of matrices and their operations
	8	Determinants and their properties
	9	Matrix inversion and its applications
	10	Matrix inversion and its applications
III	11	Multiple regression and correlations
	12	Fisher's discriminate function and its application
	13	D^2 statistics in divergent analysis
	14	Cluster analysis
	15	Fixation index
	16	Genetic distance estimation and phylogeny construction
	17	Linear models and their types
	18	Least-squares (LS) analysis, Generalized LS and weighted LS
	19	BLUE, BLUP
	20	BLUE, BLUP
	21	Methods of estimation of variance components: ANOVA
	22	Methods of estimation of variance components: ML, REML
	23	Methods of estimation of variance components: MINQUE,MIVQUE
	24	Bayesian approach
IV	25	Animal model, Reduced animal model
	26	Animal model, Reduced animal model
	27	Sire model
	28	Sire model
	29	Maternal grand sire model
	30	Maternal effects model
	31	Repeatability model
	32	Random regression model
	33	Threshold model
	34	Multidimensional scaling(MDS)
	35	Principal component analysis(PCA)
	36	Data base management and use of software in animal breeding

Practical

Practical No.	**Name of Topic**
1	Collection, compilation, coding and transformation of animal breeding data
2	Collection, compilation, coding and transformation of animal breeding data
3	Matrix applications
4	Determinant of matrices
5	Inverse of matrices

6	Dominance and identical by descent matrix
7	Dominance and identical by descent matrix
8	Building of models for various types of data
9	Building of models for various types of data
10	Least-squares analysis of data
11	Least-squares analysis of data
12	Least-squares analysis of data
13	Estimation of BLUE solutions
14	Estimation of BLUP solutions
15	Estimation of BLUP solutions
16	Formation of numerator relationship
17	Estimation of variance components
18	Estimation of variance components

Course Title : Conservation of Animal Genetics Resources
Course Code : AGB-606
Credit Hours : 2+0

Theory

Unit No.	Lecture No	Name of Topic
I	1	Domestic animal diversity in India: Origin, history and Utilization
	2	Domestic animal diversity in India: Origin, history and Utilization
	3	Domestic animal diversity in India: Origin, history and Utilization
	4	Present status and flow of AnGR and It's contribution to livelihood security
	5	Present status and flow of AnGR and It's contribution to livelihood security
	6	Present status and flow of AnGR and It's contribution to livelihood security
	7	Methodology for Phenotypic and genotypic characterization of livestock and poultry breeds through systematic survey
	8	Methodology for Phenotypic and genotypic characterization of livestock and poultry breeds through systematic survey
	9	Management of breed
	10	Physical, biochemical and performance traits and uniqueness of animal breed
	11	Physical, biochemical and performance traits and uniqueness of animal breed
	12	Physical, biochemical and performance traits and uniqueness of animal breed
	13	Social, cultural and economic aspects of owners/communities rearing the breed
	14	Social, cultural and economic aspects of owners/communities rearing the breed

II	15	Methods for increasing effective population size of endangered breed/species
	16	
	17	Effective number of alleles, inbreeding effective size, variance effective size, minimal viable population size.
	18	Effective number of alleles, inbreeding effective size, variance effective size, minimal viable population size.
	19	Methodology of characterization of AnGR
	20	Methodology of characterization of AnGR
	21	nuDNA and mtDNA based diversity analysis and relationship among the breeds
	22	Concept of conservation *in-situ (in-vivo)*
	23	Concept of conservation e*x-situ (in-vitro)*
	24	Models of conservation
	25	Models of conservation
	26	Prioritization of breeds for conservation
	27	National and international strategies for conservation of livestock and poultry genetic resources
	28	National and international strategies for conservation of livestock and poultry genetic resources
	29	Gene bank concept
	30	Preservation of ecosystem
III	31	Status, opportunities and challenges in the conservation of AnGR
	32	IPR issues on animal genetic resources/animal products or by-products
	33	IPR issues on animal genetic resources/animal products or by-products
	34	IPR issues on animal genetic resources/animal products or by-products
	35	Registration of livestock breeds and protection of livestock owner's right in India
	36	Breed societies and their role in conservation

