Subject No. 51 /2018 **Approval to the lecture and practical schedules of the subjects offered by the departments viz., Dairy Technology, Dairy Engineering, Dairy Chemistry, Dairy Microbiology & Dairy Business Management in the Faculty of Dairy Technology in accordance with 5th Deans' committee recommendations .....**

It is to submit that the recommendations of 5th Dean's Committee of ICAR have been implemented in the Faculty of Dairy Technology, MAFSU, from the academic year 2016-2017. The lectures and practical schedule of newly adopted B. Tech (DT) syllabus in the Faculty of Dairy Technology of all departments are submitted for the perusal and approval of the Academic Council. (See ANNEXURE I, II, III, IV and V).

Hence the subject is submitted before Hon'ble Academic Council as per provisions of MAFSU, Act 1998, Section 30 (Power and duties of Academic Council.) (1) and (2).

ANNEXURE I

List of Courses offered by Department of Dairy Technology

Sr. No.	Discipline and Title of the Course	Credits Hours
1	Market Milk	4 (3+1)
2	Traditional Indian Dairy Products	3 (2+1)
3	Fat Rich Dairy Products	3 (2+1)
4	Condensed & Dried Milks	4 (3+1)
5	Cheese Technology	5 (3+2)
6	Ice-cream & Frozen Deserts	3 (2+1)
7	By Products Technology	3 (2+1)
8	Packaging of Dairy Products	3 (2+1)
9	Sensory Evaluation of Dairy Products	3 (2+1)
10	Food Technology - I	3(2+1)
11	Dairy Plant Management	2 (1+1)
12	Waste Disposal & Pollution Abatement	2 (1+1)
13	Food Technology -II	3 (2+1)
	Total	41 (27+14)

ANNEXURE II

List of Courses offered by Department of Dairy Engineering

Sr. No.	Discipline and Title of the Course	Credits Hours
1	Workshop Practice	2 (1+1)
2	Fluid Mechanics	3 (2+1)
3	Engineering Drawing	1 (0+1)
4	Thermodynamics	2 (1+1)
5	Heat & Mass Transfer	3 (2+1)
6	Boilers and Steam Generation	2 (1+1)
7	Basic Electrical Engineering	3 (2+1)
8	Refrigeration & Air-conditioning	3 (2+1)
9	Dairy Engineering	3 (2+1)
10	Dairy Process Engineering	3 (2+1)
11	Instrumentation and Process Control	3 (2+1)
12	Food Engineering	3 (2+1)
13	Material Strength & Dairy Machine Design	3 (2+1)
14	Dairy Plant Design and Layout	2(1+1)
15	Energy Conservation and Management	2(1+1)
	Total	38 (23+15)

ANNEXURE III

List of Courses offered by Department of Dairy Chemistry

Sr. No.	Discipline and Title of the Course	Credit Hours
1	Physical Chemistry of Milk	3 (2+1)
2	Biochemistry	2 (1+1)
3	Human Nutrition	2 (1+1)
4	Chemistry of Milk	3 (2+1)
5	Chemistry of Dairy Products	3 (2+1)
6	Chemical Quality Assurance	2 (1+1)
7	Food Chemistry	3 (2+1)
	Total	18 (11+7)

ANNEXURE IV

List of Courses offered by Department of Dairy Microbiology

Sr. No.	Discipline and Title of the Course	Credits Hours
1	Fundamentals of Microbiology	3 (2+1)
2	Microbiology of fluid milk	2 (1+1)
3	Microbiology of Dairy Products	2 (1+1)
4	Starter Cultures and Fermented Milk Products	3 (2+1)
5	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
6	Food and Industrial Microbiology	3 (2+1)
	Total	16 (10+6)

ANNEXURE V

List of Courses offered by Department of Dairy Business Management

Sr. No.	Discipline and Title of the Course	Credits
1	Milk Production Management and Dairy Development	3 (2+1)
2	Computer and Application Software Packages	2 (1+1)
3	Economic Analysis	2 (2+0)
4	Environmental Studies	2 (1+1)
5	ICT in Dairy Industry and Operation Research	4(2+2)
6	Fundamentals of Dairy Extension	3 (2+1)
7	Marketing Management & International Trade	2 (2+0)
8	Communication Skills	2 (1+1)
9	Industrial Statistics	2 (1+1)
10	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
11	Financial Management and Cost Accounting	3 (2+1)
	Total	27 (18+9)

