DEPARTMENT OF HIGHER EDUCATION

RAJA MAHENDRA PRATAP SINGH UNIVERSITY, ALIGARH

AS PER THE ICAR-Sixth Deans' Committee

Course Curriculum of M.Sc. (Ag.)
Animal Husbandry and Dairying (Animal Science)

Course Curriculum of M.Sc. (Ag.) Animal Science
(Based on Restructured and Revised Syllabi of PG Programme by ICAR)

1st Year (1st Semester)			Evaluation Marks			
Code No.	**Course Title**	**Credit Hours**	**Mid Term (Internal)**	**Practical (External)/ Assignment (Internal 2)**	**End term/Final (External)**	**Total**
ASC 501	Cattle and Buffalo Production Management	3(2+1)	20	30	50	100
ASC 502	Livestock Farm Machinery Management	3(2+1)	20	30	50	100
ASC 503	Ruminant Nutrition	3(2+1)	20	30	50	100
	Elective	3(2+1)	20	30	50	100
AST 501	Experimental Design	3(2+1)	20	30	50	100
PGS 501	Basic Concepts in Laboratory Technique	1(0+1)	40	10	-	50
PGS 502	Intellectual Property and Its Management in Agriculture	1(1+0)	-	-	50	50
	Total Credit	**17**				**600**
1st Year (2nd Semester)			**Evaluation Marks**			
ASC 504	Feed and Fodder Technology	3(2+1)	20	30	50	100
ASC 505	Non-Ruminant Nutrition	3(2+1)	20	30	50	100
ASC 506	Cattle and Buffalo Breeding	2(1+1)	20	30	50	100
	Elective	3(2+1)	20	30	50	100
AST 502	Date Analysis Using Statistical Packages	3(2+1)	20	30	50	100
PGS 503	Agriculture Research, Research Ethic and Rural Development Programmes	1(1+0)	-	-	50	50
PGS 504	Library and Information Services	1(0+1)	40	10	-	50
	Total Credit	**16**				**600**
2nd Year (3rd Semester)			**Evaluation Marks**			
ASC 507	Integrated Livestock Farming Systems	3(2+1)	20	30	50	100
ASC 508	Sheep and Goat Production Management	3(2+1)	20	30	50	100
ASC 509	Behavior and Welfare of Farm Animals	2(1+1)	20	30	50	100
	Elective	2(1+1)	20	30	50	100
PGS 505	Technical Writing and	1(0+1)	20	30	50	100

	Communications Skills					
	Total Credits	**11**				**500**
2nd Year (4th Semester)			**Evaluation Marks**			
ASC 510	Master' Seminar	1(0+1)	-	100	-	100
ASC-511 A	Master Research (Thesis)	30	Satisfactory/Unsatisfactory			
OR						
ASC-511 B	IDEA (Internship for Development of Entrepreneurship in Agriculture)	30	Satisfactory/Unsatisfactory			
	TOTAL	**1+30**				**100**
	Grand total credit hours	**45+30=75**				**1800**

M.Sc. (Ag.) ANIMAL SCIENCE
The following nomenclature and Credit Hrs. are following while structuring Syllabus:

A. Course Work	Course Code	Allotted Credit Hours
1. Major Course	ASC- 501 To ASC- 509	25
2. Minor Course	Elective	08
3. Supporting Course	AST-501 & AST-502	06
4. Common Course	PGS-501 To PGS-505	05
5. Seminar	ASC- 510	01
B. 1.Thesis Research/ IDEA	Master Research or IDEA	30
Total		**75**

List of Minor Papers for Other Departments

Sr. No.	Course Code	Course Name	Allotted Credit Hours	Sem.
1	ASC 501	Cattle and Buffalo Production Management	3(2+1)	1st
2	ASC 504	Feed and Fodder Technology	3(2+1)	2nd
3	ASC 507	Integrated Livestock Farming Systems	2(1+1)	3rd

Note: - 1. The student has to opt. Minor Courses of Minimum 8 credit hours offer by other department

2. The first course of every semester from the respective department is treated as a Minor for other department.

1st Semester

(ASC 501) Cattle and Buffalo Production Management 3(2+1)

Theory

Unit I

Development of dairy industry in India and the world. Present status and future prospects of dairying in India and the world. SWOT analysis of the dairy sector in different agro-climatic zones. Production systems in vogue under Indian conditions. Breeds of cattle and buffalo with more emphasis on breeds of economic importance.