Course Title : Cattle and Buffalo Breeding
Course Code : AGB 607
Credit Hours : 2+1=3

Theory

Unit No.	Lecture No.	Name of Topic
I	1	History of dairy cattle and buffalo breeding
	2	Evolution of cattle and buffalo breeds and their characteristics
	3	Evolution of cattle and buffalo breeds and their characteristics

	4	Population dynamics and production systems
	5	Population dynamics and production systems
	6	Inheritance of important economic traits
	7	Inheritance of important economic traits
	8	Recording and handling of breeding data
	9	Recording and handling of breeding data
	10	Standardization of records
	11	Standardization of records
	12	Computation of correction factors for the adjustment of the data.
	13	Computation of correction factors for the adjustment of the data.
	14	International Committee on Animal Recording (ICAR) and INAPH
	15	International Committee on Animal Recording (ICAR) and INAPH
	16	Progeny testing under farm and field conditions
	17	Progeny testing under farm and field conditions
II	18	Evaluation of bulls by different models
	19	Evaluation of bulls by different models
	20	Estimation of breeding values of the cows
	21	Estimation of breeding values of the cows
	22	Nucleus breeding system
	23	Nucleus breeding system
	24	Marker- assisted selection
	25	Genomic selection
III	26	Crossbreeding in cattle in India and abroad
	27	Crossbreeding in cattle in India and abroad
	28	Development of new breeds
	29	Conservation of threatened breeds of cattle and buffaloes
	30	Role of breed associations in dairy improvement
	31	Breeding policy : National and State
	32	Breeding policy : National and State
IV	33	Import of exotic germplasm for breeding cattle in the tropics
	34	Appraisal of buffalo and cattle breeding programme
	35	Appraisal of buffalo and cattle breeding programme
	36	Role of breed associations in dairy improvement

Practical

Practical No.	Name of Topic
1	Performance recording
2	Performance recording
3	Standardization of records
4	Standardization of records
5	Estimation of economic traits
6	Estimation of economic traits

7	Computation of genetic parameters
8	Computation of genetic parameters
9	Computation of genetic parameters
10	Genetic gain
11	Genetic gain
12	Sire evaluation methods
13	Sire evaluation methods
14	Sire evaluation methods
15	Estimation of heterosis
16	Estimation of heterosis
17	Estimation of heterosis
18	Culling and replacement

Course Title : Sheep and Goat Breeding
Course Code : AGB 608
Credit Hours : 2+0=2

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Breeds-Sheep
	2	Breeds-Sheep
	3	Breeds-Goat
	4	Breeds-Goat
	5	Economic traits-Sheep
	6	Economic traits-Goat
	7	Population dynamics and production systems
	8	Prolificacy
	9	Breeding records and standardization
	10	Computation of correction factors
II	11	Genetic parameters
	12	Genetic parameters
	13	Selection of males and females of Sheep
	14	Selection of males and females of Sheep
	15	Selection of males and females of Goat
	16	Selection of males and females of Goat
	17	Selection indices for sheep and goat
	18	Selection indices for sheep and goat
	19	Breeding systems
	20	Breeding systems
	21	Breeding strategies for improvement of production (meat, milk and wool) and reproduction (fertility and fecundity)-Sheep
	22	Breeding strategies for improvement of production (meat, milk and wool) and reproduction (fertility and fecundity)-Goat

	23	Inbreeding and its effects on production traits
	24	Group Breeding schemes
	25	Development of new breeds
	26	Strategies for introgression of genes (fecundity & growth)-Sheep
	27	Strategies for introgression of genes (fecundity & growth)-Goat
III	28	Breeding policy
	29	Breeding policy
	30	Sheep and goat improvement programme in India
	31	Sheep and goat improvement programme in India
	32	Conservation of breeds
	33	Conservation of breeds
	34	Culling and replacement
	35	Culling and replacement
	36	Equivalent Animal Death Rate (EADR).

