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

Master's Programme in Dairy Science

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit(s)
1.	Major	20
2.	Minor	09
3.	Supporting	06
4.	Seminar	01
5.	Research	20
	Total Credits	**56**
	Compulsory Non Credit Courses	06

Sr. No.	Course Number	Course Title	Credits
A) Major subjects (Min. 20 credits)			
1	DSC –501	Market Milk Process Technology	3 = 2 + 1
2	DSC –502	Dairy Processing and Product Technology	3 = 2 + 1
3	DSC –504	Chemistry of Milk and Milk Products	3 = 2 + 1
4	DSC –506	Microbiology of Milk and Milk Products	3 = 2 + 1
5	DSC –503	Traditional and Value Added Dairy Products	3 = 2 + 1
6	DSC –507	Dairy Starter and Fermented Milk	2 = 1 + 1
7	DSC –508	Milk By-Product Technology	1 = 0 + 1
8	DSC –505	Physico-Chemical Aspect of Milk Constituents and Milk Products	2 = 1 + 1
B) Minor Subjects (Min. 09 credits)			
1	AH-501	Livestock Production and Management	3 = 2 + 1
2	DSC-510	Quality Control and Sensory Evaluation of Milk and Milk Products	3 = 2 + 1
3	DSC -509	Packaging for Milk and Milk Products	1 = 0 + 1

4	AH- 505	Physiology of Lactation	2 = 2 + 0
C) Supporting Subjects (Min. 06 credits)			
1	BIOCHEM-501	Basic Biochemistry	3 =2+1
2	STAT-508	Design of Experiments for Animal Science	3 = 2+1
D) Seminar (01 credit)			
1	DSC- 591	Master's Seminar	1 =0+1
E) Master's Research (20 credits)			
1	Thesis – 599	Research	20=0+20
F) Non Credit Compulsory Courses			
1	PGS-501	Library and Information Services	1=0+1
2	PGS-504	Basic Concepts in Laboratory Techniques	1=0+1
3	PGS-502	Technical Writing and Communication Skills	1=0+1
4	PGS-503	Intellectual Property and its Management in Agriculture	1=0+1
5	PGS-505(ecourse)	Agriculture Research, Research Ethics and Rural Development Programmes	1 = 1 + 0
6	PGS-506(e course)	Disaster Management	1 = 1 + 0

Course Contents

A) Major Subjects:

Dairy Science
M. Sc. (Agri.)
COURSE NO: DSC 501
COURSE TITLE: MARKET MILK PROCESS TECHNOLOGY
COURSE CREDITS: 2+1= 3

Theory:

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

Practical:

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

Suggested Readings:

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

COURSE NO. DSC 502
COURSE TITLE: DAIRY PROCESSING AND PRODUCT TECHNOLOGY
Course Credits: 2+1=3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Role and importance of dairy processing	1	3
2	Principles involved in various processes	1	3
3	Modern machinery, equipments, utensils required for dairy processing and its availability.	1	3
4	Technological and quality aspects of Evaporated / condensed milk	2	6
5	Desiccated and dried milk	2	6
6	Ice-cream, frozen desserts	2	6
7	Butter, clarified butter fat / butter oil	2	6
8	Cheeses	2	6
9	Physico- chemical changes taking place in milk constituent and physical state while conversion of raw material into products.	2	6
10	Classification of various processed dairy products. Manufacture technology, quality requirement of dairy products.	1	3
11	Cheeses- Cheddar, Mozzarella	2	7
12	Condensed and evaporated milk	2	6
13	Milk powders	2	6
14	Ice-cream and frozen dessert	2	7
15	Butter	2	7
16	Butter oil	2	6
17	Baby foods	2	6
18	New process technique in reaction to manufacture quality products UF, MF, RO, Hurdle technology, osmotic dehydration etc.	2	7

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Manufacture of evaporated milk.	2	12
2	Manufacture of condensed milk.	2	12
3	Preparation of cheddar cheese	3	19
4	Preparation of Ice-cream with Ice-cream freezing machine	2	13
5	Study of solubility index of market samples SMP / WMP	1	6
6	Preparation of butter	2	13
7	Manufacture of laboratory made butter oil	2	12

Suggested Reading:

1. Sukumar, Dc. (2005) Outline of Dairy Technology. Oxford Univ. Press, New Delhi
2. Bhandari, V., (2001) Ice cream Manufacture and Technology. Tala Me Graw-Hill publishing Co,Ltd, New Delhi.
3. Arbuckle, W.S., (1972) Ice Cream, A,Vl publication, Westpord.Aulhor, La Grange llinoisHall, C.W. and Hedrick. T.ly (1971) Drying of milk and milk products, AVI publishing Co, Weeport.
4. Sangu, K.P.S (2002) Dairy Processing Technology

COURSE NO. DSC 503
COURSE TITLE: TRADITIONAL AND VALUE ADDED DAIRY PRODUCTS
COURSE CREDITS: 2+1=3
THEORY

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Present status of Indigenous traditional milk products	1	3
2	Scope for globalization of traditional dairy products	1	3
3	Govt. policies for manufacture and marketing of traditional dairy products	2	6
4	Classification of traditional dairy products- Heat desiccated, Heat concentrated, Heat and acid coagulated, Fermented and frozen	5	16
5	Process improvement of traditional milk products	1	3
6	Processing and process improvement of milk sweets	3	10
7	New products based on fruits, vegetable, cereals etc.	4	13
8	Application of membrane technology for manufacture of traditional dairy product	1	3
9	Application of microwave heating in manufacture of traditional dairy products.	1	3
10	Advances in manufacture of ghee	2	7
11	Establishment of commercial dairy plant	2	6
12	Concept of convenience traditional dairy products	2	6
13	Manufacture of convenience dairy foods	1	3
14	Use of natural preservatives in traditional dairy foods	2	6
15	Use of permitted synthetic preservatives in traditional dairy foods	1	3
16	Scope for packaging of traditional dairy foods	1	3
17	New packaging systems for traditional dairy foods	2	6

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Manufacture of Khoa, Rabadi and Basundi	3	17
2	Manufacture of Paneer	1	6
3	Manufacture of Chhana	1	6
4	Manufacture of Dahi, Lassi and Shrikhand	1	6
5	Manufacture of Khoa based value added sweets – Pedha, Burfi, Gulabjamun	3	18
6	Manufacture of Chhana based value added sweets Rasmalai, Sandesh.Rasogolla	1	6
7	Peparation of Makhan and Ghee	3	17
8	Application microwave heating	2	12
9	Proposal for establishment of commercial unit for traditional and value added milk products	2	12

Suggested Readings:

1. Anonymonous, (1998) Lecture Compendium Dairy Technol. NDRI, Karnal.
2. Achaya K.T. and Rangappa S.K. (1973), Indian Dairy products.
3. Gould G.W., (1995), Advances in traditional dairy products.
4. Sukumar De, (1990), Out line of Dairy Technology. Oxford Publ. New Delhi.
5. Renner, E. and Abd E.L. Salam M.H. (1991), Application of Ultrafiltration in the Dairy
6. Cheryen, Munir, (1990), Ultrafiltration and microfiltration Hand book. Technomic Publishing House.
7. Aneja R.P; Mathura, B.N; Chandan R.C and Banerjce A.K. (2002) Technology of Indian Milk Product.

Course No. DSC 504
Course Title: Chemistry of Milk and Milk Products
Course Credits: 2+1=3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Gross chemical composition of milk of various livestock species- cow, buffalo, goat, sheep etc.	2	6
2	Chemical composition of milk as influenced by breeds within the species cow, buffalo, goat, sheep.	2	6
3	Nutritional importance of milk and its constituents.	2	7
4	Milk lipid: definition, fatty acid composition, essential fatty acids.	2	7
5	Types of fatty acids- saturated, unsaturated, short chain medium chain and long chain fatty acids	2	6
6	Physical properties of milk lipids.	2	6
7	Role of milk lipids in manufacture of various dairy products.	2	6
8	Milk proteins: Types of proteins i.e. casein, whey protein, minor proteins. Fractions of individual proteins.	2	6

9	Importance of proteins in product manufacturing.	2	6
10	Lactose: Chemical structure form of lactose, state in milk, class of lactose i.e. mono and disaccharide etc.	3	10
11	Role of lactose in dairy product.	2	7
12	Physical changes taking place during manufacture of various products in individual milk constituents.	3	9
13	Chemical changes taking place during manufacture of various products in individual milk constituents.	3	9
14	Desirable and undesirable changes due to processing and storage.	3	9