Unit II

Housing/ Shelter management. Housing and equipment requirements for different classes of cattle and buffaloes. Layout plans and construction details for different sized farms in different climatic zones of India. Ventilation and lighting systems in dairy farms.

Unit III

Feed and fodder resources used for feeding cattle and buffaloes. Scientific technique and regimen of feeding and watering of different categories of cattle and buffaloes. Feed and fodder requirements of different categories of cattle and buffaloes. Supply of green fodder round the year. Enrichment of poor-quality roughages. Nonconventional feeding resources. Pasture management.

Unit IV

Traits of economic importance and their inter-relationships. Selection and methods of breeding. Reproduction management - pre-natal and post-natal care and management of dams. Care of neonates and young calves. Management strategies for reducing mortality in calves, optimizing age at first calving and calving interval. Improving breeding efficiency of dairy animals.

Unit V

Farm management - Routine management practices and farm Laboure management. Milking management - Machine milking and hand milking. Clean milk production Techniques of harvesting clean milk, cooling and transportation. Different laws Animal Production Sciences: Livestock Production and Management 687 and practices governing the dairy sector to produce quality products on par with international standards. Health management of dairy animals. Summer and winter management of dairy animals. Draught ability and management of draught animals.

Practical

Visits to different sized dairy farms and assessment of routine managemental practices. Analysis of various farm records for economic evaluation. Computation of practical and economical rations. Layout plans and housing details. Housing, milking, calf, heifer and adult management. Dairy Cattle and Buffalo judging and body condition scoring (BCS). Project preparation for commercial farms.

Suggested Reading

• Arora SP. 1997. Feeding of Dairy Cattle and Buffaloes. Kalyani Publication. • Dutta G. 1994. Care and Management of Dairy Cattle and Buffaloes, 3rd ed. ICAR. • Flanders F and Gillespie J. 2015. Modern Livestock and Poultry Production, 9th ed. Delmar Cengage Learning Edition. • Gupta PR. 2017. Dairy India-2017, 7th ed. Dairy India Yearbook, Thomson Press Ltd. • ICAR. Livestock Production and Management - ICAR Course PDF eBook (online free). • Phillips CJC. 2011. Principles of Cattle Production. CABI Publishing. • Sastry NSR. 2016. Livestock Production Under Diverse Constraints - Indian Experience in its Management. ISAPM Publication. • Thomas CK, Sastry NSR and Ravikiran G. 2012. Dairy Bovine Production, 2nd ed. Kalyani Publishers. • Tyler HD and Ensminger ME. 2006. Dairy Cattle Science, Pearson Prentice Hall Publishing. • Selected articles from journals

(ASC 502) Livestock Farm Machinery Management 3(2+1)

Theory

Unit I

Visit to Instructional Livestock Farm Complex, Identification of various livestock farm machineries Milk storing equipment, pasteurization equipment and transportation of milk, handling of equipment for preparation traditional milk products

Unit II

Familiarization with different parts and their functions of tractor and power tiller (for tillage implements for fodder land development).

Unit III

Irrigation of fodder field. Familiarization with different electric motors and diesel engines, use of sprinkler for irrigation.

Unit IV

Non-conventional energy source-Wind energy and its utilization in livestock farm. Familiarization with different parts of milking/ shearing machines, handling, operation and cleaning after use, instruments used for milk packaging. Automatic feeders and waterers

Unit V

Post-harvest equipment/ machineries. Common terms used in harvesting of fodder crops; hay and forage harvesting equipment, mowers, field choppers, chaff cutters for silage making, different types of silos, forage harvesters, mechanical hay driers, conventional balers, hay stackers, straw combine.

