DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

B.V.Sc & A.H. courses are offered as per Veterinary Council of India guidelines and details of courses offered, their syllabi and schedule of lecture and practical are available in the department/ Office of the Deputy Registrar, College of Veterinary and Animal Sciences.

POST GRADUATE COURSES OFFERED, THEIR SYLLABI AND SCHEDULE OF LECTURE AND PRACTICAL (w.e.f. AY 2022-23)

Course Contents

M.V.Sc. in Livestock Products Technology

1. **Course Title : Abattoir Practices and Meat Plant Operations**
2. **Course Number : LPT601 Prerequisite Nil**
3. **Credit Hours : 2+1**
4. **Why this Course? :** Human Resource Development (Manager, Supervisor, Meat inspector and other Technocrats) for Slaughterhouses and Meat processing plants.
5. **Aim of the Course :** To impart knowledge about the handling of meat animals, layout and design of abattoir, acquaint with meat inspection procedures, sanitation and basics of slaughterhouse practices and meat plant operations.

Catalogue Description

6. **Theory**

Unit I **15 Lectures**

Modern meat hygiene system and its importance –Good animal husbandry practices in farms of slaughter animal origin- Handling and transportation of meat animals including poultry - Pre-slaughter handling and care of food animals – Antemortem factors influencing the yield and quality of meat from farm animals and poultry–Stress and Transport shrink - Ante-mortem inspection - Humane slaughter - Principles and methods of stunning – Poultry stunning- economic factors and animal welfare influencing selection of stunning method for buffalo, sheep and goat, pig and poultry slaughter- Ritual methods of the slaughter of food animals and poultry-stunning methods permitted in Halal method-for farm animals and poultry- Meat hygienic practices and carcass decontamination- Machinery for slaughter and dressing of food animals – Robotics and automation in abattoir and meat plant operations- Postmortem inspection – laboratory and diagnostic tests commonly conducted during abattoir operations and meat inspection- leadership and scientific role of veterinarian in abattoir–poultry meat inspection- Need for review of meat inspection procedures in light of modern developments in science and technology- Good Practices in Meat Industry – Grading of carcasses- USDA and BIS methods- for beef, buffalo, pork, sheep, goat and poultry- Different methods of fabrication of carcasses

and terminologies used for cuts of beef (with special reference to Australian method), pork, mutton, chevon and broiler carcass, Handling and safe disposal of condemned and unfit parts and carcasses.

Unit II **15 Lectures**

Abattoir - layout, designing, organization and operation - Modular abattoir, mobile abattoir, zero discharge abattoirs and slaughter slab design for small villages-Municipal abattoir, Export abattoir, Robotic slaughter house - Important equipment and machineries used in abattoir – Factors to be considered in designing capacity of abattoir- levels of mechanization and automation used- Semiautomatic and automatic mechanized poultry processing plant design- Important equipment and machineries used - Maintenance of meat and poultry processing plants- Operational controls and process yields -Metrics for assessing efficiency of abattoir and poultry processing plant operations: transport shrink, dressing percent, chiller loss, cutting loss, condemnation weight, production of carcass weight, boneless or bone-in fabricated meat production etc. and their record keeping-automation and computerization of inspection records and Legislations and major regulations for establishment and operation of slaughterhouses and meat processing plants in India and abroad (FSSAI, Codex Alimentarius Commission, EEC, USDA, Australian standards)- Regulations governing meat animal transport, care and handling prior to slaughter, Major animal husbandry rules and regulations including those of disease control/ eradication having impact on abattoir operations.

Unit III **4 Lectures**

Sanitation of slaughterhouse - Sanitary practices in meat plant and its benefits –Meat hygiene assessment: objective methods for the monitoring of product and processes- Abattoir waste management practices -Solid and liquid waste management–water conservation - Different methods of effluent treatment and designs of effluent treatment plants - State and Central Pollution Control Board norms.

7. **Practical** **17 Classes**

Design and outlay of modern abattoir including poultry processing and effluent treatment plants for different capacities - Judging and grading of food animals - Procedure for the slaughter of food animals and poultry - Ante-mortem and post mortem inspection and handling of condemned carcasses and anthrax suspected carcasses-Grading and fabrication of carcasses of beef, mutton, chevon and poultry - Recording of carcass data - carcass yield, meat bone ratio, etc. - Measurement of effluent characteristics - pH, BOD, COD, suspended solids, etc. - Visit slaughterhouse, poultry processing and effluent treatment plants - DPR for the establishment of an abattoir

8. **Lecture Schedule and no. of classes**

1. Modern meat hygiene system and its importance –Good animal husbandry 01

	practices in farms of slaughter animal origin	
2.	Handling and transportation of meat animals including poultry - Pre-slaughter handling and care of food animals – Ante mortem factors influencing the yield and quality of meat from farm animals and poultry–Stress and Transport shrink	01
3.	Ante-mortem inspection	01
4.	Humane slaughter	01
5.	Principles and methods of stunning – stunning of farm animals and poultry - economic and animal welfare factors influencing selection of stunning method for buffalo, sheep and goat, pig and poultry slaughter	01
6.	Ritual methods of the slaughter of food animals and poultry-stunning methods permitted in Halal method-for farm animals and poultry	01
7.	Machinery for slaughter and dressing of food animals	01
8.	Slaughter of common food animals and poultry	02
9.	Postmortem inspection – laboratory and diagnostic tests commonly conducted during abattoir operations and meat inspection- leadership and scientific role of veterinarian in abattoir–poultry meat inspection	02
10.	Need for review of meat inspection procedures in light of modern developments in science and technology	01
11.	Meat hygienic practices and carcass decontamination-	01
12.	Robotics and automation in abattoir and meat plant operations	01
13.	Good Practices in Meat Industry	01
14.	Grading of carcasses- USDA and BIS methods- for beef, buffalo, pork, sheep, goat and poultry	02
15.	Different methods of fabrication of carcasses and terminologies used for cuts of beef (with special reference to Australian method), pork, mutton, chevon and broiler carcass	01
16.	Handling and safe disposal of condemned and unfit parts and carcasses.	01
17.	Abattoir – layout and designing	01
18.	Abattoir organization and operation - Modular abattoir, mobile abattoir, zero discharge abattoirs and slaughter slab design for small villages-Municipal abattoir, Export abattoir, Robotic slaughter house -Important equipment and machineries used in abattoir	01
19.	Factors to be considered in designing capacity of abattoir- levels of mechanization and automation used- Semiautomatic and automatic mechanized poultry processing plant design- Important equipment and machineries suited for the capacity	01
20.	Maintenance of meat and poultry processing plants- Operational controls and process yields	01
21.	Metrics for assessing efficiency of abattoir and poultry processing plant operations: transport shrink, dressing percent, chiller loss, cutting loss, condemnation weight, production of carcass weight, boneless or bone-in fabricated meat production etc. and their record keeping, Automation and computerization of inspection records	01
22.	Legislations and major regulations for establishment and operation of slaughterhouses and meat processing plants in India and abroad (FSSAI, Codex Alimentarius Commission, EEC, USDA, Australian standards)	01

23.	Regulations governing meat animal transport, care and handling prior to slaughter	01
24.	Major animal husbandry rules and regulations including those of disease control/ eradication having impact on abattoir operations.	01
25.	Sanitation of slaughterhouse - Sanitary practices in meat plant and its benefits	01
26.	Meat hygiene assessment: objective methods for the monitoring of product and processes	01
27.	Abattoir waste management practices -Solid and liquid waste management– water conservation	01 .
28.	Different methods of effluent treatment	01
29.	Designs of effluent treatment plants	01
30.	State and Central Pollution Control Board norms.	01
	Pre final Examinations	02
	Total	35

9. **Practical Schedule and no. of classes**

1.	Design and outlay of modern abattoir including poultry processing for different capacities	03
2.	DPR for the establishment of an abattoir	01
3.	Judging and grading of food animals	01
4.	Procedure for the slaughter of food animals and poultry	04
5.	Ante-mortem and postmortem inspection	01
6.	Handling of condemned carcasses and anthrax suspected carcasses	01
7.	Grading and fabrication of carcasses of beef, mutton, chevon and poultry	01
8.	Recording of carcass data - carcass yield, meat bone ratio, etc. –	
9.	Measurement of effluent characteristics - pH, BOD, COD, suspended solids, etc.	01 01
10.	Visit to slaughterhouse and poultry processing plants	
11.	Visit to skin / hide stores and effluent treatment plants	01
12.	Designing effluent treatment plants for different capacities	01
	Lab final Examination	01
	Total	17

10. **Teaching Methods**

- Classroom teaching, practical demonstration in Divisional laboratory/ slaughter unit.
- Visit municipal slaughterhouse and meat plants.
- Demonstration of charts, video films and models
- Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning Outcome**

Gaining knowledge of abattoir practices and operations to be carried out in meat plants

12. **Suggested Readings**

- Selected Review Articles, Research Articles, Technical Articles from Industry Journals, Patent Literature
- Collins DS and Huey RJ. 2015. Gracey's Meat Hygiene, 11th Ed. John Wiley and Sons Ltd., UK.

• Heinz Gunter (2008) Abattoir Development Options and Designs for Hygienic Basic and Medium-Sized Abattoirs RAP Publication 2008/1 APHCA, FAO Regional Office, Bangkok
• Slaughterhouse and Slaughter Slab Design and Construction. FAO Animal Production and Health Paper, No. 9, FAO, Rome.
• Manual for the slaughter of small ruminants in developing countries. FAO Animal Production and Health Paper, No. 49, FAO, Rome.
• Construction and operation of medium-sized abattoirs in developing countries. FAO Animal Production and Health Paper, No. 97, FAO, Rome.
• Manual para la instalacion del pequeno matadero modular de la FAO. FAO Animal Production and Health Paper, No. 120, FAO, Rome.
• Guidelines for humane handling, transport and slaughter of livestock. FAO/RAP Publication 2001/4, FAO, Rome.
• Swatland HJ. 2004. Meat Cuts and Muscle Foods. Nottingham Univ. Press.
• Warriss P. 2010. Meat Science: An Introductory Text, 2nd ed. Oxford Press.
• Skaarup, T. 1985. Slaughterhouse cleaning and sanitation, FAO Animal Production and Health Paper 53, FAO, Rome
• Wilson, W. G. 2005. Wilson's Practical Meat Inspection Seventh Edition, Blackwell publishing, Oxford
• Gregory, N. G. and Grandin T. 1998. Animal welfare and meat science, CABi Publishing, Oxon, UK
• Hathaway, S.C. 1993. Risk analysis and Meat Hygiene. Rev. sci. tech. Off. int. Epiz., 12 (4), 1265-1290
• Owens, C.M., Alvarado, C.Z. and Sams, A. R. 2001. Poultry meat processing, 2nd edn.,CRC press, New York
• Ninios, T., Lundén, J. Korkeala, H. and Fredriksson-Ahomaa, M. 2014. Meat Inspection and Control in the Slaughter house, Wiley Blackwell, Oxford, UK
• CPCB. 2004. Solid Waste Management in Slaughter House, Central Pollution Control Board, New Delhi.
• Oreopoulou, V. and Russ, W. 2007. Utilization of By-Products and Treatment of Waste in the Food Industry, Springer.
• Barbut S. 2005. Poultry Products Technology- An Industry Guide. CRC Press.
• Carlson CW, Greaser ML and Jones KW. 2001. The Meat We Eat, 14th ed. Interstate Publishers, INC.
• Eikelenboom, G. 1983. Stunning of Animals for Slaughter. Springer.
• FAO. 2004. Good Practices for the Meat Industry. FAO Animal Production and Health Manual 2. Rome. ISBN 92-5-105146-1

13. **Suggested e-books** **As above**

14. **Suggested Websites**

Websites of APEDA, Ministry of Animal Husbandry and dairying, Central Pollution Control Board, FAO for publications on abattoir operations and effluent plant design, OIE for animal diseases and their diagnostic tests for international trade, World Meat Secretariat, EEC regulations, USDA regulations, Humane Slaughter Association, Abattoir equipment manufacturers site for design and videos, UNECE standards for meat cuts and AUS Meat

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Fresh Meat Technology**
2. **Course Number** : **LPT602** **Prerequisite** Nil
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development for Meat processing Sector
5. **Aim of the Course** : To impart knowledge about the status of the meat industry, muscle development, in vitro meat, muscle structure and composition, conversion of muscle to meat, pre and post slaughter factors influencing meat quality, meat tenderization and eating qualities of meat.

Catalogue Description

6. **Theory**

Unit I **10 Lectures**

History, current development and prospects of meat and poultry industry in India – Skeletal muscle development – pre- and post-natal-myosatellite cells- in vitro meat-its hype and truth

Structure and chemistry of muscle including poultry – Smooth muscles- Muscle Proteins - sarcoplasmic and myofibrillar proteins – Stromal proteins–Collagen-structure, types, cross linking and toughness –theory of rubber-like elasticity and variation in meat tenderness produced by connective tissues- Muscle fibres types – Muscle contraction and relaxation-Huxley's sliding filament model

Post mortem changes – Rigor mortis - Conversion of muscle to meat - Pre and post-slaughter factors affecting meat quality – Defects during the conversion of muscle to meat – PSE/ DFD/ Cold Shortening/ Thaw Rigor – Off odour development. Chilling, ageing and conditioning of meat - Electrical stimulation – Tender Stretch® and aitch bone hanging - Tenderization of meat- 'calcium' and 'calpain' theories of meat tenderization- Role of calcium, calpains, cathepsins, calpastatin, callipyge gene and other genetic factors influencing meat quality, Effect of collagen cross linking, restructuring of meat and blade tenderization on meat toughness.

Unit II **7 Lectures**

Composition and nutritive value of meat and poultry- Allegations against meat eating and its critical evaluation –Biochemistry of fat

(carcass fat and organ fat depot) and concept of n3 and n6 fatty acid content in diet and its critical evaluation- Marbling

Qualities of fresh meat – pH, Appearance and colour, odour, Water holding capacity and juiciness, texture/ tenderness and odour and flavor - firmness of muscles and its utility in grading

Designer meat- New techniques to reduce fatness in farm animals- Current approaches to designer meat and meat animal production

7. **Practical** **17 Classes**

Different methods of estimation of physicochemical properties of fresh meat – pH, colour, water holding capacity, ERV, shear force value, glycogen, R-value and myoglobin - Proximate analysis of meat- Estimation of collagen - Estimation of drip loss - Determination of sarcomere length, fibre diameter and myofibrillar fragmentation index - Fractionation of sarcoplasmic, myofibrillar and stromal proteins – SDS PAGE for determination of proteolysis– Determination of tyrosine value– Collagen solubility–Detection of PSE and DFD in carcasses– Inducing cold shortening and thaw rigor in muscles.

