Department of Animal Husbandry and Dairy Science
Mahatma Phule Krishi Vidyapeeth
Rahuri-413 722, Dist. Ahmednagar (MS)

Master's Programme in Animal Husbandry

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit(s)
1.	Major	20
2.	Minor	10
3.	Supporting	06
4.	Seminar	01
5.	Research	20
	Total Credits	**57**
	Compulsory Non Credit Courses	06

Sr. No.	Course Number	Course Title	Credits
A) Major subjects (Min. 20 credits)			
	AH -501	Livestock Production and Management	3 = 2 + 1
	AH -502	Selection Methods and Breeding Systems	3 = 2 + 1
	AH-503	Principles of Animal Nutrition	3 = 2 + 1
	AH -504	Animal Behaviour and Integrated Livestock Farming	3 = 2 + 1
	AH -505	Physiology of Lactation	2 = 2 + 0
	AH -506	Population and Quantitative Genetics	3 = 2 + 1
	AH -507	Ruminant Nutrition	3 = 2 + 1
B) Minor Subjects (Min. 10 credits)			
	DSC-501	Market Milk Process Technology	3 = 2 + 1
	AH-508	Analytical Techniques in Animal Nutrition	2 = 0+2
	AH -510	Sheep and Goat Production and Management	2 = 1 + 1
	AH-509	Molecular Genetics in Animal Breeding	2 = 1 + 1

C) Supporting Subjects (Min. 06 credits)			
	STAT-511	Statistical Methods for Applied Science	3 = 2+1
	STAT-508	Design of Experiments for Animal Science	3 = 2+1
		OR	
	MBB -511	Animal Biotechnology	3= 3+0
D) Seminar (01 credit)			
	AH- 591	Master's Seminar	1 =0+1
E) Master's Research (20 credits)			
	Thesis – 599	Research	20=0+20
F) Non Credit Compulsory Courses			
	PGS-501	Library and information services	1=0+1
	PGS-504	Basic concepts in laboratory techniques	1=0+1
	PGS-502	Technical writing and communication skills	1=0+1
	PGS-503	Intellectual property and its management in agriculture	1=0+1
	PGS-505 (e-course)	Agriculture Research, Research Ethics and Rural Development Programmes	1 = 1 + 0
	PGS-506 (e-course)	Disaster Management	1 = 1 + 0

Course Contents

A)Major Subjects:

Syllabus of Theory and Practical with Suggested Readings/Books

Animal Husbandry
M. Sc. (Agri.)

Course No. AH 501
Course Title: Livestock Production and Management
Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Developments and prospectus of livestock industry in India and abroad	1	3
2	Role and status of livestock in Agriculture	2	7
3	Sustainable Animal Production systems	2	7
4	Characteristics of ideal dairy farm	2	6
5	Selection of elite animals	1	3
6	Management of calf	1	3
7	Management of heifers	1	3
8	Management of milking cows/buffaloes	1	3
9	Management of dry cows/buffaloes	1	3
10	Management of pregnant cows/buffaloes	1	3
11	Management of breeding bulls	1	3
12	Stress management of livestock.	2	6
13	Fodder production planning and judicious utilization of resources	3	10
14	Computation of ration for different categories of livestock	5	16
15	Culling and disposal of animals	1	3
16	Marketing of livestock	1	3
17	Preparation of animals for show	1	3
18	Animal health management	1	3
19	Milking systems and hygienic milk production	1	3
20	Labour management	1	3
21	Preparation of project reports for finance	1	3
22	Introduction of computer in livestock Management	1	3

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Routine and periodic livestock farm operations	1	6
2	Management of Young stock	1	6
3	Management of growing animals	1	6
4	Management of adult stock	1	7
5	Different farm structures on livestock farm	2	13
6	Judging of livestock	1	6
7	Valuation of livestock	1	6
8	Preparation of calendar for fodder Production	1	6
9	Economics of raising different categories of animals	1	7
10	Systems of milking and clean milk Production	1	6
11	Preventive measures for health Management		6
12	Preparation of viable bank proposal for financial assistance	1	7
13	Visit to modern livestock farms, livestock markets and fairs	1	6
14	Disposal and utilization of dairy farm waste.	1	6
15	Different records maintained at Dairy farm.	1	6

Suggested Readings:

Thomas C.K. and Sastry N.S.R. (1991) Dairy Bovine production 1st ed, Kalyani Publication Ludhiana, India.