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Comparison of chemical method and electronic machine for estimation of fat and SNF.	1	6
2	Determination of milk protein by micro-kjeldahl method.	2	13
3	Isolation of casein from skim milk and its quantification.	1	6
4	Determination of lactose in milk and milk products by chemical method.	2	12
5	Determination of total ash in milk and milk products.	2	12
6	Determination of milk fat by Mojoner method in milk and milk products	2	13
7	Determination of free fatty acids in stored milk products:- Butter, Khoa, Dahi, Ghee	4	25

Suggested Readings:

1. Wong, N.P; Jenness, R; Keeney, M. and Elemer, H.M. (1988) Fundamental of dairy chemistry 3rd end Van Nostrand Rcinhold co. New York, USA
2. Walstra, P and Jenness, R; (1984) Dairy Chemistry land Physics. John wilay and sons, New York, USA
3. Fox, P.F; (1982) Development in Dairy Chemistry- 2 Lipids Applied Science publisher London and New York.
4. Fox, P.F; and Mewamy PLH; (1997) Dairy Chemistry & Biochemistry Applied science publication, London.
5. H.A. Mc kenzie; (1971) Milk Proleins Vol. I & II, Academic press New York.

Course No: DSC- 505

Course Title: Physicochemical Aspects of Milk Constituents and Milk Products

Course Credits: 1+1= 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Casein- definition, composition, structure	1	6
2	Phenomenon of denaturation of casein, various stages involved in denaturation of casein.	2	13
3	Factors affecting denaturation of casein, whey proteins- Temperature, Enzymes, pH, additives etc.	3	19
4	Fat globules – definition, classification, physical structure	1	6
5	Fat globule membrane - physics and chemistry.	1	6
6	Factors affecting fat globules size and distribution.	1	6
7	Fat globules- creaming phenomena, factors involved in creaming.	1	6
8	Churning: mechanism, role in products manufacture,	1	6
9	Lactose: mechanisms of various reactions i.e. hydrolysis, Pyrolysis, oxidation reduction , degradation etc.	2	13
10	Browning, Millard reaction.	1	6
11	Physicochemical changes during manufacture of various milk products.	2	13

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Manufacture of acid casein	1	6
2	Manufacture of rennet casein	2	12
3	Determination of Nitrogen in casein	2	13
4	Determination of whey protein	2	12
5	Isolation of whey protein	2	13
6	Manufacture of butter and determination of overrun	1	6
7	Determination of volatile fatty acids in butter	2	13
8	Manufacture of ice-cream, determination of over run	2	12
9	Study of physicochemical changes during the process of ice-cream making	2	13

Suggested Reading:

1. Fox, P.F; (1982) Development in Dairy chemistry- 1, Proteins; Applied Science publishers, London and New York.
2. Fox, P.F; (1982) Development in Dairy chemistry- 2 Lipids, Applied Science Publisher, London and New York.
3. Waletra, Pand Jenness, R, (1984) Dairy chemistry & Physics, John wiley and sous Publisher, New Youk.

4. Mathur, M.P; Datta, Roy, D; and Dinkar, P; (1999) Text book & Dairy Chemistry, ICAR, New Delhi.

5. Wong, N.P; Jenness, R; Keeney, M. and Elerner, H.M (1988) Fundamentals of Dairy Chemistry, 3rd Edu, Nostrand, Reinhold co. New York.

Course No: DSC- 506
Course Title: Microbiology of Milk and Milk Products
Course Credits: 2+1=3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Microorganism associated with milk and milk products i.e. bacteria, yeast and mould.	4	13
2	Morphological studies of microorganism viz., size, shape, colony characters etc.	2	6
3	Biochemical characteristics of microorganism i.e. grams reaction, catalase reaction, sugar requirement, fermentation etc. and Requirements- temperature, growth media	3	9
4	Spoilage of milk and milk products by microorganism yeast, mould and bacteria.	3	10
5	Pathogenic organism associated with milk and milk products and their significance.	2	6
6	Control of pathogenic and spoilage microorganism.	1	3
7	Definition of fermentation and types of fermentation.	1	3
8	Desirable and undesirable fermentation – Lactic acid, alcoholic, propionic acid, butyric acid, citric acid fermentation.	2	6
9	Antimicrobial systems in milk- Ig, LF, phagocytosis and LP system etc.	5	16
10	Microbiology of Indigenous milk product, Cream and butter, Ice-cream, Yoghurt Cheeses	3	9
11	Microbial defects in milk and milk products and its control.	1	3
12	Micro organism associated with packaging material, their effect on quality and its control.	5	16