Suggested Reading

• Kutz M. 2007. Handbook of Farm, Dairy, and Food Machinery. William Andrew Inc.
• Malhotra K. 2012. Handbook of Farm, Dairy, and Food Machinery. Centrum Press.
• Selected articles from journals.

(ASC 503) Ruminant Nutrition 3(2+1)

Theory

Unit I

Functional anatomy of the digestive system of ruminants. Introduction to rumen microflora and fauna. Development of rumen. Feeds and fodders for ruminant feeding.

Unit II

Water requirements. Nutrient requirements and feeding of calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat. Peculiarities of digestive physiology, nutrition and feeding management of camels.

Unit III

Voluntary feed intake. Determination of digestibility, factors affecting digestibility. Manipulation of rumen fermentation.

Unit IV

Concept of complete feed and total mixed ration. Precision feeding. Phase feeding. Limiting nutrients and strategic feeding of high yielding ruminants. Concept of bypass nutrients and their impact on production, reproduction and immune status.

Unit V

Nutritional approaches for increasing the functional properties of milk: role of CLA, omega fatty acids. Different systems of feeding buffalo for beef production. Feeding during stress and natural calamities. Feeding management of migratory/ nomadic small ruminants.

Practical

Design and planning of feeding experiments. Identification of feed and fodder based on its composition. Ration formulation for large and small ruminants for different physiological

stages. Estimation of digestibility and nutritive value of feeds and fodders by metabolism trial in dairy cattle. Determination of nutritive value of pastures by the use of range techniques. Collection and processing of rumen liquor. Estimation of rumen metabolic profile (pH, ammonia, lactate, and TVFA, etc.). Estimation of purine derivatives.

Suggested Reading

• Church DC. 1988. The Ruminant Animal: Digestive Physiology and Nutrition, 2nd ed. Prentice-Hall. • Dehority BA. 2003. Rumen Microbiology. Nottingham University Press. • D'Mello JPF. 2003. Amino Acids in Animal Nutrition, 2nd ed. CAB International. • Givens D, Axford R and Owen E. (Ed.). 2000. Forage Evaluation in Ruminant Nutrition. CAB International. • Hynd PI. 2019. Animal Nutrition: From Theory to Practice. CAB International. • McDowell RL. 2012. Nutrition of Grazing Ruminants in Warm Climates. Academic Press. • Moran J. 2005. Tropical Dairy Farming: Feeding Management for Small Holder Dairy Farmers in the Humid Tropics. Landblink's Press • NRC. 2001. Nutrient Requirements of Dairy Cattle, 7th rev. ed. National Research Council. National Academies Press. • NRC. 2016. Nutrient Requirements of Beef Cattle, 8th rev. ed. National Academies of Sciences, Engineering, and Medicine. National Academies Press. • NRC. 2007. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. National Research Council. National Academy Press. • Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. Basic Animal Nutrition and Feeding, 5th ed. Wiley. • Shirley RL. 2012. Nitrogen and Energy Nutrition of Ruminants. Academic Press.10. Van Soest PJ. 1994. Nutritional Ecology of the Ruminant. Cornell University Press

(AST 501) Experimental Designs 3(2+1)

Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications,

Unit V

Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

Practical

- Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
- Analysis with missing data,
- Split plot and strip plot designs.

Suggested Reading

- Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.
- Federer WT. 1985. *Experimental Designs*. MacMillan.
- Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. *Handbook on Analysis of Agricultural Experiments*. IASRI Publ.

- Pearce SC. 1983. *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley.
- www.drs.icar.gov.in.

(PGS 501) BASIC CONCEPTS IN LABORATORY TECHNIQUES 1(0+1)

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralization of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

- Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press
- Gabb MH and Latcham WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

(PGS 502) Intellectual Property and Its Management In Agriculture 1(1+0)

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' right sand biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erich FH and Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.

- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V.Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.