Bath D. L., (1978) Dairy cattle Principles practices problems profits 2nd ed , Lea and Febiger publishing house Philadelphia U.S.A.

Sastry N.S.R. Thomas C.K. and Singh R.A. (1976) Farm Animal management and poultry production, vikas publishing House Ltd, 5., Ansari Road, New Delhi 110 016

Hafez E.S.E. (1989) (Indian ed) Reproduction in farm animals K.M. Verghese Co., Po. Box No. 7119, Mumbai 31

Cooper G.M. (1998) Building construction Estimation Mc Graw Hill Book Publishing Co. Inc., New York USA

Course No. AH 502

Course Title: Principles of Animal Breeding

Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	History and concept of Animal Breeding	2	6
2	Study of common terms used in genetics	1	3
3	Chromosome, gene, mutation	1	3

4	Gene action,	1	3
5	Variations, its causes and importance	1	3
6	Inheritance, sex linked, sex influenced and sex limited characters,	2	6
7	Importance of heredity and environment,	2	6
8	Concept of heritability and its estimates,	2	6
9	Concept of repeatability and its estimates.	2	6
10	Correlated traits and correlations	1	3
11	Estimation of phenotypic segregations	1	3
12	Estimation of genetic correlation	1	3
13	Estimation of environmental correlations	3	10
14	Concept of selection and basis	1	3
15	Methods of selection	1	3
16	Response to selection	1	3
17	Sire evaluation	1	3
18	Breeding systems	2	6
19	Genotypic and phenotypic effects	1	3
20	Heterosis, practical uses	2	6
21	Concept of GCA and SCA and selection for specific combining ability	2	6
22	Breeding policy for livestock	1	3
23	Diallel crossing in poultry.	1	3

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Estimation of gene and genotypic frequency	2	13
2	Estimation of coefficient of inbreeding	2	13
3	Estimation of heritability	2	13
4	Estimation of repeatability.	2	13
5	Persistency of milk production	1	6
6	Estimation of genetic and phenotypic correlations.	2	6
7	Estimation of genetic gain	1	6
8	Estimation of breeding value of cow/sire,	1	6
9	Construction of selection index	2	6
10	Construction of sire index.	1	6
11	Estimation of heterosis and breeding efficiency.	1	6
12	Estimation of GCA and SCA.	1	6

Suggested Readings:

Lasley J.S. (1978) Genetics of livestock improvement, New Delhi, Prentice House of India.

Kanakraj, P, (2001) A text book of Animal Genetics I, International Book Distributing Co. Lucknow. India.

Jagdish Prasad, (1996) Animal genetics and breeding practices, International Book Distribution co Lucknow, India

Rice V.A. And Andrews F.N., (1964) Breeding and improvement of farm animals 6th ed.
Falconer, D.S. (1981) introduction to quantitative genetics, English language book Society, England
Tomar S.S., (1998) A text book of population genetics Vol. I and II Kalyani publisher, Ludhiana, India.

Course No. AH 503
Course Title: Principles of Animal Nutrition
Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	History of Animal nutrition	1	3
2	Classification of carbohydrates, fat and proteins	3	10
3	Role of nutrients in animal body	2	7
4	Digestion, absorption and metabolism of carbohydrates in ruminants and non ruminants	3	10
5	Digestion, absorption and metabolism of fat in ruminants and non- ruminants	2	7
6	Digestion, absorption and metabolism of proteins in ruminants and non ruminants.	3	9
7	Significance of crude fiber	1	3
8	Rumen degradable and undegradable proteins and kinetic	2	6
9	Feed energy and its partitioning	1	3
10	Systems of expressing protein values of feeding stuffs	1	3
11	Energy and protein requirement for maintenance,	2	7
12	Energy and protein requirement for growth	2	6
13	Energy and protein requirement for pregnancy	2	7
14	Energy and protein requirement for lactation in ruminants	2	6
15	Metabolic disorders in ruminants and non ruminants	2	6
16	Protein: energy inter relationships.	2	7

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Digestive systems of ruminants and non-ruminants	2	6
2	Design and lay out for nutritional experiments	1	3
3	Digestion trial and digestibility co- efficient for nutrients	2	6
4	Metabolic trial and calculation of nutrient balances.	2	6
5	Nutritive ratio	1	3
6	Estimation of PER, BV, EAAI, C : N ratio, PRV	2	7
7	Determination of energy values of feeding stuff i.e. GE, DE, ME and NE	4	13

8	Determination of energy values of feeding stuff i.e. DCP and TDN.	2	6

Suggested Readings :

Banerjee G.C. (1998) Feeds and principles of Animal nutrition. Oxford and IBH Publ. PVT Ltd, New Delhi.