8. **Lecture Schedule and no. of classes**

1.	History, current development and prospects of meat and poultry industry in India	01
2.	Skeletal muscle development – pre- and post-natal- myosatellite cells- in vitro meat-its hype and truth	01
3.	Structure and chemistry of muscle including poultry and Smooth muscles	02
4.	Muscle Proteins - sarcoplasmic and myofibrillar proteins – Stromal proteins– Collagen-structure, types, cross linking and toughness –theory of rubber-like elasticity and variation in meat tenderness produced by connective tissues	01
5.	Muscle fibres types	01
6.	Muscle contraction and relaxation-Huxley's sliding filament model	01
7.	Post mortem changes – Rigor mortis - Conversion of muscle to meat - Pre and post-slaughter factors affecting meat quality – Defects during the conversion of muscle to meat – PSE/ DFD/ Cold Shortening/ Thaw Rigor – Off odour development.	02
8.	Methods of tenderization of meat- dry and wet ageing and/ conditioning of meat - Electrical stimulation – Tender Stretch® and aitch bone hanging - 'calcium' and 'calpain' theories of meat tenderization, Role of calcium, calpains, cathepsins, calpastatin, callipyge gene and other genetic factors influencing meat quality, Effect of collagen cross linking, restructuring of meat and blade tenderization on meat toughness.	02
9.	Composition and nutritive value of meat and poultry	01
10.	Allegations against meat eating and its critical evaluation	01
11.	Marbling, carcass fat and organ fat depot- Biochemistry of fat and concept of n3 and n6 fatty acid content in diet and its critical evaluation	01

12. Qualities of fresh meat – pH, Appearance and colour, Water holding capacity and juiciness, texture/ tenderness and odour and flavor – Carcass muscle firmness and its utility in grading 02
13. Designer meat- New techniques to reduce fatness in farm animals-Current approaches to designer meat and meat animal production 01

Prefinal Examinations 02

Total 19

9. **Practical Schedule and no. of classes**

1. Estimation of physicochemical properties of fresh meat – pH, water holding capacity and extract release volume (ERV)
2. Estimation of colour
3. Estimation of shear force value
4. Estimation of glycogen
5. Estimation of R-value
6. Estimation of myoglobin
7. Proximate analysis of meat
8. Estimation of collagen
9. Estimation of drip loss
10. Determination of sarcomere length and fibre diameter
11. Myofibrillar fragmentation index
12. Fractionation of sarcoplasmic, myofibrillar and stromal proteins
13. SDS PAGE for determination of proteolysis
14. Determination of TBARS value and tyrosine value
15. Determination of collagen solubility
16. Detection of PSE and DFD in carcasses and inducing cold shortening and thaw rigor in muscles.

Lab final Examination 01

Total 17

10. **Teaching Methods**

- Classroom teaching, practical demonstration and analysis in Divisional laboratory/ slaughter unit.
- Visit slaughterhouses, meat plants and retail units
- Use of Audio-visual Capsules
- Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning Outcome**

Acquiring knowledge on quality attributes of fresh meat, factors affecting these attributes, composition and nutritive value of meat.

12. **Suggested Readings**

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. Principles of Meat Science, 5th edn., Kend All/ Hunt Publishing Company, Iowa.
- Kinsman, D. M., Kotula, A. W. and Breidenstein, B. C.1994. Muscle foods- Meat, Poultry and Seafood Technology. Springer.
- Toldra, F. 2017. Lawrie's Meat Science. 8th edn. Wood Head Publishing, UK.

- Du, M. and McCormick, R. J. 2009. Applied Muscle Biology and Meat Science. CRC Press, New York.
- Kerth, C. R. 2013. The Science of Meat Quality. Wiley-Blackwell, Oxford, UK.
- te Pas, M. F. W., Everts, M. E. and Haagsman, H.P. 2004. Muscle Development of Livestock Animals - Physiology, Genetics and Meat Quality, CABi Publishing, Oxford, UK.
- Przybylski, W. and Hopkins, D.2016. Meat Quality – Genetic and Environmental Factors. CRC Press. New York.
- Pearson AM. 1994. Quality Attributes and their Measurement in Meat, Poultry and Fish Products. Springer, New York.
- Eurell, J. A. and Frappier, B. L.2006. Dellmann's Textbook of Veterinary Histology. 6th edn. Blackwell Publishing, Oxford.
- AOAC. 2019. Official Methods of Analysis of AOAC International, 21st edn., AOAC International
- Wrolstad R. E., Acree, T. E., Decker, E. A., Penner, M. H., Reid, D. S., Schwartz, S. J., Shoemaker, C. F., Smith, D. and Sporns, P. 2005. Handbook of Food Analytical Chemistry - Water, Proteins, Enzymes, Lipids, and Carbohydrates, Wiley Interscience.
- Nielsen, S. S. 2003. Food Analysis Laboratory Manual, Springer.
- Bender A. 1992. Meat and Meat Products in Human Nutrition in Developing Countries. FAO, Rome.
- Nelson, D. L. and Cox, M. M. 2017. Principles of Biochemistry. W. H. Freeman and Company, New York.
- Reece, W. O. and Rowe E. W. 2017. Functional Anatomy and Physiology of Domestic Animals 5th edn. Wiley-Blackwell.

13. **Suggested e-books**

As above

14. **Suggested websites**

You tube videos on muscle contraction and relaxation, You tube videos on collagen structure and cross linking,

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Processing and Preservation of Meat**
2. **Course Number** : **LPT 603** **Prerequisite** Nil
3. **Credit Hours** : **2+1**
4. **Why this Course?** : Human Resource Development for Meat and Poultry Processing Industry and Entrepreneurship development
5. **Aim of the Course** : To impart knowledge about processing and preservation of meat including poultry meat, fundamentals of sensory evaluation and techniques for sensory evaluation of meat products.

Catalogue Description

6. **Theory**

Unit I **10 Lectures**

Factors influencing growth of microorganisms-intrinsic and extrinsic factors, Definition of spoilage- Methods of spoilage, definition of preservation-Basic principles of meat preservation – chilling, freezing, dehydration, freeze-drying, intermediate moisture foods, curing and smoking- Thermal processing- pasteurization, canning, retort pouch packaging- Direct microbial inhibition, irradiation, use of chemicals and antimicrobials - Hurdle Technology concept- *sous vide* processing and intermediate moisture traditional meat foods – Minimal Processing of Foods– Principles of processing foods for space travel

Unit II **15 Lectures**

Definition of Meat Processing- Important equipment and machineries in meat processing - Unit operations and principles– Concept of value addition- Meat and non-meat ingredients and their roles - Additives - Processing techniques - comminution, chopping, blending, marination, emulsification, massaging, tumbling, etc. -Cooking methods including microwaving – Development of meat products including ham, bacon, tandoori and barbeque - Emulsion formation – factors affecting emulsion formation - Emulsion based meat products - sausages, nuggets and patties - Enrobed, reformed, restructured, fermented and intermediate moisture meat products – Pet food processing– Preblending and least cost formulations in meat products– convenience meat products for military personnel and working women- common brands in market: ready-to-cook, ready-to-eat and shelf-stable products – Frozen meals, canned and retort pouch meat products and meat snacks – Traditional and ethnic meat products - Functional meat

products.

Unit III **9 Lectures**

Sensory evaluation – Sensory physiology– types of sensory evaluation– methods of sensory evaluation– Factors influencing sensory measurements– Layout and designing of sensory evaluation laboratory –Errors during sensory evaluation and their prevention– common eating quality attributes of muscle foods/ lexicons used during sensory evaluation - Types of sensory panels – Screening and selection of sensory panelists- Sensory evaluation tests-their classification, principle underlying the test, protocol, number of panelists used, suitable statistical test for data analysis for that particular test–Subjective and objective methods of evaluating texture and tenderness.

7. **Practical** **17 Classes**

Estimation of pH, FFA values, nitrite content, percent brine in cured meat products, moisture protein ratio, water activity, TBARS value, peroxide value, microbiological examination of meat products – Estimation of storage stability and shelf life of meat products- Preparation of Meat Products - Minced meat products - Emulsion based meat products – sausages, nuggets and patties - Ham and Bacon - Meat Pickles – Enrobed, restructured, fermented and shelf-stable meat products - Canned/ retorted Meat Products - Traditional and ethnic Meat Products - Kebabs - Determination of emulsion stability - Cooking yield - Sensory evaluation of meat products – Sensory evaluation protocol- scaling tests, ranking tests – screening tests and training of panelists- Development of sensory lexicon for new products– Meat descriptive analysis, differential tests, discriminative tests - Objective methods of evaluation of sensory attributes–Warner Bratzler shear- Texture Profile Analysis.

8. **Lecture Schedule and no. of classes**

1.	Definition of spoilage- Methods of spoilage, Factors influencing growth of microorganisms-intrinsic and extrinsic factors	01
2.	Definition of preservation-Basic principles of meat preservation	01
3.	Chilling, freezing, dehydration, freeze-drying, intermediate moisture foods, curing and smoking- Thermal processing- pasteurization, canning, retort pouch packaging- Direct microbial inhibition, irradiation, use of chemicals and antimicrobials	04
4.	Hurdle Technology concept- *sous vide* processing and intermediate moisture traditional meat foods	02
5.	Minimal Processing of Foods	01
6.	Principles of processing foods for space travel	01
7.	**D**efinition of Meat Processing- Important equipment and machineries in meat processing - Unit operations and principles	01

8. Concept of value addition- Meat and non-meat ingredients and their roles - Additives 01
9. Processing techniques - comminution, chopping, blending, marination, emulsification, massaging, tumbling, etc. 01
10. Cooking methods including microwaving 01
11. Development of meat products including ham, bacon, tandoori and barbeque 01
Emulsion formation – factors affecting emulsion formation - Emulsion based meat products 01
12. Sausages, nuggets and patties - Enrobed, reformed, restructured, fermented and intermediate moisture meat products – Pet food processing 02
13. Preblending and least cost formulations in meat products 01
14. Convenience meat products for military personnel and working women- common brands in market 01
15. Ready-to-cook, ready-to-eat and shelf-stable products 01
16. Frozen meals, canned and retort pouch meat products and meat snacks 01
17. Traditional and ethnic meat products 01
18. Functional meat products. 01
19. Sensory evaluation – Sensory physiology 01
20. Types of sensory evaluation– methods of sensory evaluation 01
21. Factors influencing sensory measurements 01
22. Layout and designing of sensory evaluation laboratory 01
23. Errors during sensory evaluation and their prevention 01
24. Common eating quality attributes of muscle foods/ lexicons used during sensory evaluation 01
25. Types of sensory panels – Screening and selection of sensory panellists 01
26. Sensory evaluation tests-their classification 01
27. Principle underlying common sensory tests, protocol, number of panelists used, suitable statistical test for data analysis for that particular test 01
28. Subjective and objective methods of evaluating texture and tenderness. 01

Pre final Examinations 02
Total 35

9. **Practical schedule and no. of classes**

1. Principles of estimation of storage stability and shelf life of meat products 01
2. Estimation of pH and FFA values and nitrite content 01
3. Estimation of percent brine in cured meat products, moisture protein ratio and water activity 01
4. Estimation of TBARS value and peroxide value 01
5. Principles and procedure for examination of microbiological quality of meat products 01
6. Preparation of Meat Products - sausages, nuggets and patties
7. Preparation of Meat Products - Ham / Bacon, Meat Pickles and Turkey roll 01
8. Preparation of Meat Products- fermented and shelf-stable meat products 01
9. Preparation of Meat Products - Canned/ retort pouched meat products 01
10. Traditional and ethnic Meat Products - Kebabs 01
11. Determination of emulsion stability and cooking yield 01

12. Sensory evaluation of meat products – Sensory evaluation protocol, scaling tests and ranking tests 01
13. Sensory evaluation of meat products- screening tests and training of panellists 01
14. Development of sensory lexicon for new products and Meat descriptive analysis 01
15. Differential tests and discriminative tests 01
16. Objective methods of evaluation of sensory attributes–Principles and procedure for Warner-Bratzler shear force values and Allo-Krammer Shear method 01
17. Objective methods of evaluation of sensory attributes- Texture Profile Analysis. 01

Lab final Examination 01

Total 18

10. **Teaching methods**

• Classroom teaching, practical performance in Department Experiential Learning Unit
• Visit to Meat and Poultry Processing Units
• Demonstration videos
• Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**

Theoretical and practical understanding of meat preservation, processing and sensory evaluation of the meat products.