ANNEXURE No. I

List of Teaching / Lecture Schedule

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Market milk	Course No.	DT-301 (Theory)
Course Credit:	4 (3+1)	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Market milk industry in India and abroad	
2.	Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries.	
3.	Collection and transportation of milk	
4.	Organization of milk collection routes	
5.	Practices for collection of milk	
6.	Preservation of milk at farm	
7.	Natural microbial inhibitors in milk	
8.	Lactoperoxidase system	
9.	Reception and treatment (pre-processing steps) of milk in the dairy plant: Reception, chilling, clarification and storage of milk	
10.	Reception and treatment (pre-processing steps) of milk in the dairy plant: Reception, chilling, clarification and storage of milk	
11.	General practices of reception and treatment of milk	
12.	Homogenisation: Definition, pre treatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST)	
13.	Homogenisation: Definition, pre treatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST)	
14.	Homogenisation: Definition, pre treatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST)	
15.	Effect of homogenization on physical properties of milk.	
16.	Bactofugation: Theory and microbiology	
17.	Bactofugation: Theory and microbiology	
18.	Thermal processing of milk	
19.	Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value	
20.	Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value	
21.	Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value; factor affecting on thermal destruction of m.o.	
22.	Definition and description of processes: Pasteurization	
23.	Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing	
24.	Definition and description of processes: sterilization, UHT Processing	
25.	Definition and description processes: Pasteurization, UHT Processing	
26.	Product control in market milk plant	
27.	Product control in market milk plant	
28.	Defects in market milk	
29.	Defects in market milk	
30.	Manufacture of special milks: toned, doubled toned, reconstituted, recombined	
31.	Manufacture of special milks: flavoured, homogenized, vitaminised and sweet acidophilus milk	
32.	Manufacture of special milks: toned, doubled toned, reconstituted,	

	recombined	
33.	Manufacture of sterilized milk.	
34.	Distribution systems for market milk.	
35.	UHT processing of milk	
36.	Relevance of UHT processing in the tropical climate	
37.	UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants.	
38.	UHT plants: third generation UHT plants.	
39.	UHT plants: Description. Direct Indirect, with upstream and downstream homogenization, third generation UHT plants.	
40.	Aseptic packaging, types and systems of packaging	
41.	Sterilizing packages, filling systems	
42.	Technical control in the UHT plant	
43.	Shelf life and tests for UHT milk.	
44.	Nutritive value of milk.	
45.	Nutritive value of milk.	
46.	Effect of heat processing on nutritive value	
47.	Cleaning and sanitization of dairy equipment	
48.	Cleaning and sanitization of dairy equipment	

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Market Milk	Course No	DT-301 (Practical)
Course Credit:	4 (3+1)	Semester	II (Vth Dean)

Practical No.	Topics	Date
1.	Familiarization with equipments for reception of milk in plant.	
2.	Familiarization with equipments for reception of milk in plant.	
3.	Pretreatments: Chilling, clarification, filtration.	
4.	Pretreatments: Standardization and numericals relating to it	
5.	Pretreatments: Standardization and numericals relating to it	
6.	Cream separation: parts of separator and the process.	
7.	Operation of LTLT, HTST pasteurizer, laboratory steriliser	
8.	Operation of LTLT, HTST pasteurizer, laboratory steriliser	
9.	Preparation of special milks; toned, double toned milk	
10.	Preparation of special milks; standardized milk	
11.	Preparation of special milks, flavoured milk	
12.	Preparation of special milks; sterilized milk	
13.	Cleaning of storage tanks, cream separators, HTST plants; manual cleaning and CIP	
14.	Detection of adulterants and preservatives in milk	
15.	Assessment of homogenisation efficiency in milk	
16.	Strength of common detergents and sanitizers used in market milk plant	