Ranjhan S.K. (1983) Animal nutrition and feeding practices kalyani Pub. Co., Ludhiana, New Delhi.

Maynord, L.A. Loosli J.K,. Hintz H.F. and Warner R.C. (1979) Animal nutrition 7th ed. Tata Mc Grow Hill publishing Co., New Delhi

Prasad. J. Tyagi A.K. and Niraj, (1999), Principles and practices Animal nutrition, Kalyani publishing Co. Ludhinana, New Delhi.

Reddy, B.V. (2001) Principles of Animal nutrition and feed technology, oxford and IBH Publ, New Delhi

Ranjhan S.K. and Krishna G. (1980) Laboratory methods for Research workers, Kalyani Publ. Co., Ludhiana, New Delhi

Mc Donald P., Edwards R.A. and JFD Greenhalgh (1969) Animal nutrition.

Course No. AH 504

Course Title: Animal Behaviour and Integrated Livestock Farming

Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Introduction, Importance and Patterns of livestock behavior	1	6
2	Daily and seasonal cycles of behavior	1	3
3	Physiological basis of behavior	1	3
4	Environmental modification of behavior	1	3
5	Developmental changes in behavior	1	3
6	Genetic differences in behavior	1	3
7	Behavioral disorders.	1	3
8	Physical environment and behavior	1	3
9	Common vices and their remedial measures	1	3
10	Analysis of behavior in relation to location, climatic environment and social behavior.	2	7
11	Scope and limitation of integrated farming systems	1	3
12	Sustainability of integrated livestock farming systems and their economic importance.	2	6
13	Livestock enterprises viz; cattle, buffalo,	2	6
14	Livestock enterprises viz; sheep, goat,	2	6
15	Livestock enterprises viz; poultry .	1	3
16	New approach for changing farming systems in present energy crises vis-à-vis gobar gas	4	13

	plant, FYM, solar and wind energy utilization.		
17	Project formulation, and evaluation of various livestock enterprises.	4	13
18	Various livestock farming systems and their economic analysis.	4	13

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Behavioral pattern of cattle- Indigenous and crossbreds	1	6
2	Behavioral pattern of buffalo	1	6
3	Behavioral pattern of sheep	1	6
4	Behavioral pattern of goat	1	6
5	Reproductive behavior	1	7
6	feeding/ grazing behavior	1	6
7	Common vices of different livestock species	2	13
8	Energy crises vis-à-vis gobar gas plant, FYM, solar and wind energy utilization	4	25
9	Evaluation of farming systems and preparation of feasibility report	4	25

Suggested Readings:

Arora MP. 1995. Animal Behaviour. WB London.
Bouenger EG. 1994. Animal Behaviour. WB London.
Fraser AF & Broom DM. 1997. Farm Animal Behaviour and Welfare. CABI.
Fraser AF & Broom DM. 1999. Farm Animal Behaviour and Welfare.
Kumar V. 1996. Animal Behaviour. WB London.
Mukharjee TK. 1992. Integrated livestock Fish Production Systems.
Raman KV & Balaguru T. (Eds.). 1992. Farming systems Research in India: Strategies for Implementation. NAARM.
Renard C. (Ed.). 1997. Crop Residues in Sustainable Mixed Crop / Livestock Farming Systems. CABI.
Speirs M. & Opsen O. 1992. Indigenous Integrated arming System in the Sahel. World Bank.