12. **Suggested readings**

- Aberle, E.D., Forest, J.C., Gerrard, D.E. and Mills, E. 2013. Principles of Meat Science, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Toldra, F. 2017. Lawrie's Meat Science. 8th edn. Wood Head Publishing, UK.
- Kinsman, D. M., Kotula, A. W. and Breidenstein, B. C.1994. Muscle foods: Meat, Poultry and Seafood Technology. Springer.
- Barbut S. 2005. Poultry Products Technology. CRC Press.
- Carlson, C.W, Greaser, M.L. and Jones, K.W. 2001. The Meat We Eat, 14th ed. Interstate Publishers, INC.
- Pearson AM and Gillett TA. 1996. Processed Meats, 3rd ed. Chapman and Hall, Inc, New York.
- Toldrá F. 2010. Handbook of Meat Processing, Wiley-Blackwell.
- Hoogenkamp, H. W.2005. Soy Protein and Formulated Meat Products, CABi Publishing, Oxfordshire, UK.
- Stone, H. and Sidel, J. L.2004.Sensory Evaluation Practices 3rd edn. Elsevier Academic Press, London.
- Poste, L. M., Mackie, D. A. Butler, G. and Larmond, E.1991. Laboratory Methods for Sensory Analysis of Food. Research Branch, Agriculture Canada Publication 1864/E.
- Clark, S., Costello, M., Drake, M. A. and Bodyfelt, F.2009. The Sensory Evaluation of Dairy Products 2nd edn. Springer.
- Bourne, M. C.2002.Food Texture and Viscosity: Concept and Measurement 2nd edn. Academic Press. London.
- FAO.1985.Small-scale sausage production. FAO Animal Production and Health Paper

52. Rome. ISBN 92-5-102187-2

- Knipe, C. L. and Rust, R. E. 2010. Thermal Processing of Ready-to-eat Meat Products. Wiley-Blackwell, Oxford, UK.
- Holdsworth, D. and Simpson, R.2007. Thermal Processing of Packaged Foods. 2nd edn. Springer.
- Heinz, G. and Hautzinger, P. 2007. Meat Processing Technology for Small to Medium Scale Producers. APHCA, FAO Regional Office for Asia and the Pacific (RAP), Bangkok. ISBN: 978-974-7946-99-4
- Leistner, L. and Gould, G. W. 2002. Hurdle Technologies Combination Treatments for Food Stability, Safety and Quality, Kluwer / Plenum Publishers, New York.
- Gould, G. W. 1995. New Methods of Food Preservation. Chapman & Hall, London.
- Ohlsson, T. and Bengtsson, N. 2002. Minimal Processing Technologies in the Food Industry. Woodhead Publishing Limited, Cambridge.
- Robertson, G. L. 2010.0Food packaging and shelf life : a practical guide, CRC press, New York

13. **Suggested e-books**

As above

14. **Suggested websites**

Mado® Germany website and other meat processing machinery manufacturers' websites, You tube videos for meat products, You tube videos for fully automated meat processing lines

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Processing of Milk and Milk Products**
2. **Course Number** : **LPT 604** **Prerequisite** Nil
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for Milk Processing Industry, Cooperatives, etc.
5. **Aim of the Course** : To impart knowledge about the organization of dairy plants, unit operations, cleaning and sanitization of milk processing plants, milk products processing, applications of membrane technologies and about production and processing cost in dairy industries.

Catalogue Description

6. **Theory** :

Unit I **6 Lectures**

Composition, nutritional, physico-chemical and functional properties of milk- A1 and A2 milk – Equipment and machineries commonly used in dairy processing-Important unit operations in milk processing and basic principles and optimum operating conditions- Basic concepts of dairy plant organization and operation - Automation in the Dairy Industry- Collection, chilling, transportation of milk-Reception of milk- Heat treatments of Milk

Unit II **7 Lectures**

Manufacture of milk products and important quality control and quality assurance aspects- Flavoured Milk - Drying of milk and milk products - Evaporated and condensed milk - Milk powders – Butter - Ice cream and other frozen desserts - Manufacture of different fermented milk products - Manufacture of cheddar, mozzarella, cottage and processed cheese - Manufacture of indigenous milk products – paneer, channa, khoa, ghee, dahi and shrikhand - Rheology of milk products and their significance

Unit III **4 Lectures**

Dairy by-products- Membrane filtration technology- principles and concepts - Manufacturing of casein and its functional properties - Caseinates- Co-precipitates - Whey protein concentrates (WPC) – Lactose manufacture- Dairy whiteners- Standards for milk and milk products. Production and processing costs of milk and dairy products.

7. **Practical** **17 Classes**

Platform tests - Determination of fat, SNF, TS, protein, lactose and ash contents of milk - Preparation of butter, ice cream, cheese – cheddar,

mozzarella and cottage cheese, khoa, paneer, channa, ghee, dahi, yoghurt, casein, caseinate, co-precipitate, flavoured milk - Determination of degree of browning - Measurement of rheological properties of different milk products - Evaluation of sensory quality of milk and milk products - Visit to dairy plants.

8. **Lecture schedule and no. of classes**

1.	Composition, nutritive value of milk, physico-chemical and functional properties of milk- A1 and A2 milk and their importance	01
2.	Equipment and machineries commonly used in dairy processing	01
3.	Important unit operations in milk processing and basic principles and optimum operating conditions	01
4.	Basic concepts of dairy plant organization and operation	01
5.	Automation in the Dairy Industry	
6.	Collection, chilling, transportation of milk-Reception of milk- Heat treatments of milk – Pasteurization and UHT processing of milk and cream	01
7.	Principles of manufacture, processing, quality control and quality assurance of Flavoured Milk	01
8.	Principles of manufacture, processing, quality control and quality assurance of dried milk products and infant milk powder	01
9.	Principles of manufacture, processing, quality control and quality assurance of evaporated and condensed milk	01
10.	Principles of manufacture, processing, quality control and quality assurance of butter and different fermented milk products	01
11.	Principles of manufacture, processing, quality control and quality assurance of ice cream and other frozen desserts	01 01
12.	Principles of manufacture, processing, quality control and quality assurance of different cheeses - cheddar, mozzarella, cottage and processed cheese	01
13.	Principles of manufacture, processing, quality control and quality assurance of of indigenous milk products – paneer, channa, khoa, ghee, dahi and shrikhand - Rheology of major milk products and their significance	01
14.	Dairy by-products- Membrane filtration technology- principles and concepts Principles of manufacture, processing, quality control and quality assurance of casein and functional properties of casein	01 01
15.	Principles of manufacture, processing, quality control and quality assurance of caseinates, co-precipitates, whey protein concentrates (WPC) and lactose	01 01
16.	FSSR Standards for milk and milk products	
17.	Costing of milk and dairy products - production and processing cost.	01
	Pre final Examinations	02
	Total	19

9. **Practical schedule and no. of classes**

1.	Platform tests	01
2.	Determination of fat, SNF and TS	01
3.	Determination of protein	01
4.	Determination of lactose	01
5.	Determination of ash content of milk	01

6. Preparation of butter and ghee	01
7. Preparation of ice cream	01
8. Preparation of cheese – cheddar, mozzarella and cottage cheese	01
9. Preparation of khoa, paneer and channa,	01
10. Preparation of dahi and yoghurt,	01
11. Preparation of casein, caseinate and co-precipitate	01
12. Preparation of flavoured milk	01
13. Determination of degree of browning	01
14. Measurement of rheological properties of different milk products	01
15. Evaluation of sensory quality of milk and milk products	01
16. Visit to dairy plants.	01
Lab final Examination	01
Total	17

10. **Teaching methods**
    - Classroom teaching and laboratory practical.
    - Visit the milk processing plant.
    - Use of Audio-visual Capsules
    - Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**
    Gaining knowledge of handling and processing of milk and milk products.

12. **Suggested readings**

    - Early, R. 1998. The Technology of Dairy Products, Blackie Academic and Professional, London.
    - Spreer, E. 1993. Milk and Dairy Products. Marcel Dekker.
    - Walstra, P., Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology, 2nd ed. Taylor and Francis Group.
    - Britz, T. J. and Robinson, R. K. 2008. Advanced Dairy Science and Technology, Blackwell Publishing Ltd, Oxford, UK.
    - Aneja, R.P, Mathur, B.N, Banerjee, A.K. and Chandan, R.C. 2002. Technology of Indian Milk Products. Dairy India
    - Chandan, R.C., Kilara, A and Shah, N.P. 2008. Dairy Processing and Quality Assurance, 1st edn. Willey–Blackwell.
    - Varnam, A.H. and Sutherland, J.P. 1994. Milk and Milk Products Technology. Chapman and Hall, UK.
    - Web, B.H., Johnson, A.H. and Alford, J.A. 1987. Fundamental of Dairy Chemistry, 3rd ed. Westport AVI Publ.
    - Belloin, J. C.1988. Milk and dairy products: production and processing costs, FAO Animal Production and Health Paper 62, FAO, Rome. ISBN 92-5-102503-7
    - Davis, J.G. 2010. Milk Testing: A Laboratory Control of Milk. Agribios.
    - MIF. 2005. Analysis of Milk and its Products: A lab Manual, 2nd ed. Milk Industries Foundation. Biotech Books, Delhi.

    Vliet, T. V. 2010. Rheology and fracture mechanics of foods, CRC Press, New York.

13. **Suggested e-books**

As above

14. **Suggested websites**

NDDB website, IDF website, Codex standards website, Dairy equipment manufacturers' website, You tube videos

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title : Packaging and Marketing of Livestock Products**
2. **Course Number : LPT605 Prerequisite Nil**
3. **Credit Hours : 1+1**
4. **Why this Course? :** Human Resource Development (Manager, Supervisor, Marketing Executives and other Technocrats) for Packaging Industry and Business Planning.
5. **Aim of the Course :** To impart knowledge about properties of different packaging material, techniques used in packaging of different livestock products, marketing channels, new start ups in meat retail, value chain of processed products and costing of live animals and retail meat.

Catalogue Description

6. **Theory : 10 Lectures**

Unit I

Principles of packaging - objectives and functions – Flexible and Rigid Packaging–Packaging materials and their characteristics - Product characteristics affecting packaging requirements -Different packaging systems - Vacuum packaging – MAP and role of different gases - Retort pouch processing - Active and intelligent/ smart (biosensors) packaging - Edible and biodegradable packaging – Proprietary Packaging Technology- Cryovac®– Nanotechnology for food packaging - Recycling of packaging materials - Labelling requirements – Barcoding and its importance - Packaging standards and regulations – Economics of different packaging systems– Packaging of fresh, frozen, cured, dehydrated, freeze-dried and shelf-stable products of milk, meat and chicken - Aseptic packaging of milk - UHT milk– Spoilage of packaged milk, meat and egg products (packaged fresh, frozen, cured, cooked meat products, meat snack, canned foods, intermediate moisture foods)

Unit II **7 Lectures**

Marketing of Livestock Products - Types of markets - Marketing channels for milk, meat, egg products-Marketing channels of live meat animals and poultry – Role of different market intermediaries for live animals and livestock products- Existing systems of marketing - their constraints and possible solutions - Value Chain of meat, poultry and processed products–Price forecasting for livestock products- International price trend for livestock products in the past two decades- Farmer Producer Organizations – Co-operative marketing organizations involved in milk, meat, poultry processing and their retailing in India- strategies and interventions for better profitability –

Meat retailing and establishment of retail outlets for meat and poultry – Digital marketing of meat and retailing – Startup India – New organized players in Indian Retail Meat market – FSSAI, APEDA, EIA, GOI/ SPS/ TBT regulations governing marketing of domestic market, Import and Export of Livestock Products- Essential documentation requirements for export of livestock products.

7. **Practical** **17 Classes**

Different packaging materials and their properties - Determination of thickness, bursting strength, piercing strength, water vapour transmission rate, gas transmission rate, headspace gas analysis - Vacuum, shrink, MAP and retort packaging of meat and milk products - Visit milk and meat processing plants - Study of the value chain of livestock products including online marketing- price forecasting for milk- Costing of live animals for slaughter- Estimation of purchase price of live animals intended for slaughter-buffaloes, goat, sheep, pig and poultry- Estimation of cost of retail price of chevon, mutton, buffalo beef (carabeef) and broiler meat-Price forecasting for egg, live broiler and buffalo marketing and skim milk powder.

8. **Lecture schedule and no. of classes**

1.	Principles of packaging - objectives and functions; Flexible and Rigid Packaging; Packaging materials and their characteristics; Product characteristics affecting packaging requirements	01
2.	Different packaging systems - Vacuum packaging – MAP and role of different gases in packaging, Proprietary Packaging Technology- Cryovac®	01
3.	Retort pouch processing, active and intelligent/ smart (biosensors) packaging, edible and biodegradable packaging	01
4.	Nanotechnology for food packaging and recycling of packaging materials	01
5.	Labelling requirements and barcoding and their importance, packaging standards and regulations; Economics of different packaging systems	01
6.	Packaging of fresh, frozen, cured, dehydrated, freeze-dried and shelf-stable products of milk, meat and chicken	01
7.	Aseptic packaging of milk - UHT milk	01
8.	Spoilage of packaged milk, meat and egg products (packaged fresh, frozen, cured, cooked meat products, meat snack, canned foods, intermediate moisture foods)	01
9.	Marketing of Livestock Products - Types of markets	01
10.	Marketing channels for milk, meat, egg products-Marketing channels of live meat animals and poultry	01
11.	Role of different market intermediaries for live animals and livestock products Existing systems of marketing - their constraints and possible solutions	01
12.	Value Chain of meat, poultry and processed products	01
13.	Price forecasting for livestock products and international price trend for livestock products in the past two decades	01
14.	Farmer Producer Organizations – Co-operative marketing organizations involved in milk, meat, poultry processing and their retailing in India; Strategies and interventions for better profitability	01

15. Meat retailing and establishment of retail outlets for meat and poultry – Digital marketing of meat and retailing – Startup India – New organized players in Indian Retail Meat market 01
16. FSSAI, APEDA, EIA, GOI/ SPS/ TBT regulations governing marketing of domestic market 01
17. Import and Export of Livestock Products- Essential documentation requirements for export of livestock products. 01

Prefinal Examinations 02
Total 19

9. **Practical schedule and no. of classes**
    1. Packaging materials and their properties 01
    2. Determination of thickness, bursting strength, piercing strength, water vapour transmission rate, gas transmission rate 01
    3. Headspace gas analysis 01
    4. Vacuum, shrink, MAP and retort packaging of meat and milk products 02
    5. Visit to milk and meat processing plants 02
    6. Study of the value chain of livestock products including online marketing 01
    7. Price forecasting for milk 01
    8. Costing of live animals for slaughter 01
    9. Estimation of purchase price of live animals intended for slaughter-buffaloes, goat, sheep, pig and poultry 01
    10. Costing of meat cuts 01
    11. Estimation of cost of retail price of chevon, mutton, buffalo beef (carabeef) and broiler meat 01
    12. Price forecasting for egg and live broiler 01
    13. price forecasting of buffalo meat 01
    14. Price forecasting for skim milk powder. 01

    Lab final Examination 01
    Total 18

10. **Teaching methods**
    - Classroom teaching, Practical demonstration in the laboratory.
    - Visit market and packaging units.
    - Demonstration using video films and models.
    - Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**
    Developing an understanding of packaging and marketing of livestock products

12. **Suggested readings**

    - Robertson GC. 2012. Food Packaging- Principles and Practices, 3rd ed. CRC Press.
    - Lesser, W.H. 1993. Marketing of Livestock and Meat. Food Products Press. New York. ISBN 1-56022-016-3
    - Gerrard, F. 1978. Meat Technology. Northwood Publications. ISBN-10-0719826071
    - Carlson CW, Greaser ML and Jones KW. 2001. The Meat We Eat, 14th ed. Interstate

Publishers, INC.
• Paine, F. A. and Paine, H. Y. 1992. A Handbook of Food Packaging. Springer Science. ISBN 978-1-4615-2810-4
• Cornell Small Farm Program. 2019. Guide to Direct Marketing Livestock and Poultry.
• Selected Articles from Journals.