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Introduction of various equipments, glassware required for microbial studies.	1	6
2	Cleaning, sanitization and sterilization of glassware.	1	6
3	Study of culture media its ingredients and preparation of culture media.	1	6
4	Sampling of milk and milk products	1	6
5	Enumeration of microorganism in raw & processed milk.	3	19

6	Enumeration of microorganism in milk products: Khoa, Paneer, Dahi etc.	2	13
7	Isolation of E. coli from milk.	2	13
8	Testing dairy utensils for microbial sterility.	2	12
9	16Testing of packaging material used for milk & milk product.	3	19

Suggested Reading:

1. Yadav J.S; Grover S. and Batish V.K. (1993) A comprehensive Dairy Microbiology. Metropolitan. Metropolitan, New Delhi (Inidia) 110 002.
2. Foster, E.M. (1958) Dairy microbiology, Macmillan & co. Ltd; London.
3. Robinson, R.K. (1991) Dairy Microbiology Vol. l, The microbiology of milk, Applied Science publisher, London.
4. Robinson, R.K. (1981) Dairy Microbiology Vol. ll – The microbiology of milk products, Applied Science publisher, London.
5. Elmer. H. Marth and Same, S.L. Applied Dairy Microbiology, 2nd ed., Steele Mared Dekkar, lnc. New York.
6. Richardson Gary H. Standard methods for the examination of Dairy Products, 15th ed. American Public health Association, Washinnton D.C.
7. Marvin L. Speck, Compendium of methods for the microbiological examination of food. 2nd Edn., American public health Association, Washington. D.C.

Course No. DSC 507

Course Title: Dairy Starter and Fermented Milk

Course Credits: 1+1=2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Dairy starter: Definition, scope, role in the manufacture and preservation of milk in the form of fermented milk.	1	6
2	Classification of dairy starter organisms: According to products, physicochemical characters, types of fermentation i.e. Homo and Hetero, end products, oxygen requirements etc.	2	13
3	Adjunct starter: Definition, organisms, role	1	6
4	Metabolism of starter organism - different pathways, Types of fermentation:Desirable – Lactic acid, alcoholic, propionic acid, citric acid, Undesirable: gassiness, lipolysis, proteolysis etc.	2	13
5	Types of starter culture: Single strain, mixed strain, multiple.	1	6
6	Methods of propagation of starter culture.	2	13
7	Methods of preservation of starter culture. Liquid, freezing, drying, freeze drying, lyophilized, starter concentrates, etc.	2	12
8	Concept of probiotic – probiotic starter organism, nutritional and therapeutic importance.	1	6
9	Factors affecting starter activities.	1	6

10	Microbiological consideration of various fermented Milk and milk product- Dahi, chhach, butter, makkhan, chakka, shrikhand, yoghurt, kumis, kefir, etc.	2	13
11	Nutritional and therapeutic importance of fermented milk.	1	6

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Activation of starter culture	2	12
2	Propagation of starter culture	1	6
3	Examination of purity of starter culture by culture technique and microscopically.	2	13
4	Examination of activity of starter culture by chemical method.	2	13
5	Preservation of starter culture- liquid culture and freezing.	2	13
6	Demonstration of inhibitory agent on activity of starter culture- antibiotic, residues in milk.	2	12
7	Manufacture of fermented milk: Technology and evaluation	2	12
8	Dahi, yoghurt, butter, Chakka, Shrikhand, butter milk / Chhach, Lassi etc.	3	19

Suggested Reading:

1. Yadav, J.S; Grover, S and Batish, V.K; (2004) A comprechemisive Dairy Microbiology metropolitan Book co. Pvt. Ltd. Delhi.
2. Foster, E.M. (1958) Dairy microbiology, Mac Millan and co. Ltd. London.
3. Robinson, R.K; (1981) Dairy Microbiology, Vol. II, Microbiology of Milk products, Applied science publisher, London.
4. Davice, F.L; and Law, B.A. (1984) Advances in microbiology and Biochemistry of cheese and Fermented Milk; Elsever Applied sci. London.
5. APHA (1948) Standard Methods for Examination of Dairy products, 9th Edn. American Public Health Association, Washington