Course No. AH 505

Course Title: Physiology of lactation

Course Credit: 2+0 = 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Introduction and importance of physiology of lactation in relation with milking management	2	6
2	Internal structure of udder of different species	2	6
3	Duct system, blood supply, lymphatic and nervous	4	13

	system of udder		
4	Development of mammary glands	1	3
5	Hormones and their role in development of mammary glands	2	6
6	Involution of udder	1	3
7	Initiation and maintenance of lactation	2	7
8	Induction of lactation	1	3
9	Control of milk secretion	1	3
10	Biosynthesis of milk	1	7
11	Biosynthesis of protein	1	3
12	Biosynthesis of lactose	1	3
13	Biosynthesis of fat	1	3
14	Biosynthesis of minerals	1	3
15	Biosynthesis of vitamins	1	3
16	Milk harvesting and milking manage	3	10
17	Factors affecting milk yield	2	6
18	Factors affecting composition viz., physiological, genetic, nutritional and environmental.	4	12

Suggested Readings :

Banarjee G.C., (1986) Text book of Animal Husbandary 6th Oxford and IBH Publication Pvt. Ltd. New Delhi

Smith, V.R. (1981) Physiology of lactation Iowa state University Press Ames Town

Smith, V.R. and Bruce Larson (1984) Lactation II

Colin, T., White Moore, (1980) Lactation of the dairy cow.

Bath D.L., (1978) Dairy cattle principles, Practices profits and problems 2nd ed Lea and Ebiger Publishing House, Philadelefia.

Thomes, C.K. and Sastri, N.S.R., (1991) Dairy bovine production Kalyani publication Co. Ludhiana India

Hafez, E.S.E. (1980) Reproduction in farm animals 4th ed K.M. Verghese Co. P.B. No. 7119 Bombay 400 031

Smith, G.H and Vanvleck L.D., (1974) Principles of Dairy Science W.H. freeman and Co., Sanfransisco.

Course No. AH 506
Course Title: Poultry Production
Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Importance of poultry keeping in India	1	3
2	Classification of chicken	1	3
3	Important breeds and varieties of chicken	1	3
4	Selection and care of hatching eggs	2	7
5	Incubation of eggs	1	3

6	Hatchery management	1	3
7	Care and management of chicks	1	3
8	Care and management of growers	1	3
9	Care and management of layers	1	3
10	Care and management of broilers	1	3
11	Selection and culling of birds for egg and meat production	2	7
12	Thermal stress in poultry during summer	2	6
13	Feeding practices for various categories of birds	2	6
14	Prophylactic measures for prevention of diseases	2	6
15	Methods to enhance egg production	2	7
16	Methods to enhance meat production	2	6
17	Economics of poultry production and marketing	2	7
18	Care and management of turkey	1	3
19	Care and management of ducks	1	3
20	Care and management of quails	1	3
21	Care and management of geese and guinea fowl	1	3
22	Care and management of Ostrich / emu	1	3

Practical:

Sr. No.	Name of Topic	No. of Practicals	Weightage (%)
1	Body parts of adult chicken	1	6
2	Body parts of duck	1	6
3	Body parts of turkey	1	6
4	Routine management practices of poultry farm viz., fumigation, incubation, brooding, debeaking and sanitation	1	6
5	Hatching of eggs and chick sexing	1	6
6	Management of chicks	1	6
7	Management of pullets and growers	1	6
8	Management of layers	1	6
9	Management of broilers	1	6
10	Selection and culling	1	6
11	Feed and feed formulation and management	1	6
12	Different housing regimes	1	6
13	Vaccination	1	6
14	Dressing of birds	1	6
15	Organoleptic evaluation of chicken mean	1	6
16	Proposal for commercial layer and broiler farms	1	6

Suggested reading:

Jull, M.A. (1951). Poultry husbandry Mc Grow Hill Co New York
Singh R.A. 2001. Poultry Production Kalyani Publishers New Delhi
Pand, B. 1985 Poultry Production

Anonymous 1996. Advances in poultry production processings of 20th world poultry congress.
Gupta S. 2001. Indian Poultry year book, new Delhi
Banargee G.C. 1976. Poultry Oxford and IBH publication Co. New Delhi
Jagdish Prasad 2000. Poultry production and management, Kalayani Publishers, New Delhi
Newman, T. Principles and Practices of poultry husbandry Green World Publication Co. Lucknow
Saxena U.C. 2000. Hand book of poultry feeding and management PIXE Publications, Karnal
Narhari D. 2000. Poultry economics and Projects New Print and Process