Course Title : Poultry Breeding
Course Code : AGB 609
Credit Hours :- 2+1=3

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Origin and history of poultry species: Chicken, turkey, duck and quail
	2	Origin and history of poultry species: Chicken, turkey, duck and quail
	3	Important qualitative traits in poultry including lethal
	4	Important qualitative traits in poultry including lethal
	5	Economic traits of egg type chicken and their standardization
	6	Economic traits of egg type chicken and their standardization
	7	Economic traits of meat-type chicken and their standardization
	8	Different mating systems
	9	Different mating systems
	10	Different mating systems
II	11	Selection criteria
	12	Selection indices
	13	Response to selection
	14	Genetic controls; Genotype and environment interaction;
	15	Inbreeding and its effects on production traits in egg and meat-type chickens; Development of inbred lines and strains; Strain and line crosses
	16	Introduction to diallel cross; Specialized sire and dam lines
	17	Utilisation of heterosis and reciprocal effect; Recurrent selection; reciprocal recurrent selection and modified RRS
	18	Utilisation of heterosis and reciprocal effect; Recurrent selection; reciprocal recurrent selection and modified RRS
	19	Genetic improvement programs in poultry
	20	Genetic improvement programs in poultry
	21	Selection strategies for the improvement of layers and broilers
	22	Selection strategies for the improvement of layers and broilers
	23	Performance testing of commercial strains
	24	Backyard poultry

III	25	Industrial breeding
	26	Artificial insemination in chicken;
	27	Auto-sexing in chicken
	28	Random Sample Test
IV	29	Biochemical variants and immunogenetics of poultry;
	30	Biochemical variants and immunogenetics of poultry;
	31	Use of molecular genetics in poultry breeding;
	32	Use of molecular genetics in poultry breeding;
	33	Quantitative trait loci;
	34	Quantitative trait loci;
	35	Marker-assisted selection and genomic selection;
	36	Conservation of poultry genetic resources

Practical

Practical No.	**Name of Topic**
1	Inheritance of qualitative traits
2	Economic traits of egg-type and meat-type chicken
3	Procedures of standardization
4	Procedures of standardization
5	Estimations of heritability
6	Estimations of heritability
7	The correlation between various production traits
8	Inbreeding co-efficient
9	Heterosis
10	Selection of sires and dams
11	Selection of sires and dams
12	Osborne index
13	Restricted selection index
14	Collection and evaluation of semen and insemination
15	Estimation of GCA and SCA
16	Estimation of GCA and SCA

Course Title : Laboratory Animal and Rabbit Breeding
Course Code : AGB 610
Credit Hours : 2+0

Theory

Unit No.	**Lecture No.**	**Name of Topic**
I	1.	Introduction to laboratory animal genetics
	2.	Breeding and Management of mice colonies
	3.	Breeding and Management of rats colonies
	4.	Breeding and Management of hamsters & guinea pigs
	5.	Breeding and Management of rabbits
	6.	Use of primates in animal research.
II	7.	Selection methods and mating systems in monogamous
	8.	Selection methods and mating systems in polygamous
	9.	Selection methods and mating systems in other species
III	10.	Development of genetically controlled laboratory animals

	11.	Rules for nomenclature: Inbred strains & outbred stocks,
	12.	Rules for nomenclature: Inbred strains & outbred stocks,
	13.	Mutant stocks & recombinant inbred strains
	14.	Transgenic strains
	15.	Transgenic strains
	16.	Gene targeting and production of 'gene knock-out' animals
	17.	Production and use of specific pathogen-free animals
	18.	Guidelines and SOPs for the establishment of lab animal house
	19.	Genetic control and monitoring of lab animals
	20.	Record-keeping in Lab Animal House
	21.	FELASA role in ethics of laboratory animal research
	22.	FELASA role in ethics of laboratory animal research
	23.	CPCSEA role in ethics of laboratory animal research
	24.	CPCSEA role in ethics of laboratory animal research
	25.	Ethics of laboratory animal research: IAEA regulations
	26.	Ethics of laboratory animal research: IAEA regulations
	27.	Rabbit breeds for meat and wool
	28.	Rabbit breeds for meat and wool
IV	29.	Economic traits and their inheritance in Rabbit
	30.	Breeding and Management of Rabbits
	31.	Breeding records in Rabbit
	32.	Standardization in Rabbit
	33.	Selection methods in Rabbits
	34.	Breeding systems in Rabbits
	35.	Breeding importance of laboratory animals and their applications in animal genetics
	36.	Importance of Lab Animals in Research