13. **Suggested e-books**

As above

14. **Suggested websites**

Websites of FAOSTAT, NDDB, Packaging machine manufacturers website, live animal price calculators online

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title : Microbiology and Quality Control of Livestock Products**
2. **Course Number : LPT 606 Prerequisite Nil**
3. **Credit Hours : 1+1**
4. **Why this Course? :** Human Resource Development for Quality Control of Livestock Products
5. **Aim of the Course :** To develop an understanding about microbial spoilage of different livestock products, quality control, food safety management systems, private retail standards and legal standards.

Catalogue Description

6. **Theory :**

Unit I 9 Lectures

Microorganisms associated with spoilage of livestock products - Factors affecting microbial growth - Contamination of livestock products - Microbial spoilage of meat, poultry, eggs, milk and their products - Physical and chemical changes produced by microbes in milk, meat, eggs and their products and spoilage characteristics – Microbiological examination of food products-principles, draw backs and its usefulness– Meat and milk-borne infections and intoxications - Control of microbial growth in livestock products - Antimicrobial resistance (AMR)- Residues of heavy metals, pesticides, antibiotics, growth promoters and other chemical residues in livestock products and their effects on the health of the consumer.

Unit II 8 Lectures

Quality control and quality assurance concepts, Quality assurance and quality control practices in abattoir, meat processing and value addition, effluent treatment plant, rendering plant, egg drying, market milk, ice cream, paneer, cheese, khoa and other milk products - Quality Management Systems –ISO 9001 - Food Safety System Certification (FSSC) - Risk-based quality assessment - HACCP concepts - Good Hygienic practices (GHP) and Good Manufacturing Practices (GMP)- ISO 22000- Private retail standards and their significance- Sanitary and Phytosanitary measures (SPS) and Food Safety and Standards Act (FSSAI, 2006 Act) - Codex regulations for food products safety -FSSAI/ BIS standards for milk, meat and poultry- Introduction to Good Laboratory Practices (GLP)- Microbial quality control

7. **Practical 17 Classes**

Basic requirements for setting up of quality control laboratory - Sampling methods and microbiological examination of processing plants, products, environment and equipment - - Microbial evaluation of market samples of milk, meat and egg – Total Viable Count, coliform count, Anaerobic count etc. - Pathogens of Public Health importance - E. coli, Salmonella, Staphylococcus aureus, Campylobacter –ATP bioluminescence based tests- Rapid detection methods of food pathogens. Development of SOPs, GMPs, SSOPs and

HACCP plan for milk and meat processing plants

8. **Lecture schedule and no. of classes**

1.	Microorganisms associated with spoilage of livestock products- milk, meat and eggs and factors affecting microbial growth	02
2.	Contamination of livestock products- Milk, meat and eggs and microbial spoilage of meat, poultry, eggs, milk and their products	01
3.	Physical and chemical changes produced by microbes in milk, meat, eggs and their products and spoilage characteristics	01
4.	Microbiological examination of food products-principles, draw backs and its usefulness	01
5.	Meat and milk-borne infections and intoxications and Control of microbial growth in livestock products	01
6.	Antimicrobial resistance (AMR), Residues of heavy metals, pesticides, antibiotics, growth promoters and other chemical residues in livestock products and their effects on the health of the consumer.	01
7.	Quality control and quality assurance concepts, Quality Management Systems – ISO 9001 - Food Safety System Certification (FSSC), ISO 22000, Private retail standards and their significance	01
8.	Risk-based quality assessment and HACCP concepts, Good Hygienic practices (GHP) and Good Manufacturing Practices (GMP)	01
9.	Quality assurance and quality control practices in abattoir, meat processing and value addition	01
10.	Quality assurance and quality control practices in Effluent treatment plant and rendering plant	01
11.	Quality assurance and quality control practices in egg drying	01
12.	Quality assurance and quality control practices in market milk, ice cream, paneer, cheese, khoa and other milk products	01
13.	Sanitary and Phytosanitary measures (SPS) and Technical Barriers to Trade, Food Safety and Standards Act (FSSAI, 2006 Act), Codex regulations for food products safety	01
14.	FSSAI/ BIS standards for milk, meat and poultry	01
15.	Introduction to Good Laboratory Practices (GLP)	01
16.	Microbial quality control	01
	Pre final Examinations	02
	Total	19

9. **Practical schedule and no. of classes**

1.	Concept of quality and components of meat quality. Basic requirements for setting up of quality control laboratory	01 02
2.	Sampling methods and microbiological sampling of processing plants, products, environment and equipment	04
3.	Microbial evaluation of market samples of milk, meat and egg – Total Viable Count, coliform count, Anaerobic count etc.	02
4.	Microbial evaluation of pathogens of public health importance - E. *coli, Salmonella, Staphylococcus aureus, Campylobacter*	01
5.	ATP bioluminescence based tests	01

6. Rapid detection methods of food pathogens –DEFT etc. 01
7. Development of SOPs for milk and meat processing plants 01
8. Development of GMPs for milk and meat processing plants 01
9. Development of SSOPs for milk and meat processing plants 02
10. Development of HACCP plan for milk and meat processing plants

Lab final Examination 01

Total 17

10. **Teaching methods**

- Classroom teaching with laboratory analysis.
- Sampling and survey of market, butchers shop, milk and meat processing plants.
- Visits to units having HACCP and ISO certification.
- Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**

Acquiring knowledge on microbiology, quality control, food safety management systems and legal standards for different livestock products.

12. **Suggested readings**

- Toldra, F. 2017. Lawrie's Meat Science. 8th edn. Wood Head Publishing, UK.
- Kinsman, D. M., Kotula, A. W. and Breidenstein, B. C.1994. Muscle foods: Meat, Poultry and Seafood Technology. Springer.
- Bell, C., Neaves, P. and Williams, A.P. 2005. Food Microbiology and Laboratory Practices, 1st edn. Blackwell Publishing.
- Collins, D.S. and Huey, R.J. 2015. Gracey's Meat Hygiene, 11th ed. John Wiley and Sons Ltd., UK.
- Frazier, W.C. and Westhoff, D.C. 2013. Food Microbiology, 5th ed. McGraw Hill Publication.
- Jay, J.M., Loessner, M.J. and Golden, D.A. 2006. Modern Food Microbiology, 7th ed. Springer.
- Lund, B.M., Baird-Parker, T.C. and Gould, G.W. 2000. The Microbiological Safety and Quality of Food, Vol. I and II, Aspen Publishers, Inc., Maryland.
- ICMSF. 2005. Microorganisms in Foods 6 - Microbial Ecology of Food Commodities, Kluwer Academic/Plenum Publishers, New York. ISBN: 0-306-48675-X.
- Marth, E.H. and Steele, J. L. 2001. Applied Dairy Microbiology, Marcel Dekker, Inc., New York.
- Marth, E.H. 1978. Standard Methods for the Examination of dairy Products, 14th edn., American Public Health Association, Washington D.C.
- APHA, 2015. Compendium of Methods for Microbiological Examination of Foods, 5th edn. American Public Health Association, Washington D.C.

13. **Suggested e-books**

As above

14. **Suggested websites**

Websites of FSIS, ICMSF, Codex Alimentarius Commision, NACMSF, WHO etc.

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Slaughterhouse By-products Technology**
2. **Course Number** : **LPT607** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development for better utilization of animal by-products and pollution control
5. **Aim of the Course** : To impart knowledge about the utilization and processing of various animal by-products.

Catalogue Description

6. **Theory** :

Unit I **6 Lectures**

Status and scope of slaughterhouse by-products utilization and their importance- Byproduct trade practices - Planning, design and layout of by-products plant - Classification of by-products - edible and inedible - Rendering methods, advantages and disadvantages - safety of rendering process - products of rendering -their yield and quality characteristics of rendered fat and meat cum bone meal- Methods of safe disposal of condemned parts- Utilization of organic wastes (dung, ingesta, bedding etc.) in slaughter house

Unit II **6 Lectures**

Preparation of casings- methods, their grading and preservation- Utilization of blood, horns and hooves, intestine, bones, feathers, bristles, glandular by-products and ruminal contents - Value-added by-products from slaughterhouse and poultry processing plants – Pet foods, their types and processing of animal by-products for pet foods - High-value low volume by-products – collagen sheets, scaffolds, bone morphogenic proteins, biopeptides, biodiesel, etc.- Legislation and regulations related to animal by-products.

Unit III **5 Lectures**

Flaying- methods- recent advances, fleshing of hide Classification and factors affecting the quality of hides and skin - Physical and chemical characteristics of hide and skin - Grading of hide and methods of preservation of hide and skin, advantages and disadvantages - processing of hide and skin for the manufacture of leather - Preparation and quality control of gelatine and glue.

7. **Practical** **17 Classes**

Preparation of casing, neats foot oil, gelatin and glue - Grading of casings- Demonstration of preparation of carcass meal, meat meal, bone meal, blood meal, feather meal, slime meal - Collection and

preservation of glandular by-products - Preparation of pet foods -Visit local by-products processing units - Quality evaluation of rendered animal fat.

8. **Lecture schedule and no. of classes**

1.	Status and scope of slaughterhouse by-products utilization and their importance; Byproduct trade practices	01
2.	Planning, design and layout of by-products plant	01
3.	Classification of by-products - edible and inedible; Rendering methods, advantages and disadvantages - safety of rendering process	01
4.	Products of rendering; yield and quality characteristics of rendered fat and meat cum bone meal	01
5.	Methods of safe disposal of condemned parts and Utilization of organic wastes (dung, ingesta, bedding etc.) in slaughter house	01
6.	Preparation of casings- methods, their grading and preservation	01
7.	Utilization of blood, horns and hooves, intestine, bones, feathers, bristles, glandular by-products and ruminal contents	01
8.	Value-added by-products from slaughterhouse and poultry processing plants	01
9.	Pet foods, their types and processing of animal by-products for pet foods	01
10.	High-value low volume by-products – collagen sheets, scaffolds, bone morphogenic proteins, biopeptides, biodiesel, etc.	01
11.	Legislation and regulations related to animal by-products.	01
12.	Flaying- methods- recent advances, fleshing of hide	01
13.	Classification of of hides and skin and factors affecting their quality	01
14.	Physical and chemical characteristics of hide and skin and grading of hide	01
15.	Methods of preservation of hide and skin, advantages and disadvantages	01
16.	Processing of hide and skin for the manufacture of leather	01
17.	Preparation and quality control of gelatine and glue.	01
	Pre final Examinations	02
	Total	19

9. **Practical schedule and no. of classes**

1.	Preparation of casing	02
2.	Preparation of neats foot oil	01
3.	Preparation of gelatin and glue	01
4.	Grading of casings	01
5.	Preparation of carcass meal	01
6.	Preparation of meat meal	01
7.	Preparation of bone meal	01
8.	Preparation of blood meal	01
9.	Preparation of feather meal	01
10.	Preparation of slime meal	01
11.	Preparation of collection and preservation of glandular by-products	01
12.	Preparation of pet foods	02
13.	Visit local by-products processing units	01
14.	Quality evaluation of rendered animal fat.	01
	Lab final Examination	01
	Total	17

10. **Teaching methods**
    - Classroom teaching, practical demonstration of different by-products preparation in the Experiential Learning Unit
    - Visit of municipal slaughterhouse and tanneries.
    - Use of Audio-visual Capsules.
    - Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**
    Gaining knowledge on proper and safe utilization of slaughterhouse by-products

12. **Suggested readings**

    - Mann, I. 1962. Animal By-products: Processing and Utilization. FAO, Rome.
    - Ockerman, H.W. and Hansen, C.L. 1999. Animal By-product Processing and Utilization. CRC Press, New York.
    - Ockerman, H. W. and Basu, L. 2010. Edible Rendering: Rendered Products for Human Use, Ohio State University.
    - Kumar, M .1989. Handbook of Rural Technology for the Processing of Animal Byproducts, FAO, Rome. ISBN: 92-5-102907-5
    - Pearson, A.M. and Dutson, T.R. 1992. Inedible Meat By-Products, Advances in Meat Research, Volume 8, Elsevier Applied Science, London.
    - Pearson, A.M. and Dutson, T.R. 1992. Edible Meat By-Products, Advances in Meat Research, Volume 5, Elsevier Applied Science, London. ISBN: 1851662545.
    - Meeker, D. L. 2006. Essential Rendering: All About The Animal By-Products Industry, National Renderers Association ISBN: 0-9654660-3-5

13. **Suggested e-books**

    As above

14. **Suggested websites**

    Websites of AAFCO and National Renderer Magazine, Rendering equipment manufacturers' websites, EEC regulations on rendering safety, Website of MIRINZ, New Zealand, CSIRO website

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title : In-Plant Training**
2. **Course Number : LPT608** **Prerequisite Nil**
3. **Credit Hours : 0+2**
4. **Why this Course? :** Development of Entrepreneurial Skill and Human Resources for Meat and Milk Industry
5. **Aim of the Course :** To impart industrial exposure and develop practical skill among postgraduate students

Catalogue Description

6. **Practical : 34 sessions/ Hours equivalent to 34 credit hours of practical**

   LPT students shall undergo in-plant training in any one of the specialized area of Livestock Products Technology in an institute/ industry – private or public sector. After completion of the training, the student will submit a training report. The student shall have a printed and prepared training manual before commencement of training. The evaluation will be based on attendance, report submission and viva-voce examination.

7. **Practical Schedule and no. of classes**

   Studying raw material procurement, quality evaluation, costing, operation controls, quality control, quality assurance, laboratory procedures, packaging and marketing, costing of the produce, plant layout and design etc. **(34 classes x 3 hrs =102 hrs)**

   Project Report Evaluation and Viva-voce 01

   Total 35

8. **Teaching methods**
   - Deputation to slaughterhouse/ meat/ milk processing plants
   - Use of Audio-visual Capsules.
   - Presentation of Project Report

9. **Learning outcome**

   Students after undergoing training will have a good understanding of the functioning of the industry and undergo on the job training.

10. **Suggested readings**
    - Interaction with Industry Persons.
    - Training manual to be read and understood before undergoing training.
    - Selected articles from Journals.
    - Books as per milk or meat industry requirement

11. **Suggested e-books**

As above

12. **Suggested websites**

Websites and you tube videos concerned with area of training

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Egg and Egg Products Technology**
2. **Course Number** : **LPT609** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development for Egg Processing Industry/ Plants
5. **Aim of the Course** : To impart knowledge about the status of egg production, composition, nutritive value, preservation, grading, processing, packaging and marketing of eggs and egg products.