Course No: DSC- 508
Course Title: Milk by- Products Technology
Course Credits: 0+1= 1

Practical:

Sr. No.	Name of Topic	No. of Practical	Weightage (Marks)
1	Types of various by-products and their chemical composition.	1	6
2	Dairy by- products, nutrient loss, environment pollution.	1	6
3	Present scenario- availability and/or utilization pattern.	1	6
4	Scope for utilization of dairy by-products.	1	6
5	Technology availability and its impact.	1	7
6	Innovative Technology in existence.	1	6

7	Application of Technology for conversion of by products for suitable utilization.	1	6
8	Manufacture of whey based products	3	19
9	Manufacture of ghee residues based products .	3	19
10	Manufacture of butter milk or related products.	3	19

Suggested Reading:

1. By-products from milk (1970) B.H. Webb and R.O. Whittier AVI Pub. Co.
2. Modern dairy technology- (1986) R.K. Robinson Ellsevier Applied Eci. Pub.
3. Trends in utilization of whey and whey derivatives, IDF bulletin No. 233(1988)

B) Minor Subjects

Course No: DSC- 509

Course Title: Packaging for Milk and Milk Products

Course Credits: 1+0= 1

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Packaging: concept, history, importance, scope in relation to dairy industry	1	6
2	Trends of present packaging in dairy industry.	1	6
3	Present status of packaging.	1	6
4	Packaging materials, classification, characteristics, merits and demerits.	2	13
5	Criteria for selection of packaging materials desirable / undesirable.	2	13
6	Legal aspects of packaging.	2	12
7	Safety aspects of packaging, packaging materials in relation to human, animal and environment.	2	13
8	various forms (structures, size, shape) of packaging containers and its merit & demerits.	2	12
9	Concept of coding and labeling procedures.	3	19

Suggested Readings:

Principles of Package developments (1972). Roger C Griffin and Stanley Sacharrin

Handbook of package material (1976). Stanley Sacharrin

Principles of food packaging (1976). S. Sac row and R.C. Griffin

New monograph on UHT milk (1981). IDF Bulletin No. 133

Plastics in packaging (1988). Indian Institute of Packaging

Packaging of food products (1988). Indian Institute of Packaging

BIS specification on packaging material

Course No: DSC- 510

Course Title: Quality Control and Sensory Evaluation of Milk and Milk Products

Course Credits: 2+1= 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Concept and need of quality.	1	3
2	Quality assurance: Meaning, scope.	1	3
3	Inter relation of quality assurance and quality control.	1	3
4	Quality control: Meaning, advantages and response.	1	3
5	Management and quality control.	1	3
6	Quality control and consumers.	1	3
7	Various quality management systems i.e. ISO- 9000, TQM, HACCP.	1	3
8	Various organization involved in quality control and their functioning. (National and International)	2	7
9	Chemical standard for milk and milk products - national and international.	2	6
10	Microbial standards for milk and milk products - national and international.	1	3
11	Guide lines for setting quality control laboratory for milk and milk product.	1	3
12	Design, layout and requirements for quality control laboratory.	2	7
13	Sensory evaluation: concept, meaning, scope, principle involved.	2	6
14	Role of sense organs and its physiological considerations while evaluating test product i.e. skin, eye, tongue, nose and ear.	2	6
15	Classification of taste, flavour, odour.	2	7
16	Taste blindness, taste stimuli.	2	6
17	Terminology in relation to sensory evaluation.	2	6
18	Score cards: milk and milk products.	2	7
19	Score card structure, based on numerical value.	1	3
20	Application of score card in sensory evaluation.	1	3
21	Guidelines for setting of sensory evaluation laboratory.	1	3
22	Design, layout & requirements for sensory evaluation laboratory.	1	3
23	Tabulation and interpretation of data.	1	3