- The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks
- Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000;
- PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

2nd Semester

(ASC-504) Feed and Fodder Technology 3(2+1)

Theory

Unit I

Various feed mill equipment and their handling; layout and operations in feed mill (small, medium and large feed plants); automated feed mill: merits and demerits. Procurement of feed ingredients: specification and guidelines. Quality control of feed ingredients and finished feeds. BIS standard.

Unit II

Principles and process of material handling, weighing, grinding, mixing, pelleting, packaging and other major processing operations. Crumbling, flaking, popping and extrusion. Premixes. Codex Alimentarius, HACCP.

Unit III

Feed and fodder processing and preservation techniques. Densification, chemical and biological treatment of feeds/ fodders. Fodder conservation through hay and silages; Microbiological evaluation of processed and preserved feeds; Effect of preservation on the nutritional value of feed.

Unit IV

Feed storage and go down management; goods sanitation and hygiene of go-down. Traditional and modern farm-level storage structures. Factors affecting feedstuffs during storage. Liquid feed ingredients. Storage losses;

Unit V

insect pests and rodents control measures; Mycotoxins in feedstuffs and its control measures

Practical

Quality control and inspection of feed materials. Qualitative tests for adulterants urea, urease, thiram. Identification of insect pests and fungi in stored products. Feed microscopy. Formulation and preparation premixes. Quality evaluation of silage and hay, Laboratory preparation of silage. Visit to feed plant: Hands-on training on preparation of feed and mineral mixture. Preparation of project report on plant layout and design, problems related to feasibility, record-keeping in different sections of a feed mill

Suggested Reading

• Dryden G. 2008. Animal Nutrition Science. CAB International.
• Kundu SS, Mahanta SK, Singh S and Pathak PS. 2016. Animal Feed Technology. Satish Publishers
• Perry TW, Cullison AE and Lowrey RS. 2003. Feeds and feeding, 6th ed. Pearson.
• Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. Basic Animal Nutrition and Feeding, 5th ed. Wiley.
• Schofield EK (Ed.). 2005. Feed Manufacturing Technology V. American Feed Industry Association, Arlington.

(ASC-505) Non-Ruminant Nutrition 3(2+1)

Theory

Unit I

Feeding of poultry for meat and egg production. Ideal protein concept. Standard ileal digestible amino acids. Nutrient requirements for broilers and layers. Feeding of breeder hens; nutritional factors affecting hatchability. Feeding systems for poultry. Feed additives for poultry. Nutritional approaches for designer egg and meat production. Nutritional disorders in poultry and the role of nutrition in diseases prevention. Water intake and quality in poultry production.

Unit II

Nutrition and feeding of swine in different stages of growth and production. Nutritional factors affecting the quality of the products: lean meat production. Water intake and quality in pig production.

Unit III

Feeding of equines. Feeding of rabbits. Hindgut fermentation and its importance. Nutrient requirements of equines. Special features of equine feeding management. Nutritional management of colic and other health disorders. Nutrient requirements of rabbits for wool and meat production. Nutrition-related disorders in rabbits.

Practical

- Design and planning for poultry and swine feeding experiments.
- Calculation of nutrient requirements for broilers and layers.
- Formulation and compounding of general and least-cost rations, determination of the nutritive value of poultry and swine feeds by balance experiments.
- Formulation of rations for horses and rabbits. Visit poultry and piggery units, feed and fodder stores.
- Calculation of different measures of protein quality.

Suggested Reading

•Adamo G and Costanza A (Eds.). Rabbits Biology, Diet and Eating Habits and Disorders. Nova Biomedical.

• Cheeky PR. 1987. Rabbit Feeding and Nutrition. Academic Press, Inc.

• Chiba LI (Ed.). 2012. Sustainable Swine Nutrition. Wiley-Blackwell. • de Blas C and Wiseman J. (Eds.). 2010. d

Nutrition of the Rabbit, 2nd ed. CAB International.

• D'Mello JPF. 2003. Amino Acids in Animal Nutrition, 2nd ed. CAB International.

• Frape D. 2010. Equine Nutrition and Feeding, 4th ed. Wiley-Blackwell.