Course No. AH 507
Course Title: Ruminant Nutrition
Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Nutrients and their metabolism with special ference to milk production	1	3
2	Nutrients and their metabolism with special reference to meat production	1	3
3	Nutrients and their metabolism with special reference to wool production.	1	3
4	Feeding standards-history, comparative appraisal and limitations.	2	7
5	Nutrient requirements for different categories of cattle	1	7
6	Nutrient requirements for different categories of buffaloes	1	3
7	Nutrient requirements for different categories of sheep	1	3
8	Nutrient requirements for different categories of goat.	1	3
9	Introduction to rumen microflora and fauna.	1	3
10	Development of rumen.	1	3
11	Milk replacer and calf starters.	1	3
12	Feed formulation for large ruminants for different physiological stages	4	13
13	Feed formulation for small ruminants for different physiological stages.	4	13
14	Concept of complete feed.	1	3
15	Limiting nutrients and strategic feeding of high yielding ruminants.	2	7

16	Concept of by-pass nutrients and their impact on production, reproduction and immune status.	3	10
17	Importance of CLA, omega fatty acids, and scope for value addition in milk	2	6
18	Systems of feeding buffalo for beef production	1	3
19	Feeding of livestock in various agro-climatic zones of India and during natural calamities.	2	7
20	Feed additives and supplements.	1	3

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Identification of feeds and fodder on the basis of its composition.	2	12
2	Artificial rumen technique	2	12
3	Methods for evaluation of feed stuffs *in vitro, in sacco* digestion kinetics.	4	25
4	Determination of nutritive value of feeds and fodders by the metabolism trial in dairy cattle	3	12
5	Determination of nutritive value of pastures by the use of range techniques	2	12
6	Study of rumen metabolic profile.	1	6
7	Preparation of Bypass Nutrients	2	13
8	Rumen studies: Identification of rumen microbes.	1	6
9	Enrichment of low quality feeds and fodder.	1	6
10	Computation of ration for various categories of livestock.	1	6

Suggested Readings:

Dhority BA. 2003. Rumen Microbiology. Nottingham Univ. Press.
Kellems RO & Church DC. 2002. Livestock Feeds and Feeding. Prentice Hall. Ranjhan S.K. 2001. Animal Nutrition in the Tropics. Sangam Books.

B) Minor Subjects

Course No. AH 508
Course Title: Analytical Techniques in Animal Nutrition
Course Credit: 0+2 = 2

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Proximate analysis of feeds including minerals	6	19
2	Proximate analysis of fodders including minerals	7	22

3	Van Soest method of chemical analysis	3	9
4	estimation of anti nutritional factors	4	13
5	estimation of aflatoxins	4	12
6	determination of gross energy content of feeds	4	12
7	NIR method of feed analysis	4	13

Suggested Readings:

Gupta P.C. Khatta V.K. and Mandal. A.B. (1988) Analytical Techniques in Animal nutrition,

Ranjhan, S.K. and Gopal Krishna (1980) Laboratory Manual for nutritional research, Kalyani Publ. New Delhi

Banerjee G.C. (1978) Animal Nutrition oxford and IBH publication co New Delhi

Cullisan A.E. (1978) Feeds and feeding

A.O.A.C (1995) A.O.A.C. Official Methods of analysis Association of official analytical chemist Inc. suite 400 Virginia, USA

Ranghwan S.K. (1997) Animal Nutrition and feeding practices, Vikas publishing house Pvt. New Delhi

Course No. AH 509
Course Title: Sheep and Goat Production and Management
Course Credit: 1+1 = 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Importance of sheep and goat in India	1	6
2	Present status of sheep and goat in India	1	6
3	Breeds of sheep and goat	1	6
4	Improvement of sheep for mutton and wool and goat for meat and milk	1	7
5	Establishment of commercial sheep and goat farm	1	6
6	Care and management of young stock	1	6
7	Care and management of breeding stock	1	6
8	Care and management of pregnant and lactating animals	1	7
9	Improvement and utilization of pasture and Grassland	1	6
10	Silvipasture for sustainable sheep and goat production,	1	6
11	Utilization of top feeds and non conventional feed and fodder resources,	1	6
12	Economics of sheep and goat production,	1	6

13	Common diseases of sheep and goat and their control,	1	6
14	Hygienic slaughtering of sheep and goat for meat,	1	7
15	Marketing structure for meat, milk and wool,	1	6
16	Recent advances in sheep and goat production and management.	1	7