Catalogue Description

6. **Theory** :

Unit I **9 Lectures**

Status of egg production and processing in India - Structure, detailed composition, nutritive value and functional properties of eggs - Grading, preservation, packaging and marketing of shell eggs - Quality evaluation of shell eggs and factors influencing egg quality - Defects and Spoilage of shell eggs -Designer eggs

Unit II **8 Lectures**

Layout and design of egg processing Unit – Principles, different methods and procedures of pasteurization, chilling, freezing, desugarization and drying of albumen, yolk and whole egg liquid and preparation of egg products - Packaging of egg products - Spoilage of egg products- Quality control and quality assurance of egg products - Quality standards of egg products - Codex standards and FSSR standards.

7. **Practical** **17 Classes**

Quality evaluation and grading of shell egg- Evaluation of physical, chemical and functional of egg and egg products - Microbiological quality evaluation of egg and egg products- Preservation of eggs - Preparation of value-added egg products –Testing for efficiency of pasteurization of egg liquids- Proximate composition of egg- Cholesterol estimation and estimation FFA and n3 and n6 fatty acids in egg products- Estimation of antibiotic residues in egg products- Visit to egg processing plant.

8. **Lecture schedule and no. of classes**

1.	Status of egg production and processing in India	01
2.	Structure, detailed composition and nutritive value of eggs	01
3.	Functional properties of eggs	01
4.	Grading, preservation, packaging and marketing of shell eggs	01

5. Quality evaluation of shell eggs and factors influencing egg quality 01
6. Defects and Spoilage of shell eggs; designer eggs 01
7. Layout and design of egg processing Unit 01
8. Principles, different methods and procedures of pasteurization, chilling, freezing, desugarization and drying of albumen, yolk and whole egg liquid 03
9. Preparation of egg products 01
10. Packaging of egg products 01
11. Spoilage of egg products 01
12. Quality control and quality assurance of egg products 01
13. Quality standards of egg products 01
14. Codex standards and FSSR standards. 01

Pre final Examinations 02

Total 18

9. **Practical schedule and no. of classes**

1. Quality evaluation and grading of shell egg 01
2. Evaluation of physical, chemical and functional properties of egg and egg products 03
3. Microbiological quality evaluation of egg and egg products 02
4. Preservation of eggs 01
5. Preparation of value-added egg products 01
6. Testing for efficiency of pasteurization of egg liquids 01
7. Proximate composition of egg 02
8. Cholesterol estimation 01
9. Estimation of FFA 01
10. Estimation of n3 and n6 fatty acids in egg products 01
11. Estimation of antibiotic residues in egg products 01
12. Visit to egg processing plant. 01

Lab final Examination 01

Total 17

10. **Teaching methods**

• Classroom teaching, practical demonstration in Divisional laboratory.
• Visit egg processing plant.
• Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**

Gaining knowledge on composition, nutritive value, preservation and marketing of eggs. Quality maintenance and development of designer egg products.

12. **Suggested readings**

- Romanoff, A. L. and Romanoff, A. J. 1949. Avian Egg. John Wiley and Sons.
- Stadelman, W. L. and Cotterill, O. J. 2002. Egg Science and Technology, 4th ed. CBS Publishers, New Delhi.
- Mountney, G. J. and Parkhurst, C. R. 1995. Poultry Products Technology 3rd edn. Food Products Press, New York.
- Bell, D. D. and Weaver Jr., W. D. 2002. Commercial Chicken Meat and Egg Production,

5th edn. Springer.
- Froning, G. W., D. Peters, P. Muriana,K. Eskridge, D. Travnicek and S. S. Sumner. 2002. International Egg Pasteurization Manual, United Egg Association, Washington D.C.
- Bell, D. D. and W. D. Weaver Jr. 2002. Commercial Chicken Meat and Egg Production, 5th Edn., Springer ScÎence+Business Media, New York.
- Yamamoto, T., L. R. Juneja, H. Hatta and M. Kim. 1997. Hen Eggs-Their Basic and Applied Science. CRC Press LLC., New York.
- Sim, J.S., S. Nakai and W Guenter. 2000. Egg Nutrition and Biotechnology. CABi
- Publishing, Oxford, UK.
- Selected articles from Journals and patent literature

13. **Suggested e-books**

As above

14. **Suggested websites**

Website of FAOSTAT, Egg grading and processing equipment manufacturers' website and You tube videos on egg processing and grading

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Market Milk Processing and Dairy Plant Practices**
2. **Course Number** : **LPT610** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for Milk Processing Industry and Dairy Plants.
5. **Aim of the Course** : To impart knowledge about procurement of milk, assessment of its quality, common unit operations, milk processing techniques, quality control and quality assurance, legal standards, the layout of milk processing plant and dairy effluent plant, and preparation of market milk and special milk.

Catalogue Description

6. **Theory** :

Unit I **5 Lectures**

Design and layout of dairy plants of different capacities -Organization of procurement and pricing plans of raw milk - Operation of automatic milk collection stations - Reception of milk at Raw Milk Reception Dock (RMRD) - Assessing raw milk quality - Sanitary handling of milk - Milk standards and legislations.

Unit II **6 Lectures**

Unit operations in milk processing plants - Clarification – Bactofugation - Different chilling methods - Standardization - Homogenization (theories, methods and effects) – Churning- Cream separation- Heat treatments (thermization, boiling, pasteurization, sterilization (UHT and In-container) –Condensing -Drying – Packaging- Separation technologies (Microfiltration, Ultrafiltration, reverse osmosis, diafiltration, nanofiltration etc).

Unit III **2 Lectures**

Distribution methods for liquid milk - Consumer pricing - Traceability - Handling of unsold and returned milk- Adulteration of milk and detection - Residues in milk and preventive steps.

Unit IV **4 Lectures**

Fortified, special and functional market milk -Dairy by-products - Cleaning and sanitization of machinery and dairy plant- Treatment of Dairy Effluents.

7. **Practical** **17 Classes**

Platform tests - Principles of rapid milk analyzers including milko-tester and operation of automatic milk collection stations - Raw milk quality, somatic cell count, bacteriological count - Estimation of

homogenization efficiency - Assessment of efficiency of pasteurization, sterilization and boiling- Detection of adulterants.

8. **Lecture schedule and no. of classes**

1. Design and layout of small, medium and large dairy plants	01
2. Organization of procurement and pricing plans of raw milk; Operation of automatic milk collection stations	01
3. Reception of milk at Raw Milk Reception Dock (RMRD)	01
4. Assessing raw milk quality; sanitary handling of milk	01
5. Milk standards and legislations.	01
6. Unit operations in milk processing plants – Clarification, bactofugation, standardization and homogenization (theories, methods and effects)	01
7. Unit operations in milk processing plants- different chilling methods, Cream separation, Churning	01
8. Unit operations in milk processing plants -Heat treatments (thermization, boiling, pasteurization, sterilization (UHT and In-container),	01
9. Unit operations in milk processing plants –Condensing and drying,	01
10. Unit operations in milk processing plants –Packaging	01
11. Separation technologies (Microfiltration, Ultrafiltration, reverse osmosis, diafiltration, nanofiltration etc).	01
12. Distribution methods for liquid milk; consumer pricing; and traceability	01
13. Handling of unsold and returned milk; adulteration of milk and it's detection; residues in milk and preventive steps	01
14. Fortified milk; special and functional market milk	01
15. Dairy by-products	01
16. Cleaning and sanitization of machinery and dairy plant	01
17. Treatment of Dairy Effluents	01
Pre final Examinations	02
Total	19

9. **Practical schedule and no. of classes**

1. Layout of dairy plant	01
2. Common machineries used in dairy plant and their principles and operation	01
3. Standardization of milk for cheese manufacturing, condensed milk, standardized milk, churning of butter, Ice cream mix preparation	02
4. Platform tests	01
5. Principles of rapid milk analyzers including milko-tester	01
6. Operation of automatic milk collection stations	01
7. Assessing the raw milk quality- somatic cell count, bacteriological count	02
8. Estimation of homogenization efficiency	01
9. Assessment of efficiency of pasteurization	01
10. Assessment of efficiency of sterilization and boiling	01
11. Detection of adulterants	02
12. Visit to dairy plant	01
13. Visit to dairy effluent treatment plant	01
Lab final Examination	01
Total	**17**

10. **Teaching methods**
    - Classroom teaching and laboratory analysis.
    - Visit milk processing plants
    - Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**

    Acquaintance with the processing of market milk and common unit operations in a dairy plant.

12. **Suggested readings**
    - FAO. 2013. Milk and Dairy Products in Human Nutrition. FAO, Rome.
    - Early, R. 1998. The Technology of Dairy Products, Blackie Academic and Professional, London.
    - Spreer, E. 1993. Milk and Dairy Products. Marcel Dekker.
    - Walstra, P., Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology, 2nd ed. Taylor and Francis Group.
    - Britz, T. J. and Robinson, R. K. 2008. Advanced Dairy Science and Technology, Blackwell Publishing Ltd, Oxford, UK.

13. **Suggested e-books**

    As above

14. **Suggested websites**

    Dairy equipment manufacturers website like APV, tetra-pak etc. Website of Codex Alimentarius Commission, NDDB, FSSAI etc.

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Processing and Marketing of Wool**
2. **Course Number** : **LPT611** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for Wool Processing Industry

5. **Aim of the Course** : To impart knowledge about the growth and structure of wool and fibres and their use. Grading, processing, marketing and specifications of wool and speciality fibres.

Catalogue Description

6. **Theory** :

Unit I **10 Lectures**

Status and prospects of wool industry - Wool types and their uses - Growth and molecular structure of wool fibre - physical and chemical properties of wool - Grading of wool, Characteristics of speciality hair fibres and their uses- factors influencing the quality of wool and speciality hair fibres - principles and steps involved in the processing of wool and speciality hair fibres, Impurities in wool and their removal, Defects in wool.

Unit II **7 Lectures**

Physical, chemical and mechanical testing of wool - by-products of wool industry - Trade and Marketing of wool, specification and regulation for quality control - Characteristics of natural and synthetic fibres

7. **Practical** **17 Classes**

Physical, chemical and mechanical testing of wool and speciality hair fibres - Characterization of wool - grading of wool - Identification of natural and synthetic fibres - Visit the wool processing industry and acquaintance with various steps in the processing of wool and speciality hair fibres.

8. **Lecture Schedule and no. of classes**

1.	Status and prospects of wool industry; Wool types and their uses	01
2.	Growth and molecular structure of wool fibre	01
3.	Physical and chemical properties of wool	02
4.	Grading of wool	01
5.	Characteristics of speciality hair fibres and their uses	01
6.	Factors influencing the quality of wool and speciality hair fibres	02
7.	Principles and steps involved in the processing of wool and speciality hair fibres	02
8.	Impurities in wool and their removal; defects in wool	01

9.	Physical, chemical and mechanical testing of wool	02
10.	By-products of wool industry	01
11.	Trade and Marketing of wool	01
12.	Specifications and regulations for quality control	01
13.	Characteristics of natural and synthetic fibres	01
	Pre final Examinations	02
	Total	**19**

9. **Practical Schedule and no. of classes**

1.	Physical testing of wool and speciality hair fibres	02
2.	Chemical testing of wool and speciality hair fibres	02
3.	Mechanical testing of wool and speciality hair fibres	02
4.	Characterization of wool	02
5.	Grading of wool	03
6.	Identification of natural and synthetic fibres	02
7.	Visit to the wool processing industry and acquaintance with various steps in the processing of wool and speciality hair fibres	02
	Lab final Examination	01
	Total	**16**

10. **Teaching methods**

• Classroom teaching and laboratory analysis.
• Visit wool processing units.

11. **Learning outcome**

Gaining knowledge on the quality and processing of wool

12. **Suggested readings**

- Bergen WV. 1963. Wool Hand Book, Vols. I and II. Interscience.
- Houck MM. 2009. Identification of Textile Fibres. Woodhead Publishing Limited, Cambridge, England.
- Johnson NAG and Russell IM. 2009. Advances in Wool Technology. Woodhead Publishing Limited, Cambridge, England.
- Cottle DJ 2010.International Sheep and Wool Handbook. Nottingham University Press, Nottingham, NG11 0AX, United Kingdom
- Simpson W S and G H Crawshaw. 2002. Wool: Science and Technology, Woodhead Publishing Ltd, Cambridge, England
- Rogers G.E., P.J. Reis and K.A. Ward and R.C. Marshall. 1989. The Biology of Wool and Hair. Chapman and Hall Ltd, London.
- Johnson N. A. G. and I. M. Russell.2009. Woodhead Publishing Ltd, Cambridge, England

13. **Suggested e-books**

As above

14. **Suggested websites**

Websites of CSIRO, Australia, New Zealand Government and USDA; and EEC websites

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title : Biotechnology of Foods of Animal Origin**
2. **Course Number : LPT 612 Prerequisite Nil**
3. **Credit Hours : 1+1**
4. **Why this Course? :** Human Resource Development for meat and milk processing Industry with understanding of the latest biological techniques
5. **Aim of the Course :** To impart knowledge about new biotechnological techniques and tools for improving livestock productivity, quality control and food value.

Catalogue Description

6. **Theory : 10 Lectures**

Unit I Role of Biotechnology in improving productivity and quality of Meat, Milk and their products - Application of biotechnological tools in food preservation and packaging - Transgenic meat animal production - techniques - Genes influencing meat quality traits – Production of meat and milk with the desired composition - Application of enzymes in dairy and meat industry - Genetically modified enzymes - Biotechnologically produced food flavours and colours for animal products.

Unit II **7 Lectures**

Starter cultures in Meat and milk - Pre and probiotics, and their supplementation in animal origin foods - Biopreservation- Bacteriocin - Fermentation technology - Upstream and Downstream processing - Biosensors - Antimicrobial Peptides - Meat Species Identification- Molecular tools.

7. **Practical** **17 Classes**

Introduction of basic biotechnological techniques such as western blotting, enzyme isolation and identification, DNA extraction, amplification, different types of PCR, Acquaintance with RT-PCR, Multiplex PCR, gene identification and characterization - Biotechnological techniques for meat species identification and meat quality - Electrophoresis, Chromatography for fatty acids- Operation of fermenters.