Course Title : Swine Breeding
Course Code : AGB 611
Credit Hours : 1+0

Theory

Unit No.	Lecture No.	Name of topic
I	1	History and development of swine industry
	2	Different breeds of pigs-Indian
	3	Different breeds of pigs-Exotic
	4	Economic traits of swine
	5	Breeding records and standardization of records in pig.
	6	Computation of correction factors in data
	7	Computation of correction factors in data
	8	Culling and replacement of pig
	9	Equivalent Animal Death Rate (EADR) in pig
	10	Genetic parameters; Bases and methods of selection in pig
	11	Selection of boars and sows in pig.
	12	Selection of boars and sows in pig.

II	13	Breeding systems; Breeding strategies for improvement of indigenous and pure exotic breeds.
	14	Inbreeding and its effects on performance traits of pig
	15	Exploitation of heterosis in pig
	16	Development of synthetic varieties/ breeds in swine
III	17	Swine breeding policy; National swine improvement programme in India.
	18	Conservation of native breeds of pig

Course Title : Pet Animal Breeding (Dogs and Cats)
Course Code : AGB 612
Credit Hours : 1+0=1

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Breeds of dogs: Classification of breeds, important Indian and exotic breeds
	2	Breeds of dogs: Classification of breeds, important Indian and exotic breeds
	3	Pedigree breeding and maintenance of breeding records
	4	Pedigree breeding and maintenance of breeding records
	5	Kennel Club
	6	Breed associations
	7	Breed associations
	8	Breeding management of dog.
	9	Breeding management of dog.
II	10	Breeds of cats: Classification of breeds
	11	Breeds of cats: Classification of breeds
	12	Important Indian and exotic breeds.
	13	Important Indian and exotic breeds.
	14	Pedigree breeding and maintenance of breeding records.
	15	Pedigree breeding and maintenance of breeding records.
	16	Pedigree breeding and maintenance of breeding records.
	17	Breeding management of cat.
	18	Breeding management of cat.

Course Title : Wild Animal Genetics and Breeding
Course Code : AGB 613
CreditHours : 1+0

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Wild life Biodiversity in India
	2	Adaptation and Natural selection, Species and Speciation
	3	Population dynamics; Variation; Loss of genetic variation;
	4	Hardy Weinberg equilibrium.
II	5	Inbreeding and Inbreeding depression
	6	Inbreeding and Inbreeding depression
	7	Effective population size

	8	Demographic bottleneck
	9	Genetic considerations in the translocation of wild animals
	10	Wild animal breeding in nature and captivity
	11	Captive breeding projects and principles
	12	Concept of landscape genetics.
III	13	Conservation of wild animals; Cryopreservation of semen and embryos of endangered species; Frozen zoo concept
	14	Genetic markers and its various types
	15	Application of molecular and cytogenetic techniques in wildlife breeding
	16	Application of molecular and cytogenetic techniques in wildlife breeding
	17	Genetic defects in wild animals
	18	Wildlife Protection Act

Course Title : Equine Breeding
Course Code : AGB 614
Credit Hours : 1+0=1

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Equine population in India
	2	Domestic diversity, its origin, history and utilization
	3	Breeds of native and exotic horses
	4	Breeds of native and exotic horses
	5	Types and classes of light and work-horses.
II	6	Cytogenetics of horses and donkeys
	7	Breeding of horses and donkeys and production of mules
	8	Foaling and care of foal
	9	Important quantitative and qualitative traits and their inheritance
	10	Important quantitative and qualitative traits and their inheritance
	11	Recording and handling of breeding data
	12	Standardization of records
III	13	Stallion and mare complementation
	14	Judging criteria for elite animals
	15	Conservation strategies
	16	Selecting the mare and the stallion for breeding
	17	Ongoing breed improvement programmes
	18	Biotechnology in equine breeding programmes