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Routine and periodic farm operations followed on sheep and goat farms	1	6
2	Management calendar for sheep and goat	1	7
3	Management calendar for goat	1	6
4	Recording of data on Production and reproduction	1	7
5	Economic rearing of kids and lambs	1	6
6	Grazing behaviour and feeding practices for sheep and goat,	1	6
7	Selection and breeding of sheep and goats	1	6
8	General care and management of pregnant and lactating does	1	7
9	General care and management of pregnant and lactating ewes	1	6
10	Shearing management,	1	6
11	Systems of housing	1	6
12	Farm equipments used at goat and sheep farm	1	7
13	Slaughter and carcass evaluation,	1	6
14	Cost of production of mutton, wool and milk	1	6
15	Rearing of sheep and goat on silvipastural system	1	6
16	Preparation of proposal for commercial sheep and goat farm.	1	6

Suggested Readings :

Bhattacharya N.K. (1989) Goat Produciton CIRG Makhadoom

Kurag C.K. (1985) Management practices for goats NDRI Karnal

Jindal (1984) Goat production Falcon book Publication Co. new Delhi

Kaushik S.K. (1988) Sheep production in tropics and subtropics

Devendra, C. and Burns, (1970) Goat production in tropics

Acharya R.M. (1982) Breeding strategy for sheep in India

Ranjan, S.K. (1989) Text Book Quality meat production Vikas publication house, New . Delhi.

Course No. AH 510
Course Title: Population and Quantitative Genetics
Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Individual verses population.	1	3
2	Genetic Structure of population	1	6
3	Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal populations.	3	10
4	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	4	13
5	Small population, random genetic drift	2	6
6	effective population size, pedigreed populations,	2	6
7	regular and irregular inbreeding systems.	3	9
8	Quantitative genetics-gene effects, population mean and variance and its partitioning,	3	9
9	biometric relations between relatives.	1	6
10	Genetic and phenotypic parameters-their methods of estimation, uses, possible biases and precision.	4	13
11	Scale effects and threshold traits.	2	6
12	Laws of probability in animal breeding, gene frequencies, genotypic frequencies and their estimation, Hardy Weinberg equilibrium,	4	13

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Estimation of gene and genotypic frequencies under different conditions.	4	25
2	Estimation of inbreeding coefficient in regular and irregular systems. 9-10. Estimation of effective population size.	3	19
3	Computation of quantitative genetic effects.	2	13
4	Estimation of variance components	1	12
5	Computation of heritability,	1	12
6	Computation of repeatability,	1	6
7	Computation of genetic, environmental and phenotypic correlations.	1	13

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.
Prichner F. 1981. Population Genetics in Animal Breeding. S. Chand.

Course No. AH 511
Course Title: Molecular Genetics in Animal Breeding
Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Basic concept, Genesis and importance of molecular techniques	2	6
2	Genome organization physical and genetic map	2	7
3	Current status of genome maps of livestock.	1	6
4	Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting.	6	13
5	DNA sequencing,	1	6
6	Genome sequencing	1	7
7	Genomic Library,	1	6
8	Polymerase Chain Reaction (PCR), its types (PCR-RELP, AS-PCR , RT-PCR etc.) and applications;	3	6
9	Transgenesis and methods of gene transfer.	2	6
10	Statistical techniques for analyzing molecular genetic data,	2	7
11	Quantitative Trait Loci (QTL) mapping and its application in animal breeding,	3	6
12	Genome scan,	1	6
13	Candidate gene approach,	2	6
14	Genomic selection,	1	6
15	Marker Assisted Selection – basic concept.	3	6

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Extraction and purification of genomic DNA,	4	25
2	Gel electrophoresis,	1	13
3	PAGE,	1	6
4	Restriction enzyme digestion of DNA and analysis,	2	13
5	PCR,	1	6
6	PCR-RELP,	1	7
7	PCR-SSCP,	1	6
8	Bioinformatics tool for DNA sequence analysis,	2	6
9	Design of primer,	1	6
10	Isolation of RNA, cDNA synthesis,	1	6
11	Statistical methods for analyzing molecular genetic data	1	6

Suggested Readings:

Akano IE 1992. *DNA Technology*, IAP Academic Press.