8. **Lecture schedule and no. of classes**

1.	Role of Biotechnology in improving productivity and quality of Meat, Milk and their products	01
2.	Application of biotechnological tools in food preservation and packaging	01
3.	Application of biotechnological tools in packaging	01
4.	Techniques in transgenic meat animal production	01

5.	Genes influencing meat quality traits	01
6.	Production of meat and milk with the desired composition	01
7.	Application of enzymes in dairy and meat industry	01
8.	Genetically modified enzymes	01
9.	Biotechnologically produced food flavours and colours for animal products.	01
10.	Starter cultures in Meat and milk	02
11.	Pre and probiotics, and their supplementation in animal origin foods	01
12.	Bio preservation; Bacteriocin	01
13.	Fermentation technology - Upstream and Downstream processing – Biosensors	02
14.	Antimicrobial Peptides	01
15.	Meat Species Identification and use of molecular tools	01
	Pre final Examinations	02
	Total	**19**

9. **Practical schedule and no. of classes**

1.	Basic biotechnological tools and their applications in relation to livestock products technology	01
2.	Principle and procedure of protein (western) blotting and nucleic acid blotting	01
3.	Principle and procedure of enzyme isolation and identification	01
4.	Principle and procedure of DNA extraction	01
5.	Principle and procedure of Amplification of DNA	01
6.	Different types of PCR	01
7.	Acquaintance with RT-PCR and Multiplex PCR	02
8.	Gene identification and characterization	01
9.	Biotechnological techniques for meat species identification	02
10.	Biotechnological techniques for meat quality identification (tenderness etc.)	02
11.	Methods of Electrophoresis- Principle and procedure	02
12.	Chromatography for fatty acids – Principle and Procedure	01
13.	Principles and operation of fermenters	01
	Lab final Examination	01
	Total	**18**

10. **Teaching methods**

- Classroom teaching.
- Use of Audio-visual capsules.
- Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

11. **Learning outcome**

Gaining knowledge on utilization of biotechnology as a tool to improve production, shelf life and nutritive value of livestock products.

12. **Suggested readings**

- Toldra F. (Ed). 2008. Meat Biotechnology, Springer Science, New York.
- Shetty, K., Paliyath, G., Pometto, A. and Levin, R. E.2006. Food Biotechnology, 2nd edn., CRC Press, New York.

- Fiems, L.O., Cottyn, B.G. and Demeyer, D.I. 1991. Animal Biotechnology and the Quality of Meat Production, Developments in Animal and Veterinary Sciences: 25, Elsevier, Oxford, UK.
- Wilson, K. and Walker, J. 2005. Principles and Techniques of Biochemistry and Molecular Biology, 6th edn. Cambridge University Press.
- Boyer, R. 2000. Modern Experimental Biochemistry, 3rd edn., Benjamin Cummings, Boston.
- Selected articles from Journals.

13. **Suggested e-books**

As above

14. **Suggested websites**

Instrument manufacturers' websites, You tube videos on different techniques and their principles

Course Contents

M.V.Sc. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Fish and Fish Products Technology**
2. **Course Number** : **LPT613** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for Fish Processing Industry
5. **Aim of the Course** : To impart knowledge about fish resources, structure and composition of fish muscles, preservation and processing of fish, marketing of fish products, deterioration of quality and legislations for quality control.

Catalogue Description

6. **Theory** :

Unit I **9 Lectures**

Fishery resources, marine and freshwater fishes- Transportation and hygienic handling of fish - Fish Muscle structure, composition and nutritive value - Processing of fish - gutting, filleting, beheading, peeling, deveining, etc. - Preservation - chilling, freezing, etc. - Principles and procedure of canning, curing, smoking, dehydration - Surimi and other Fish based products.

Unit II **8 Lectures**

Quality control- identification of freshness of fish - Chemical and Microbial spoilage of fish, labelling and marketing of fish and fish products, utilization of fish processing waste. National and international regulations, standards, quality control and marketing of fish and fish products.

Practical **17 Classes**

Visit fish processing plant - Grading of live fish for freshness - Filleting and other techniques for the processing of fish - Proximate Composition of Fish - Physicochemical and Microbial evaluation of fish quality - Preparation of Value added fish products.

7. **Lecture schedule and no. of classes**

1.	Fishery resources -marine and freshwater fishes	01
2.	Transportation and hygienic handling of fish	01
3.	Fish Muscle structure	01
4.	Fish muscle composition and nutritive value	01
5.	Processing of fish - gutting, filleting, beheading, peeling, deveining, etc.	01
6.	Preservation of fish- chilling, freezing, etc.	01
7.	Principles and procedure of canning	01
8.	Principles and procedure of canning curing and smoking	01
9.	Principles and procedure of dehydration	01
10.	*Surimi* and other Fish based products	01

11. Quality control techniques	01
12. Identification of freshness of fish	01
13. Chemical and Microbial spoilage of fish	01
14. Labelling and marketing of fish and fish products	01
15. Utilization of fish processing waste	01
16. National and international regulations, standards and quality control	01
17. Marketing of fish and fish products	01
Pre final Examinations	02
Total	**19**

8. **Practical schedule and no. of classes**

1. Anatomy and structure of fish and identification of common varieties of commercial importance – marine and fresh water	01
2. Visit to fish processing plant	01
3. Grading of live fish for freshness	01
4. Filleting and other techniques for the processing of fish	01
5. Proximate Composition of Fish – Moisture	01
6. Proximate Composition of Fish – Protein	01
7. Proximate Composition of Fish – Fat	01
8. Proximate Composition of Fish – Ash	01
9. Physicochemical evaluation of fish quality	01
10. Microbial evaluation of fish quality	01
11. Preparation of Value added fish products –*surimi*	01
12. Preparation of Value added fish products –smoked fish	01
13. Preparation of Value added fish products –dried fish	01
14. Preparation of Value added fish products –fish sausage	01
15. Preparation of Value added fish products –fish nuggets	01
16. Preparation of Value added fish products –fish patties	01
17. Preparation of Value added fish products –traditional fish product	01
Lab final Examination	01
Total	**18**

9. **Teaching methods**

- Classroom teaching.
- Practical demonstration in the laboratory.
- Presentation and discussion of selected review articles, research articles, technical articles from industry journals and patent literature

10. **Learning outcome**

Acquiring knowledge on the structure of fish muscle, preservation, processing and quality control of fish and fish products.

11. **Suggested readings**

- Hall, G.M. 1997. Fish Processing Technology, 2nd edition, Chapman & Hall, London.
- Balachandran, K. K. 2002. Post Harvest Technology of Fish and Fish Products, Daya Publishing, New Delhi.
- Rehbein, H. and Oehlenschläger, J. 2009. Fishery Products Quality, Safety and Authenticity, Blackwell Publishing Ltd, Oxford.

• Bremner, H. A. 2002. Safety and Quality Issues in Fish, Woodhead Publishing Limited, Cambridge.
• Suzuki T. 1981. Fish and Krill: Protein Processing Technology. Applied Science Publ.
• Gopakumar, K. 2002. Text Book of Fish Processing Technology. ICAR, New Delhi.
• Selected articles from Journals

12. **Suggested e-books**

As above

13. **Suggested websites**

Websites of FAO, MPEDA, CIFT, WHO, Codex Alimentarius Commission, EEC regulations, World Bank reports, You tube videos on processing and filleting

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Modern Abattoir Practices and Animal By-Products Technology**
2. **Course Number** : **LPT 701** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for Slaughterhouses, Tanneries and other by-products industries.
5. **Aim of the Course** : To impart knowledge about advances in abattoir practices and animal by-products utilization

Catalogue Description

6. **Theory** :

Unit I **5 Lectures**

Current scenario of slaughterhouses and processing plants in India – Establishment and operation of a modern abattoir - Basic machinery and tools of slaughterhouse - Automation/ Robotics in meat and by-product processing – Latest developments in the evaluation of carcass quality – Chilling and freezing of carcass – Maintenance of cold storages.

Unit II **8 Lectures**

Latest machinery and tools used in by-products processing plant - New technologies for utilization of animal by-products as food, feed, pharmaceuticals and other miscellaneous products - Leather chemistry and processing technology – Latest Techniques in handling, preservation, tannery procedure, manufacture and testing of leather - Value addition in leather processing - Developments in gelatin, glue and natural casings production - Characterization, processing, yield and quality control of rendered fat and meat cum bone meal.

Unit III **4 Lectures**

Organization, layout and operation of dry and wet rendering plants. Latest trends in the disposal of slaughterhouse effluents and control of environmental pollution. Designs and function of effluent treatment plants.

7. **Practical** **17 Lectures**

Plan and outlay of various components of a modern abattoir. Designs of ETP. Estimation of TS (suspended and dissolved) BOD and COD from abattoir effluents. Ante-mortem inspection of food animals, methods of stunning, stunning instruments. Slaughter and dressing of food animals. Electrical stimulation of carcasses. Post mortem

inspection of carcasses of food animals - Visit municipal slaughterhouse, by-product processing plant, Effluent treatment plant and tanneries.

8. **Lecture schedule and no. of classes**

1. Current scenario of slaughterhouses and processing plants in India	01
2. Establishment and operation of a modern abattoir	01
3. Basic machinery and tools of slaughterhouse and Automation/ Robotics in meat and by-product processing	01
4. Latest developments in the evaluation of carcass quality	01
5. Chilling and freezing of carcass and maintenance of cold storages	01
6. Latest machinery and tools used in by-products processing plant	01
7. New technologies for utilization of animal by-products as food, feed, pharmaceuticals and other miscellaneous products	02
8. Leather chemistry and processing technology – Latest Techniques in handling, preservation, tannery procedure, manufacture and testing of leather 11. Value addition in leather processing	02
9. Developments in gelatin, glue and natural casings production	01
10. Characterization, processing, yield and quality control of rendered fat and meat cum bone meal.	01
11. Organization, layout and operation of dry and wet rendering plants.	01
12. Latest trends in the disposal of slaughterhouse effluents and control of environmental pollution	01
13. Designs and function of effluent treatment plants.	01
Pre final Examinations	02
Total	18

9. **Practical schedule**

1. Plan and outlay of various components of a modern abattoir	01
2. Designs of ETP.	01
3. Estimation of TS (suspended and dissolved) from abattoir effluents	01
4. Estimation of BOD from abattoir effluents	01
5. Estimation of COD from abattoir effluents.	01
6. Ante-mortem inspection of food animals	01
7. Methods of stunning	01
8. Stunning instruments	01
9. Slaughter and dressing of cattle	01
10. Slaughter and dressing of pig	01
11. Slaughter and dressing of sheep and goat	01
12. Electrical stimulation of carcasses	01
13. Post mortem inspection of carcasses of food animals	01
14. Visit to municipal slaughterhouse	01
15. Visit to by-product processing plant	01
16. Effluent treatment plant and tanneries	01
Lab final Examination	01
Total	17

10. **Teaching methods**
    - Classroom teaching, practical demonstration in laboratory/ slaughter unit.
    - Visit municipal slaughterhouse and tanneries.
    - Demonstration through charts, video films and models.

11. **Learning outcome**
    Understanding of latest techniques employed in abattoir practices and slaughterhouse by-products utilization.

12. **Suggested readings**
    - Biswas A and Kondaiah N. 2014. Meat Science and Technology, 1st ed. Jaya Publishing House.
    - Collins DS and Huey RJ. 2015. Gracey's Meat Hygiene, 11th ed. John Wiley and Sons Ltd., UK.
    - Jensen WK, Devine C and Dikeman M. 2004. Encyclopaedia of Meat Sciences, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
    - Kerry J, Kerry J and Ledward D. 2005. Meat Processing- Improving Quality. Woodhead Publishing Ltd., UK.
    - Swatland HJ. 2004. Meat Cuts and Muscle Foods. Nottingham University Press.
    - Warriss P. 2010. Meat Science: An Introductory Text, 2nd ed. Oxford Press.
    - **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

    As above

14. **Suggested websites**

    Websites of APEDA, EEC, USDA, slaughter and rendering equipment manufacturers, FAO sites for slaughter house design, CPCB, DAHD and DGFT sites

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Advances in Meat Production and Fresh Meat Technology**
2. **Course Number** : **LPT 702** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for Meat Industry
5. **Aim of the Course** : To impart knowledge about the latest trends in meat production, the ultra structure of muscle fibres, strategies for improving meat production and traceability of meat products.

Catalogue Description

6. **Theory** :

Unit I **7 Lectures**

Current status of meat production trends in India - Government policies – economics and viability – Traceability in the meat industry – Strategies for augmenting meat production - Salvaging male buffalo calf - Non-conventional meat resources.

Unit II **10 Lectures**

Pre- and Post-natal development of Muscle fibres - Genetic, nutritional and physiological aspects of muscle development - Ultrastructure of skeletal muscle - Modern tools for fibre typing of muscle - Chemical and biochemical aspects of rigor mortis and fresh meat quality – Odour, colour, water holding capacity – Texture profile - Artificial tenderization - Myofibrillar, sarcoplasmic and connective tissue proteins - Cytoskeletal proteins - Lipid profile - Meat in human nutrition – Meat and health issues.

7. **Practical** **17 Classes**

Economics of establishing commercial meat animal production Unit - Extraction of sarcoplasmic and myofibrillar proteins and their fractionation - Estimation of Collagen content of Meat - Histochemistry of muscle tissues - Muscle fibre typing - Meat tenderization techniques.

8. **Lecture schedule and no. of classes**

1. Current status of meat production trends in India	01
2. Government policies concerned with meat industry	01
3. Economics and viability of Indian meat industry	01
4.Traceability in the meat industry	01
5. Strategies for augmenting meat production - Salvaging male buffalo calf	01
6. Non-conventional meat resources.	01
7. Pre- and Post-natal development of Muscle fibres	01
8. Genetic, nutritional and physiological aspects of muscle development	01

9. Ultrastructure of skeletal muscle	01
10. Modern tools for fibre typing of muscle	01
11. Chemical and biochemical aspects of rigor mortis	01
12. Fresh meat quality – Odour, colour, water holding capacity and texture profile	01
13. Artificial tenderization	01
14. Myofibrillar, sarcoplasmic and connective tissue proteins; cytoskeletal proteins	01
15. Lipid profile	01
16. Meat in human nutrition – Meat and health issues.	01
Prefinal Examinations	02
Total	18

9. **Practical schedule and no. of classes**

1. Economics of establishing commercial meat animal production Unit – 1500 goat unit	01 01
2. Economics of establishing commercial meat animal production Unit – 100 buffalo unit	01 01
3. Estimation of myoglobin content of muscle	01
4. Estimation of glycogen content of muscle	01
5. Estimation of water holding capacity of muscle	01
6. Estimation of myofibrillar fragmentation index	01
7. Estimation of cholesterol content of meat	01
8. Estimation of lipid profile of meat	01
9. Extraction of sarcoplasmic proteins and their fractionation	02
10. Extraction of myofibrillar proteins and their fractionation	02
11. Estimation of Collagen content of Meat	01
12. Histochemistry of muscle tissues	01
13. Muscle fibre typing	01
14. Meat tenderization techniques	01
Labfinal Examination	01
Total	17

10. **Teaching methods**
- Classroom teaching, practical demonstration in laboratory/ slaughter unit
- Visit municipal slaughterhouse and meat plants
- Use of Audio-visual capsules.