• Hynd PI. 2019. Animal Nutrition: From Theory to Practice. CAB International.

• Leeson S and Summers JD. 2009. Commercial Poultry Nutrition, 3rd ed. Nottingham University Press.

• Leeson S and Summers JD. 2019. Scott's Nutrition of The Chicken, 4th ed. CBS Publishers and Distributors.

• NRC. 2007. Nutrient Requirements of Horses, 6th Rev. ed. National Research Council. National Academy Press.

• NRC. 1994. Nutrient Requirements of Poultry, 9th Rev. ed. National Research Council. National Academy Press.

• NRC. 2012. Nutrient Requirements of Swine, 11th Rev. ed. National Research Council. National Academy Press.

• Varga M. 2013. Textbook of Rabbit Medicine, 2nd ed. Butterworth-Heinemann

(ASC-506) Cattle and Buffalo Breeding 2(1+1)

Theory

Unit I

History of dairy cattle and buffalo breeding; Evolution of cattle and buffalo breeds and their characteristics; Population dynamics and production systems; Inheritance of important economic traits; Recording and handling of breeding data; Standardization of records; Computation of correction factors for the adjustment of the data; International Committee on Animal Recording (ICAR) and INAPH.

Unit II

Progeny testing under farm and field conditions; Evaluation of bulls by different models; Estimation of breeding values of the cows; Nucleus breeding system; Marker assisted selection and genomic selection.

Unit III

Crossbreeding in cattle in India and abroad; Development of new breeds; Conservation of threatened breeds of cattle and buffaloes; Role of breed associations in dairy improvement; Breeding policy: national and state.

Unit IV

Import of exotic Germplasm for breeding cattle in the tropics; Appraisal of buffalo and cattle breeding programmer; Role of breed associations in dairy improvement.

Practical

Performance recording; Standardization of records; Estimation of economic traits; Computation of genetic parameters; Genetic gain; Sire evaluation methods; Estimation of heterosis; Culling and replacement.

Suggested Reading

• Chakravarty AK and Vohra V. 2011. Sustainable Breeding in Cattle and Buffalo. Satish Serial Publications.

• Lasley JF. 1972. Genetics of Livestock Improvement. IBH.

• Olden Broek K and van der Waaij L. 2014. Text book of Animal Breeding and Genetics. Wageningen University and Research Centre (Free Online).

• Schmidt GM, Van Vleck LD and Hutjens MF. 1988. Principles of Dairy Science. WH Freeman.

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

(AST 502) Data Analysis Using Statistical Packages 3(2+1)

Theory

Unit I

Introduction to various statistical packages: Excel, R, SAS, SPSS. Data Preparation; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

Unit II

Test for normality; Testing of hypothesis using chi-square, t and F statistics and-Ztest.

Unit III

Data preparation for ANOVA and ANCOVA, Factorial Experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

Unit IV

Analysis of mixed models; Estimation of variance components; Correlation and regression analysis, Probit, Logit and Tobit Models.

Unit V

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Neural networks.

Practical

- Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data
- Testing the hypothesis for one sample t-test, two sample t-test, paired t-test, test for
- large samples - Chi-squares test, F test, one-way analysis of variance;
- Designs for Factorial Experiments, fixed effect models, random effect models, mixed
- effect models, estimation of variance components;
- Linear regression, Multiple regression, Regression plots
- Discriminant analysis - fitting of discriminant functions, identification of important
- variables
- Factor analysis. Principal component analysis - obtaining principal component.

Suggested Reading

- Anderson C.W. and Loynes R.M. 1987. The Teaching of Practical Statistics. John Wiley.
- Atkinson A.C. 1985. Plots Transformations and Regression. Oxford University Press.
- Chambers J.M., Cleveland W.S., Kleiner B and Tukey P.A. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmont, California.
- Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.
- Cleveland W.S. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.
- Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.
- Erickson B.H. and Nosan Chuk T.A. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes.
- Snell E.J. and Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman and Hall.
- Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.
- Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.
- Velleman PF and Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. Duxbury Press.
- Weisberg S. 1985. Applied Linear Regression. John Wiley.
- Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall

(PGS 503)- Agricultural Research, Research Ethics and Rural Development Programmes 1 (1+0)

Theory:

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions;

UNIT II

Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT III

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT IV

Concept and connotations of rural development, rural development policies and strategies. Rural development Programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati-Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organizations.