Micklos DA, Fryer GA & Crotty DA. 2003. *DNA Science*. Cold Spring Harbour.

Setlwo JK. 2006. *Genetic Engineering – Principles and Methods*. Springer.

COURSE NO: DSC 501
COURSE TITLE: MARKET MILK PROCESS TECHNOLOGY
COURSE CREDITS: 2+1= 3

Theory:

Sr. No.	NAME OF TOPIC	No. of Lectures	Weightage (Marks)
1	Present status related to milk production, processing by organized Unorganized and private sector, Milk utilization pattern scope for export of market milk.	2	6
2	Technology mission on dairy development in India and abroad in relation to past present and future- i.e. operation flood programme, MMPO etc.	3	10
3	Procurement pattern of milk- organized, unorganized and private sector	2	6
4	Pricing policy for procurement of milk	2	6
5	Role of bulk coolers in extension of shelf life and reduction of losses of raw milk	2	6
6	Alternative practices for preservation of raw milk i.e. LP system, zero- energy chamber	3	9
7	Quality assessment of milk- Chemical and microbial standards	2	6
8	Quality control measures for market milk: detection of adulteration, HACCP etc.	2	6
9	Processing of liquid milk: cooling, separation, standardization, homogenization, pasteurization and alternative processes like UHT, sterilization, bactofugation, packaging and cold storage	4	12
10	Disposal pattern of market milk- organized and unorganized sector	1	3
11	Special milks: Processes, Standards	3	9
12	Shelf life- Flavour, tonned, low fat, fortified milk etc.	2	9
13	Problems of unsold and returned milk- Definition, courses consequences etc.	1	3
14	Utilization of unsold and returned milk: neutralization, reprocessing, product manufacturing, quality check	3	9

Practical

SR. NO.	TITLE OF PRACTICAL	No. of Practical	Weightage (Marks)
1	Study of various platform test on receiving of milk: i.e. organoleptic evaluation-verification of container, temperature, odour, dirt & dust, taste, acidity, COB, etc.	1	6
2	Sampling of milk- procedure, collection, sample preservation	1	6
3	Determination of physico chemical constituent of milk fat, SNF, pH, acidity.	1	6
4	Microbiological tests- MBR, Microscopic count, Resazurin etc.	1	6
5	Detection of adulterants in milk- starch, sugar, urea, soap, neutralizer	2	13
6	Separation of milk for various purposes	2	13
7	Standardization of milk for various purposes using Pearson square technique	1	6
8	Judging and grading of raw and processed milks.	1	6
9	Assessment of organoleptic, chemical character of unsold & returned milk.	1	6
10	Neutralization of unsold & returned acidic milk.	1	6
11	Reprocessing of unsold & returned milk. i.e. product manufacture- Khoa, Paneer / Chhana, Dahi, Butter, Ghee etc.	2	13
12	Cleaning and sanitization of dairy equipment / utensils	1	6
13	Visit to modern milk processing plant to study various operations.	1	7

Suggested Reading:

1. Sukumar De (2006) Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.
2. Henderson, J.L. (1971) Fluid milk industry. The AV Publ. Co. Inc. Westport Connecticut.
3. Robinson, R.K. (1986) Modern Dairy Technology Vol. l. Elsevier Applied Science, London.
4. Harper W.J. and Hall C.W. (1981) Dairy Technology and Engineering.
5. Aneja R.P., Mathur, B.N; Chandan R.C. and Banerjce A.K. (2002) Technology of Indian Milk Product.

C) Supporting Subjects

	STAT-511	Statistical methods for applied science	3 = 2+1
	STAT-508	Design of experiments for Animal Science	3 = 2+1
		OR	
	MBB -511	Animal Biotechnology	3= 3+0

D) Seminar

	AH- 591	Master seminar major course	1 =0+1

E) Masters' Research

	Thesis – 599	Research	20

F) Compulsory Non Credit Courses

	PGS-501	Library and information services	1=0+1
	PGS-504	Basic concepts in laboratory techniques	1=0+1
	PGS-502	Technical writing and communication skills	1=0+1
	PGS-503	Intellectual property and its management in agriculture	1=0+1
	PGS-505(ecourse)	Agriculture Research, Research Ethics and Rural Development Programmes	1 = 1 + 0
	PGS-506(e course)	Disaster Management	1 = 1 + 0