11. **Learning outcome**

Knowledge of latest trends in meat production and fresh meat technology

12. **Suggested readings**

- Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. Principles of Meat Science, 5th ed. Kendall Hunt Publishing Company, Iowa.
- Carlson CW, Greaser ML and Jones KW. 2001. The Meat We Eat, 14th ed. Interstate Publishers, Inc.
- Jensen WK, Devine C and Dikeman M. 2004. Encyclopaedia of Meat Sciences, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Lawrie RA and Ledward DA. 2006. Lawrie's Meat Science, 7th ed. Woodhead Publishing

Limited, Cambridge, England.
- Pearson AM and Dutson TR. 1997. Advances in Meat Research. Healthy Production and Processing of Meat, Poultry and Fish Products, Vol. 11. Springer.
- Swatland HJ. 2004. Meat Cuts and Muscle Foods. Nottingham Univ. Press.
- **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

As above

14. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title : Developments in Processed Meat Technology**
2. **Course Number : LPT 703 Prerequisite Nil**
3. **Credit Hours : 1+1**
4. **Why this Course? :** Human Resource Development (Manager, Supervisor and other Technocrats) for Meat Processing Industry
5. **Aim of the Course :** To impart knowledge about the advances in the technology for processing of meat and development of value-added meat products.

Catalogue Description

6. **Theory**

Unit I **5 Lectures**

Current trends in meat processing techniques - Functional properties of the tissue component in meat processing - Approaches for new product development – Latest equipment used for processing of meat products - Indigenous and heritage meat products - Curing and smoking - purpose, composition and methods of smoking - Liquid smoke - Processing of Ham, bacon, sausages, patties, meatloaves and tandoori chicken- Novel meat products - Non-thermal processing - Irradiation techniques - Canning/ retorting.

Unit II **8 Lectures**

Marination, massaging, tumbling and flaking techniques - Restructured/ reformed, intermediate moisture, fermented, enrobed, shelf-stable and dried meat products - Meat analogues and substitutes - Thermal processing of meat- Enzymatic and nonenzymatic browning reactions - Protein changes in processed meat products – Lipid changes - Protein and lipid interaction - Protein and carbohydrate interaction - Bioactive peptides.

Unit III **4 Lectures**

Functional and designer meat products - Role of omega-3 fatty acids in animal foods - Role of n-3 in PUFA enriched and CLA enriched meat and eggs – Packaging of meat and meat products - smart, active, intelligent packaging – Developments in sensory evaluation of meat products.

7. **Practical** **17 Classes**

Evaluation of textural characteristics of meat products – Estimation of emulsifying capacity, emulsion stability- Estimation of Nitrosamines and PAHs – Preparation of emulsion-based, restructured, enrobed, cured and smoked, dried, fermented, intermediate moisture, ready to

eat, and shelf-stable meat products-objective and subjective evaluation of meat products.

8. **Lecture schedule and no. of classes**

1.	Current trends in meat processing techniques	01
2.	Functional properties of the tissue component in meat processing	01
3.	Approaches for new product development	01
4.	Latest equipment used for processing of meat products	01
5.	Indigenous and heritage meat products	01
6.	Curing and smoking - purpose, composition and methods of smoking; technique of liquid smoke and its advantages	01
7.	Processing of ham, bacon, sausages, patties, meatloaves and tandoori chicken	01
8.	Novel meat products- definition and regulations; non-thermal processing; irradiation techniques	01
9.	Thermal processing of meat - canning and retort pouch packaging	01
10.	Marination, massaging, tumbling and flaking- techniques and technologies; restructured and reformed meat products	01
11.	Intermediate moisture meat products; fermented meat products and enrobed meat products; shelf-stable and dried meat products and hurdle technology	01
12.	Meat analogues and substitutes	
13.	Enzymatic and nonenzymatic browning reactions	01
14.	Protein changes in processed meat products; lipid changes; protein and lipid interaction; protein and carbohydrate interaction	01 01
15.	Bioactive peptides.	
16.	Functional and designer meat products - Role of omega-3 fatty acids in animal foods - Role of n-3 in PUFA enriched and CLA enriched meat and eggs	01 01
17.	Packaging of meat and meat products - smart, active, intelligent packaging – Developments in sensory evaluation of meat products	01
	Pre final Examinations	02
	Total	19

9. **Practical schedule and no. of classes**

1.	Evaluation of textural characteristics of meat products – Sensory texture profile	01
2.	Evaluation of textural characteristics of meat products – Instrumental texture profile analysis	01
3.	Estimation of emulsifying capacity	01
4.	Estimation of emulsion stability	01
5.	Estimation of Nitrosamines	01
6.	Estimation of PAHs	01
7.	Preparation of emulsion-based meat products	01
8.	Preparation of restructured meat products	01
9.	Preparation of enrobed meat products	01
10.	Preparation of cured and smoked meat products	01
11.	Preparation of dried meat products	01
12.	Preparation of fermented meat products	01
13.	Preparation of intermediate moisture meat products	01
14.	Preparation of ready to eat meat products	01

15. Preparation of shelf-stable meat products 01
16. Objective evaluation of meat products 01
17. Subjective evaluation of meat products 01

Lab final Examination 01

Total 18

10. **Teaching methods**
    - Classroom teaching, practical performance in Divisional Pilot Processing Plant.
    - Visit Meat Processing Unit.
    - Demonstration by videos.

11. **Learning outcome**

Acquaintance with the knowledge of the latest techniques used in meat processing and packaging and development of functional meat products.

12. **Suggested readings**
    - Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. Principles of Meat Science, 5th ed. Kendall Hunt Publishing Company, Iowa.
    - Barbut S. 2005. Poultry Products Technology. CRC Press.
    - Jensen WK, Devine C and Dikeman M. 2004. Encyclopaedia of Meat Sciences, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
    - Kerry J, Kerry J and Ledward D. 2005. Meat Processing- Improving Quality. Woodhead Publishing Ltd., UK.
    - Pearson AM and Gillett TA. 1996. Processed Meats, 3rd ed. Chapman and Hall, Inc, New York.
    - Toldrá F. 2010. Handbook of Meat Processing. Wiley-Blackwell.
    - **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

As above

14. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Current Trends in Processing of Milk And Milk Products**
2. **Course Number** : **LPT 704** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human resource development (Manager, Supervisor and other Technocrats) for the milk processing industry
5. **Aim of the Course** : To impart knowledge about current trends in the processing of milk and milk products and their effect on physico-chemical and nutritional quality of milk, the scope of mechanization in the production of indigenous milk products and advances in the utilization of dairy by-products.

Catalogue Description

6. **Theory** :

Unit I **8 Lectures**

Principles and practices of production of quality raw milk - Advances in methods of chilling of milk - Thermal processing of milk – Principles and methods – types of UHT processing plants - Advances in the packaging of milk and milk products - Rheology of milk products - Preservatives, antioxidants, antibiotics and different toxic residues in milk - Advances in bacteriological and physico-chemical analysis of milk and milk product – Different legal and voluntary standards for milk and milk products - A1 and A2 milk and their significance.

Unit II **4 Lectures**

Bacteriological, physical, chemical and nutritional effects of processing on milk - ew concepts in milk processing – radiation, microwave processing and conduction heating of milk – By-products from the dairy industry and their utilization.

Unit III **5 Lectures**

Innovative mechanization in the manufacture of Indigenous dairy products - Advances in the utilization of dairy by-products - preservation of milk products - Application of immobilized enzymes in dairy products – Latest trends in cleaning and sanitation of dairy plant

7. **Practical** **17 Classes**

Quality evaluation of milk and milk products - Preparation of novel and indigenous milk products and their economics of production, quality and sensory evaluation - Use of Starter cultures - Maintenance of cultures - Demonstration of membrane processing technology - Preparation of DPR for Dairy plants of different capacities.

8. **Lecture schedule and no. of classes**

1.	Principles and practices of production of quality raw milk	01
2.	Advances in methods of chilling of milk	01
3.	Thermal processing of milk – Principles and methods	01
4.	Types of UHT processing plants	01
5.	Advances in the packaging of milk and milk products	01
6.	Rheology of milk products	01
7.	Preservatives, antioxidants, antibiotics and different toxic residues in milk Advances in bacteriological analysis of milk and milk products	01
8.	Advances in physico-chemical analysis of milk and milk product	01
9.	Different legal and voluntary standards for milk and milk products; A1 and A2 milk and their significance.	01
10.	Effects of processing on bacteriological, physical, chemical and nutritional qualities of milk	01
11.	New concepts in milk processing – radiation, microwave processing and conduction heating of milk	01
12.	By-products from the dairy industry and their utilization.	01
13.	Innovative mechanization in the manufacture of Indigenous dairy products	01
14.	Advances in the utilization of dairy by-products	01
15.	Preservation of milk products	01
16.	Application of immobilized enzymes in dairy products	01
17.	Latest trends in cleaning and sanitation of dairy plant	01
	Pre final Examinations	02
	Total	19

9. **Practical schedule and no. of classes**

1.	Physico-chemical quality evaluation of milk and some common milk products	02
2.	Nutritional quality evaluation of milk and some common milk products	02
3.	Microbiological quality evaluation of milk and some common milk products	02
4.	Rheological testing of some common milk products – TPA and Texture	02
5.	Sensory evaluation of milk and some common milk products	02
6.	Preparation of novel milk products and their economics of production- cheddar cheese	01
7.	Preparation of novel milk products and their economics of production- Mozarella cheese	01
8.	Preparation of indigenous milk products and their economics of production – Khoa, paner, chakka	01
9.	Starter cultures - Maintenance of cultures and quality evaluation	01
10.	Demonstration of membrane processing technology	01
11.	Preparation of DPR for Dairy plants of different capacities	01
	Lab final Examination	01
	Total	17

10. **Teaching methods**

- Classroom teaching and laboratory analysis.
- Visit the milk processing plant.

• Use of Audio-visual Capsules.

11. **Learning outcome**

Gaining knowledge of advances in the processing of milk and milk products.

12. **Suggested readings**

• Fuquay JW, Fox PF and McSweeney PLH. 2011. Encyclopaedia of Dairy Sciences, 2nd ed. Elsevier Academic Press, UK.
• Herrington BL. 2000. Milk and Milk Processing. Green World Publishers.
• Walstra P, Wouters JTM and Geurts, TJ. 2006. Dairy Science and Technology, 2nd ed. Taylor and Francis Group.

• **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

As above

14. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Biotechnological Techniques and Quality Control of Livestock Products**
2. **Course Number** : **LPT 705** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor and other Technocrats) for production of high-quality livestock products and their quality assurance.
5. **Aim of the Course** : To impart knowledge about advances in the application of biotechnological techniques for improving the production and quality of livestock products. To familiarize with the agencies responsible for maintaining the quality of livestock products, quality standards and legislations

Catalogue Description

6. **Theory** :

Unit I **10 Lectures**

Biotechnological tools for microbial testing of food - Industrial cell culture – Bioreactor types and design – Upstream and downstream processing – Bacterial food additives and supplements - Characteristics and application of microbial starters in milk and meat fermentation - Biotechnology in production of designer livestock products - Bio-production of flavours and colour and their application in dairy products - Enzyme applications in dairy technology. - Utilization of nanotechnology in livestock products - Biotechnology for food safety - Cultured meat – Biotechnology in meat species identification

Unit II **7 Lectures**

Importance of quality control for livestock products - Concept and application of HACCP - BIS, FSSAI and AGMARK standards - GMP and total quality management in the processing of livestock products - ISO-9000, ISO-14000 and ISO-22000 - Codex regulations of food product safety.

7. **Practical** **17 Classes**

Demonstration of the latest biotechnological techniques including DNA and protein based techniques. Operation of bioreactors - Gene identification and characterization. Visit Milk/ Meat processing plants for an understanding of HACCP and other quality management systems.

8. **Lecture schedule and no. of classes**

1. Biotechnological tools for microbial testing of food 01
2. Industrial cell culture 01

3. Bioreactor types and design – Upstream and downstream processing Bacterial food additives and supplements 01
4. Characteristics and application of microbial starters in milk and meat fermentation 02
5. Biotechnology in production of designer livestock products 01
6. Bio-production of flavours and colour and their application in dairy products Enzyme applications in dairy technology 01
7. Utilization of nanotechnology in livestock products 01
8. Biotechnology for food safety 01
9. Cultured meat 01
10. Biotechnology in meat species identification 02
11. Importance of quality assurance and quality control for livestock products 01
12. Quality management system concepts- ISO-9000; ISO-14000 and total quality management, Risk management, Traceability 01
13. Concept of GMP and its application in milk and meat industries 01
14. Evolution of the concept of HACCP and its application in the processing of livestock products 01
15. ISO-22000 – Prerequisite programs- GMPs, SSOPs and Risk management Codex regulations of food product safety and SPS measures 01

Pre final Examinations 02

Total 19

9. **Practical schedule and no. of classes**

1. Demonstration of the latest biotechnological techniques including DNA and protein based techniques. 01
2. Principles, procedure and methods of electrophoresis 01
3. Demonstration of vertical gel electrophoresis (SDS PAGE) 01
4. ELISA principles and methods 01
5. ELISA demonstration 01
6. Principles and procedure of Western blotting 01
7. Principles and procedure of Southern blotting 01
8. PCR principles, methods and procedure 01
9. PCR demonstration 01
10. Real time PCR demonstration 01
11. Mass spectrometry principles and methods 01
12. MALDI-TOF MS principles and procedure 01
13. Gene sequencing- Principles and methods; New generation sequencing 01
14. Principles of RNA sequencing 01
15. Operation of bioreactors 01
16. Gene identification and characterization 01
17. Visit Milk/ Meat processing plants for an understanding of HACCP and other quality management systems 01

Lab final Examination 01

Total 18

10. **Teaching methods**

• Laboratory analysis.