UNIT V

Critical evaluation of rural development policies and Programmes. Constraints in implementation of rural policies and Programmes.

Suggested Readings

- Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
- Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
- Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
- Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

(PGS 504)-Library and Information Services 1(0+1)

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; eresourcesaccess methods.

3rd Semester

(ASC-507) Integrated Livestock Farming Systems 3(2+1)

Theory

Unit I

Classification of livestock-based farming systems. Principles, Scope, drivers and tradeoffs in integrated livestock farming systems. Sustainability and ecological advantages of integrated livestock farming systems and their economic importance.

Unit II

Integration of various components of farming systems. Livestock-fish, arable farming, plantation crops and different livestock enterprises (cattle, buffalo, sheep, goat, pig, rabbit, poultry, beekeeping, silkworm, etc.) along with the bio-gas plant, FYM, vermicompost, solar and wind energy utilization

Unit III

New approach for changing farming systems in the light of global warming, carbon sequestration and mitigation of GHGs (reducing carbon and water footprints)

Unit IV

Project formulation and evaluation of various integrated livestock enterprises in light of reducing poverty, livelihood diversification, environmental sustainability and resource conservation.

Practical

Visit modern integrated livestock farming units. Critical analysis of different subunits, economic analysis and preparation of feasibility reports

Suggested Reading

- Ghosh B. 2007. Integrating Crops and Livestock, 1st ed. Gene-Tech Books.
- Little DC and Edwards P. 2003. Integrated Livestock-fish Farming Systems. FAO.
- Mukherjee TK, Moi PS, Panandam JM and Yang YS. (Eds.) 1992. Integrated Livestock Fish Production Systems. FAO/ IPT Workshop on Integrated Livestock-Fish Production Systems, University of Malaya, Kuala Lumpur.
- Raman KV and Balaguru T. (Eds.). 1992. Farming Systems Research in India: Strategies for Implementation. NAARM, Hyderabad.

(ASC-508) Sheep and Goat Production Management 3(2+1)

Theory

Unit I

Population structure and importance. Sheep farming under different systems of management. Advantages and limitations of sheep and goat farming. Genetic resources of sheep and goats with special emphasis on breeds of economic importance

Unit II

Shelter management. Housing and equipment requirements for different classes of sheep and goats. Designing feeders and waterers. Layout plans and construction details for different size farms in different agro-climatic zones of India.

Unit III

Feed and fodder resources for small ruminants. Common property resources (CPR's) and their management. Principles and systems of feeding and watering different categories of sheep and goat. Pasture utilization and improvement.

Unit IV

Breeding Management, Traits of economic importance and their inter-relationship. Breeding seasons. Selection of breeding animals. Methods of detection of heat, use of teaser, flushing, tupping. Estrous synchronization, Natural Service, artificial insemination and off-season breeding in small ruminants. Care and management of pregnant animals and breeding stock. Culling.

Unit V

Disease Management. Prevention and control measures including vaccination, deworming, dipping and spraying, etc. Transportation of small ruminants. Meat, Methods of slaughter, dressing percentage. Wool: Shearing methods. Importance of wool, wool quality. Goat fibers: mohair, pashmina - Marketing of goat fibers/ wool. Milk, Milking, avoidance of goatyodour in milk, clean milk production and its therapeutic uses.