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Guidelines for setting sensory evaluation laboratory.	1	6
2	Requirements for sensory evaluation laboratory.	2	13
3	Designing sensory evaluation laboratory.	1	6
4	Lay out for sensory evaluation laboratory.	1	6
5	Score cards – 20 point, 100 points, 9 point hedonic scale etc.	1	6
6	Desirable and undesirable parameters of dairy products in relation to sensory evaluation.	4	26
7	Testing of raw milk for chemical quality standards.	1	6
8	Testing of raw milk for microbial quality standards	1	6
9	Testing of chemical and microbial quality standards for milk products.	4	25

Suggested Readings:

1. Judging dairy products, J.A. Nelson and G.M.Trout (1981) AVI Pub. Co.
2. Quality control in food Industry. Vol 1, S.M. Hersehedoerfer (1967) Acd.Press
3. Quality control in food Industry. A. Kremmer and B.A. Trigg (1970), AVI Pub. Co.
4. Glossary of general terms for sensory evaluation of foods, Part I and II : ISI
5. Guide for sensory evaluation for foods, : ISI

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

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Developments and prospectus of livestock industry in India and abroad	1	3
2	Role and status of livestock in Agriculture	2	7
3	Sustainable Animal Production systems	2	7
4	Characteristics of ideal dairy farm	2	6
5	Selection of elite animals	1	3
6	Management of calf	1	3
7	Management of heifers	1	3
8	Management of milking cows/buffaloes	1	3
9	Management of dry cows/buffaloes	1	3
10	Management of pregnant cows/buffaloes	1	3
11	Management of breeding bulls	1	3
12	Stress management of livestock.	2	6

13	Fodder production planning and judicious utilization of resources	3	10
14	Computation of ration for different categories of livestock	5	16
15	Culling and disposal of animals	1	3
16	Marketing of livestock	1	3
17	Preparation of animals for show	1	3
18	Animal health management	1	3
19	Milking systems and hygienic milk production	1	3
20	Labour management	1	3
21	Preparation of project reports for finance	1	3
22	Introduction of computer in livestock Management	1	3

Practical:

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

Suggested Readings:

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

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

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

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

7119, Mumbai 31
Cooper G.M. (1998) Building construction Estimation Mc Graw Hill Book Publishing Co. Inc., New York USA

Course No. AH 505
Course Title: Physiology of lactation
Course Credit: 2+0 = 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Introduction and importance of physiology of lactation in relation with milking management	2	6
2	Internal structure of udder of different species	2	6
3	Duct system, blood supply, lymphatic and nervous system of udder	4	13
4	Development of mammary glands	1	3
5	Hormones and their role in development of mammary glands	2	6
6	Involution of udder	1	3
7	Initiation and maintenance of lactation	2	7
8	Induction of lactation	1	3
9	Control of milk secretion	1	3
10	Biosynthesis of milk	1	7
11	Biosynthesis of protein	1	3
12	Biosynthesis of lactose	1	3
13	Biosynthesis of fat	1	3
14	Biosynthesis of minerals	1	3
15	Biosynthesis of vitamins	1	3
16	Milk harvesting and milking manage	3	10
17	Factors affecting milk yield	2	6
18	Factors affecting composition viz., physiological, genetic, nutritional and environmental.	4	12

Suggested Readings :

Banarjee G.C., (1986) Text book of Animal Husbandary 6th Oxford and IBH Publication Pvt. Ltd. New Delhi
Smith, V.R. (1981) Physiology of lactation Iowa state University Press Ames Town
Smith, V.R. and Bruce Larson (1984) Lactation II
Colin, T., White Moore, (1980) Lactation of the dairy cow.
Bath D.L., (1978) Dairy cattle principles, Practices profits and problems 2nd ed Lea and Ebiger Publishing House, Philadelefia.
Thomes, C.K. and Sastri, N.S.R., (1991) Dairy bovine production Kalyani publication Co. Ludhiana India
Hafez, E.S.E. (1980) Reproduction in farm animals 4th ed K.M. Verghese Co. P.B. No. 7119 Bombay 400 031
Smith, G.H and Vanvleck L.D., (1974) Principles of Dairy Science W.H. freeman and Co., Sanfransisco.

C) Supporting Subjects

1	BIOCHEM-501	Basic Biochemistry	**3 =2+1**
2	STAT-508	Design of experiments for Animal Science	3 = 2+1

D) Seminar

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

E) Masters' Research

1	Thesis – 599	Research	20=0+20

F) Compulsory Non Credit Courses

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