- Visit of ISO and HACCP certified food processing plant.
- Use of Audio-visual Capsules.

11. **Learning outcome**

Gaining knowledge on the application of biotechnology for augmenting production and quality assurance.

12. **Suggested readings**

- Fuquay JW, Fox PF and McSweeney PLH. 2011. Encyclopaedia of Dairy Sciences, 2nd ed. Elsevier Academic Press, UK.
- Jensen WK, Devine C and Dikeman M. 2004. Encyclopaedia of Meat Sciences, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
- Kerry J, Kerry J and Ledward D. 2005. Meat Processing-Improving Quality. Woodhead Publishing Ltd., UK.
- **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

As above

14. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Ethnic and Organic Meat and Milk Products**
2. **Course Number** : **LPT 706** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Improving the production, processing and marketing of ethnic and organic meat and milk and their products.
5. **Aim of the Course** : To impart knowledge about the production of ethnic and organic meat and milk products.

Catalogue Description

6. **Theory** :

Unit I **9 Lectures**

Historical developments, present scenario and prospects of ethnic meat and milk products in various parts of India - Ethnic meat products - haleem, biryani, chettinad recipe, pork vindaloo, Kebab, Goan sausages, Kashmiri wazwan and meat products of North Eastern Region (NER) - Ethnic milk products – churpi, kalari, kunda, etc. - Constraints in promoting ethnic meat products - Approaches for development and commercialization of ethnic meat products - Fermented and non-fermented ethnic milk and meat foods – Impact of Globalization and role of WTO in promoting ethnic meat and milk products from India.

Unit II **5 Lectures**

Entrepreneurship Development for Ethnic meat and milk Products – Formulation, composition, quality, safety and shelf life of ethnic meat and milk products of India - Geographical indicators for recognition of ethnic meat and milk products.

Unit III **3 Lectures**

Organic meat and milk products - introduction, registration, certification, marketing and scope.

7. **Practical** **17 Classes**

Preparation of ethnic meat products - haleem, biryani, chettinad recipe, pork vindaloo, Kebab, Goan sausages, Kashmiri wazwan and meat products of NER/ local region, Preparation of Ethnic milk products – churpi, kalari, Kunda, etc. - Composition, physico-chemical and microbial quality of ethnic milk and meat products - Packaging and marketing of ethnic milk and meat products

8. **Lecture schedule and no. of classes**

1.	Historical developments, present scenario and prospects of ethnic meat and milk products in various parts of India	01
2.	Ethnic meat products - haleem, biryani, chettinad recipe, pork vindaloo	01
	Kebab, Goan sausages, Kashmiri wazwan	01
3.	Meat products of North Eastern Region (NER)	01
4.	Ethnic milk products – churpi, kalari, kunda, etc.	01
5.	Constraints in promoting ethnic meat products and approaches for development and commercialization of ethnic meat products	01
6.	Fermented and non-fermented ethnic milk foods	02
7.	Fermented and non-fermented ethnic meat foods	02
8.	Impact of Globalization and role of WTO in promoting ethnic meat and milk products from India	01
9.	Entrepreneurial opportunities for ethnic meat and milk products	01
10.	Formulation, composition, quality, safety and shelf life of ethnic milk products of India	02
11.	Formulation, composition, quality, safety and shelf life of ethnic meat products of India	02
12.	Geographical Indication and its importance for recognition of ethnic meat and milk products	01
13.	Organic meat and milk products - introduction, registration, certification, marketing and scope	01
	Pre final Examinations	02
	Total	19

9. **Practical schedule and no. of classes**

1.	Preparation of ethnic meat products - *haleem, biryani, chettinad* recipe	01
2.	Preparation of ethnic meat products -pork vindaloo, kebab and Kashmiri wazwan	01
3.	Preparation of ethnic meat products -Goan sausages	01
4.	Preparation of ethnic meat products of NER/ local region	01
5.	Preparation of ethnic milk products – *churpi, kalari, Kunda*, etc.	01
6.	Composition, physico-chemical and microbial quality of ethnic milk products – *khoa, channa, kulfi, burfi* from sweet shops	03
7.	Composition, physico-chemical and microbial quality of ethnic meat products- *tandoori chicken, kebabs, paya,* chicken *samosa*, meat pickle from shops and packaged ethnic meat products from super markets	03
8.	Characterization of an example ethnic milk or meat product	01
9.	Texture characterization of ethnic milk and meat products	01
10.	Sensory ballot development for ethnic milk and meat products	01
11.	Sensory evaluation of ethnic milk and meat products	01
12.	Packaging and marketing of ethnic milk and meat products	01
	Lab final Examination	01
	Total	17

10. **Teaching methods**
    - Classroom teaching, practical demonstration in the laboratory
    - Through the study of reports published by Govt. agencies time to time

11. **Learning outcome**
    To acquaint with the knowledge for the production of ethnic and organic meat and milk products.

12. **Suggested readings**
    - Books on Indian Food.
    - **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

    As above

14. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title : Industrial and Entrepreneurial Training**
2. **Course Number : LPT 707** **Prerequisite Nil**
3. **Credit Hours : 0+2**
4. **Why this Course? :** Human Resource Development for catering to livestock products and related industry
5. **Aim of the Course :** To prepare students to venture into various start-ups for self-reliant enterprises.

Catalogue Description

6. **Practical** **34 Classes**

Preparation of basic feasibility report including raw material availability, marketing potential, economic viability and regulatory requirements for different livestock products related industry. Entrepreneurial training in an industrial establishment related to livestock products (17 sessions/ Hours equivalent to 17 credit hours of practical).Preparation of Detailed project reports (DPR) for the establishment of livestock products enterprises, viz. slaughterhouses, milk and meat processing plants, effluent treatment and byproducts utilization plants, etc.

7. **Practical schedule**

1. Preparation of basic feasibility report including raw material availability, marketing potential, economic viability and regulatory requirements for different livestock products related industry depending on which segment of the industry the training is undertaken	
2. **Entrepreneurial training in an industrial establishment related to livestock products (17 sessions/ Hours equivalent to 17 credit hours of practical)**	**17**
3. Preparation of Detailed project reports (DPR) for the establishment of slaughterhouses or Preparation of Detailed project reports (DPR) for the establishment of milk processing plant or Preparation of Detailed project reports (DPR) for the establishment of meat processing plants or Preparation of Detailed project reports (DPR) for the establishment of effluent treatment plants or Preparation of Detailed project reports (DPR) for the establishment of byproducts utilization plant or Preparation of Detailed project reports (DPR) for the establishment of value added meat and poultry processing unit depending on the industry in which industrial training is undertaken	
Presentation of training results and submission of project report	01
Total	18

8. **Teaching methods**
   • Visiting processing units
   • Web surfing

9. **Learning outcome**
   Students envisioned having adequate knowledge and skills for setting up livestock products enterprises.

10. **Suggested readings**
   • **Selected review and research articles from scientific and industrial journals and patent literature**
   • Through Interaction with Industry personnel.

11. **Suggested e-books**

As above

12. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : Current Trends in Disposal and Utilization of Waste From Meat and Dairy Industry
2. **Course Number** : **LPT 708** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development (Manager, Supervisor, Meat inspector and other Technocrats) for better utilization of animal wastes and effluent treatments.
5. **Aim of the Course** : To impart knowledge about disposal and handling of wastes from the meat and dairy industry, Agencies involved and their norms for pollution control from meat and dairy industries.

Catalogue Description

6. **Theory** :

Unit I **8 Lectures**

Terminologies used in solid and liquid waste management systems - Public health significance - Classification, composition, functional elements and sources of solid waste from Meat and Dairy Processing plants and their management - Aerobic and anaerobic systems of liquid waste management.

Unit II **9 Lectures**

Waste handling, separation, storage, processing and utilization of Solid waste - Common solid waste disposal methods like rendering, composting, deep burial and incineration - Scope for zero waste management - Properties of dried sludge and its utilisation as manure - Economical aspects of waste treatment and disposal - Utilization of meat and dairy processing wastes - Application of nanotechnology in waste management - State and Central Pollution Control Board norms.

7. **Practical** **17 Classes**

Visit Sewage and Effluent Treatment Plants - Estimation of pH, dissolved oxygen, TSS, BOD and COD - Estimation of micronutrients in treated effluents – Design and schematic layout of various solid and liquid waste treatment plants.

8. **Lecture schedule and no. of classes**

1. Solid and liquid waste management systems- terminologies used and its public health significance	01
2. Classification, composition, functional elements and sources of solid waste from meat and dairy processing plants and their management; plastic waste generated during operation and their management	01
3. Waste handling, separation, storage, processing and utilization of solid waste Common solid waste disposal methods - rendering, composting, deep burial and	01

incineration

4. Effluent characteristics – BOD, COD, TS, SS, FOG, pH, Colour etc. and their significance 01
5. Effluent treatment plant facilities and associated equipment 01
6. Liquid effluent waste management – Preliminary, primary, secondary (aerobic and anaerobic systems) and tertiary treatment of– methods, principle and operation, cost etc. 02
7. Zero discharge abattoirs and Biomass plants in abattoirs 01
8. Water conservation and sustainability practices in milk and meat industry 01
9. Energy conservation and sustainability practices in milk and meat industry 01
10. Scope for zero waste management 01
11. Properties of dried sludge and its utilisation as manure 01
12. Economical aspects and sustainability of waste treatment and disposal 01
13. Utilization of meat and dairy processing wastes 01
14. Application of nanotechnology in waste management 01
15. State and Central Pollution Control Board norms 01

Pre final Examinations 02
Total 18

9. **Practical schedule and no. of classes**

1. Visit to water treatment plants 01
2. Visit to sewage treatment plants 01
3. Visit to and effluent treatment plants 01
4. Estimation of pH 01
5. Estimation of dissolved oxygen 01
6. Estimation of TSS in effluent 01
7. Estimation of BOD in effluent 01
8. Estimation of COD in effluent 01
9. Estimation of chloride in effluent 01
10. Estimation of total Kjeldahl nitrogen in effluents 01
11. Estimation of nitrate in effluents 01
12. Estimation of phosphorous in treated effluents 01
13. Estimation of mercury in treated effluents 01
14. Estimation of nitrogen in treated effluents 01
15. Design and schematic layout of various solid and liquid waste treatment plants. 01
16. Water conservation practices in industries 01

Lab final Examination 01
Total

10. **Teaching methods**
    - Classroom teaching
    - Visit Sewage Treatment Plant
11. **Learning outcome**
    Gaining knowledge on advances in the utilization of wastes from the meat and dairy industry.
12. **Suggested readings**

• **Selected review and research articles from scientific and industrial journals and patent literature**

• Through Interaction with personnel of Municipal Corporation and Pollution Control Board.

13. **Suggested e-books**

As above

14. **Suggested websites**

Course Contents

PH.D. in Livestock Products Technology

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

1. **Course Title** : **Advances in Egg and Egg Products Technology**
2. **Course Number** : **LPT 709** **Prerequisite** **Nil**
3. **Credit Hours** : **1+1**
4. **Why this Course?** : Human Resource Development for Egg Processing Industry and Egg Processing Plants
5. **Aim of the Course** : To impart knowledge about the status of egg production, composition, nutritive value, preservation, grading, processing packaging and marketing of eggs and egg products.

Catalogue Description

6. **Theory** :

Unit I **5 Lectures**

Advanced preservation techniques for egg and egg products - Maintenance of quality of eggs - Microbiology of egg - Spoilage of eggs and its prevention.

Unit II **8 Lectures**

Preparation of fast foods and role of egg in fast foods chains - Egg breaking and processing plants - lay-out and organization Preservation methods viz pasteurization, desugarization, freezing, dehydration, etc. – process and methods – Quality estimation of egg and egg products - Designer egg and egg products.

Unit III **4 Lectures**

Specifications, Standards and marketing of egg and egg products - Quality control of egg products

7. **Practical** **17 Classes**

Evaluation of physical, chemical and functional quality of egg and egg products - Detection of egg rots - Evaluation of microbiological quality of egg and egg products - Preservation techniques of eggs - Preparation of convenient, dehydrated and value added egg products - Visit a modern egg processing plant

8. **Lecture schedule**

1.	Detailed composition and physico-chemical characteristics of egg and its components	01 01
2.	Functional characteristics of egg and its components	01
3.	Advances in preservation techniques for egg and egg products	01
4.	Maintenance of quality of eggs	01
5.	Microbiology of egg	01
6.	Spoilage of eggs and its prevention.	01
7.	Preparation of fast foods and role of egg in fast foods chains	

8. Egg breaking and processing plants - lay-out and organization 01
9. Preservation methods viz pasteurization, desugarization, freezing, dehydration, etc.; their principles, process and methods 03
10. Value added egg products 01
11. Quality estimation of egg and egg products 01
12. Designer egg and egg products. 01
13. Specifications, Standards and marketing of egg and egg products 01
14. Quality assurance and quality control of egg products 01

Pre final Examinations 02

Total 18

9. **Practical schedule**

1. Egg quality identification and evaluation 01
2. Egg grading 01
3. Evaluation of physico-chemical quality of egg and egg products 01
4. Evaluation of functional quality of egg and egg products 02
5. Evaluation of microbiological quality of egg and egg products 02
6. Estimation of proximate composition of egg and egg products 01
7. Estimation of drug residues and pesticide residues in egg and egg products 02
8. Detection of egg rots 01
9. Preservation techniques of eggs 01
10. Preparation of convenient, dehydrated and value added egg products 02
11. Visit to a modern egg processing plant 01

Lab final Examination 01

Total 16

10. **Teaching methods**

• Classroom teaching, practical demonstration in the laboratory.
• Visit the egg processing plant.

11. **Learning outcome**

Gaining knowledge on composition, nutritive value, preservation and marketing of eggs. Quality maintenance and development of designer egg products.

12. **Suggested readings**

• Romanoff AL and Romanoff AJ. 1949. Avian Egg. John Wiley and Sons.
• Stadelman WL and Cotterill OJ. 2002. Egg Science and Technology, 4th ed. CBS.
• **Selected review and research articles from scientific and industrial journals and patent literature**

13. **Suggested e-books**

As above

14. **Suggested websites**