Practical

- Visits to modern sheep and goat farms and critical analysis of various managerial practices under different conditions.
- Study of practical housing management.
- Diseases control management. Shearing management. Record keeping and economics of sheep and goat farming for mutton/ chevon, wool/ fibre and milk.
- Preparation of project for commercial farming. Daily and periodical farm operations. Dipping and vaccination

Suggested Reading

• Bhat PN and Khan BU. 2009. Goat Production. Studium Press (India) Pvt. Ltd.
• Bhatt PN and Arora CL. 2009. Sheep Production. Studium Press (India) Pvt. Ltd.
• Devendra C and McLeroy GB. 1982. Goat and Sheep Production in Tropics. Longman.
• Devendra C and Burns M. 1983. Goat Production in the Tropics. CABI Publishing.
• Gupta JL. 2006. Sheep Production and Management. BS Publ.
• ICAR. 2014. Handbook of Animal Husbandry, 3rd ed. ICAR.
• Jindal SK. 2013. Goat Production and Health Management. New India Publishing Agency.
• Kaushik SK. 2017. Sheep Production. ICAR Publ.
• Peacock CP. 1996. Improving Goat Production in the Tropics: A Manual for Development Workers, OXFam, UK.

• Sastry NSR. 2016. Livestock Production Under Diverse Constraints - Indian Experience in its Management. ISAPM Publication

(ASC-509) Behavior and Welfare of Farm Animals 2(1+1)

Theory

Unit I

Introduction to Animal behavior. Evolution of animal behavior: Theories of animal behavior. Importance of animal behavior studies. Physiological basis of behavior. Natural selection, proximate and ultimate causes, fitness, optimality theory, selfish genes, kin selection, and game theory. Influence of genetic, environmental and physiological influence. Daily and seasonal cycles of behavior. Patterns of behavior. Favorable and unfavorable behaviors of domestication.

Unit II

Ethogram construction for general behavior management – interpretation - behavior assisted animal management - flight zone, Animal learning and training conditioning-operant and classical, animal behavior based housing designs – Methods of studying animal behavior- Vices – causes and prevention.

Unit III

Group formation. Social relationships like hierarchy and aggression, the process of socialization, locality and behaviour. Behavioural characters for management practices.

Unit IV

Animal welfare – concepts – animal rights – animal freedoms – animal welfare organizations Measurement of animal welfare: - indicators of animal welfare improvement of animal welfare through selection- the welfare of livestock in commercial farms and captivity, environmental enrichment- Welfare of livestock during various management activities such as handling, transportation, etc., Legislation and regulations of animal welfare – welfare and economics.

Practical

- Behavioural characters for managemental practices.
- Behavioural adaptations under domestication.
- Analysis of behaviour in relation to climate. Analysis of social behaviour.
- Preparation of ethogram (time budgeting).

Suggested Reading

- Agarwal VK. 2013. Animal Behaviour (Ethology) S. Chand and Company
- Albright JL and Arave CW. 1997. The Behaviour of Cattle. CAB International.
- Arora MP. 1995. Animal Behaviour. WB London.
- Benson BJ and Rollin BE. 2004. The Well-being of Farm Animals: Challenges and Solutions. Blackwell Publishing, USA.
- Bouenger EG. 1994. Animal Behaviour. WB London.
- Broom DM and Fraser AF. 2007 Domestic Animal Behaviour and Welfare, 4th ed. CABI. • Fraser AF and Broom DM. 1990. Farm Animal Behaviuor and Welfare. CAB international
- Hafez ESE. 1969. The Behaviour of Domestic Animals, 2nd ed. Balliere, Timdall and Cassell.
- Houpt KA. 2018. Domestic Animal Behavior for Veterinarians and Animal Scientists. 6th ed. Wiley Blackwell
- Kumar V. 1996. Animal Behaviour. WB London. • Selected articles from journals

(PGS 505) Technical Writing and Communications Skills 1(0+1)

Practical

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;
- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.; Commonly used abbreviations in the theses and research communications;
- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings

- Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
- *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
- *Collins' Cobuild English Dictionary*. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
- James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
- Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East- West Press.
- Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
- Richard WS. 1969. *Technical Writing*.
- Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

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4th Semester

(ASC-511) Master's Seminar 1(0+1)

(ASC- 511 A) Master Research 30

Or

(ASC- 511 B) IDEA (Internship for Development of Entrepreneurship In Agriculture) 30