Course Title : Camel Breeding
Course Code : AGB 615
Credit Hours : 1+0

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Population dynamics and economic importance
	2	Breeds of the camel
	3	Production systems and herd structure
	4	Inheritance of important economic traits
	5	Recording and handling of breeding data,
	6	Standardization of records
	7	Cytogenetics of the camel
	8	Behaviour and breeding management
II	9	Judging criteria for elite animals
	10	Selection of breeding stock
	11	Breeding seasons, Methods for detection of heat
	12	Natural service and artificial insemination
	13	Breed improvement programmes
	14	Breed improvement programmes
III	15	Conservation strategies
	16	Immune status of camel
	17	Molecular genetics in camel breeding
	18	Molecular genetics in camel breeding

Course Title : Yak and Mithun Breeding
Course Code : AGB 616
Credit Hours : 1+0=1

Theory

Unit No.	Lecture No.	Name of Topic
I	1	Population dynamics and economic importance of Yak and Mithun
	2	Breeds/ types of yak
	3	Breeds/ types of Mithun
	4	Production systems; important economic traits and their inheritance
	5	Recording and handling of breeding data;
	6	Standardization of records
	7	Cytogenetics of Yak and Mithun
	8	Behaviour and breeding management.
II	9	Judging criteria for elite animals
	10	Selection of breeding stock
	11	Breeding seasons; Methods for detection of heat
	12	Natural service and artificial insemination
	13	Breed improvement. programmes
	14	Breed improvement. programmes
III	15	Conservation of Yak
	16	Conservation of Mithun
	17	Molecular genetics in Yak and Mithun breeding
	18	Molecular genetics in Yak and Mithun breeding

Course Title : Statistical Methods in Animal Breeding
Course Code : AGB 617
Credit Hours : 2+1

Theory

Unit No.	Lecture no.	Name of Topic
I	1	Measures of central tendency
	2	Measures of central tendency
	3	Measures of central tendency
	4	Measures of dispersion
	5	Measures of dispersion
	6	Measures of dispersion
	7	Correlation
	8	Regression
	9	Probability
	10	Theory of distributions
	11	Transformation of data
	12	Sampling: Theory, need and properties
	13	Concept of Estimators
	14	Standard error and importance
II	15	Basics of statistical inferences
	16	Parametric tests: *Z* distribution
	17	Parametric tests: *t* distribution
	18	Parametric tests: *t* distribution
	19	Parametric tests:*F* distribution
	20	Non-parametric test: c^2 sign test
	21	Non-parametric test: run test
	22	Non-parametric test: rank test
	23	Confidence interval
III	24	Analysis of variance
	25	Analysis of variance: One way
	26	Analysis of variance: two way
	27	Analysis of variance: two way
	28	Experimental designs
	29	Experimental designs: CRD
	30	Experimental designs: RBD
	31	Experimental designs: LSD
	32	Missing plot techniques-RDB
	33	Missing plot techniques-LSD
	34	Analysis of covariance
	35	Analysis of covariance
	36	Analysis of covariance

Practical

Practical No.	Name of Topic
1	Measures of central tendency
2	Measures of dispersion
3	Correlation
4	Regression
5	Transformation of data

6	Probability
7	Z tests
8	t tests
9	F tests
10	c^2 tests
11	CRD
12	CRD
13	RBD
14	RBD
15	LSD
16	Missing Plot
17	Analysis of covariance
18	Analysis of covariance

7. Academic Calendar – UG, PG, PhD -Year wise / Semester Wise
8. College Classes Time Table :UG, PG , PhD - Year wise / Semester Wise
9. Examination Time Table – UG, PG , PhD - Semester / Year wise - Theory and Practical
10. Result –UG, PG , PhD - Semester Wise / Year Wise