Suggested Readings	
1	e-Courses by NDRI, Karnal : Dairy Technology ICAR e-Courses
2	Outlines of Dairy Technology by Sukumar De: Oxford University Press, New Delhi (2001)
3	Food Engineering and Dairy Technology by H.G. Kessler: Verlag A. Kessler, Fraising (F.R. Germany) (1981)
4	Technology of Indian milk products by Aneja R.P., Mathur B.N., Chandan, R.C., and Banerjee, A.K. : Dairy India Yearbook (2002)
5	Dairy Science and Technology by Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts.: 2nd Ed. CRC Press, Boca Raton, FL, USA (2006)

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Traditional Indian Dairy Products	Course No	DT-302 (Theory)
Course Credit:	3 (2+1)	Semester	III (Vth Dean)

Lecture No.	Topics	Date
1.	Status and significance of traditional Indian milk products in India	
2.	*Khoa:* Classification, types, standards and definition	
3.	Methods of manufacture and preservation, factors affecting yield of khoa	
4.	Mechanization in manufacture of *khoa*	
5.	*Khoa based sweets :* Burfi, Peda, Milk cake, Kalakhand, Gulabjaman and their compositional profile	
6.	Manufacture practices of Burfi, Peda	
7.	Manufacture practices of Milk cake, Kalakhand, Gulabjaman	
8.	*Rabri* and *Basundi:* Definition, Standards & Product identification,	
9.	*Rabri* and *Basundi:* Process description	
10.	*Rabri* and *Basundi* :factors affecting yield, physico-chemical changes during manufacture	
11.	*Channa:* Product description, standards and method of manufacture	
12.	Channa: packaging and preservation	
13.	*Chhana-based sweets:* Definition & Standards :Rasogolla, Sandesh, Rasomalai	
14.	Mechanization of manufacturing process of rasogolla	
15.	Mechanization of manufacturing process of sandesh	
16.	Mechanization of manufacturing process of rasmalai	
17.	*Chhana-based sweets* :advances in preservation &packaging	
18.	*Paneer:* Product description, standards	
19.	Paneer : method of manufacture	
20.	packaging and preservation	
21.	Mechanization of Paneer manufacturing/packaging process	
22.	*Chakka/Maska:* Product description, standards,	
23.	*Shrikhand* method of manufacture	
24.	small scale and industrial process of production	
25.	packaging and preservation aspects	
26.	Misti*Dahi:* Product description	
27.	Mistidahi :method of manufacture and packaging process	
28.	*Kheer and Payasam:* Product description	
29.	*Kheer and Payasam:* methods of manufacture	
30.	innovations in manufacturing and packaging processes	
31.	Biopreservative principles in enhancing the self-life of indigenous milk products	
32.	Role of active packaging in enhancing the self-life of indigenous milk products	

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Traditional Indian Dairy Products	Course No	DT-302 (Practical)
Course Credit:	3 (2+1)	Semester	III (Vth Dean)

Practical No.	Topics	Date
1.	Preparation of Khoa from cow milk	
2.	Preparation of Khoa from buffalo milk	
3.	Preparation of Khoa from concentrated milk	
4.	Preparation of Burfi, Peda, Kalakand	
5.	Preparation of Milkcake and Gulabjamun.	
6.	Preparation of Paneer from cow milk.	
7.	Preparation of Paneer from buffalo milk.	
8.	Preparation of Paneer from mixed milk.	
9.	Preparation of Sandesh.	
10.	Preparation of Rasogolla.	
11.	Preparation of kheer.	
12.	Preparation of Rabri.	
13.	Preparation of Misti Dahi,	
14.	Preparation ofChhaka.	
15.	Preparation of Shrikhand.	
16.	Visit to industry	

Suggested Readings	
1	Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.
2	Aneja, R. P.; Mathur, B. N.; Chandan, R. C.; Banerjee, A. K., 2002, Technology of Indian Milk Products:
3	Dairy Technology ICAR E- course
4	Y.H. Hui. 1993. Dairy Science and Technology Handbook, Vol. I, II and III. Wiley-VCH, USA

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Fat Rich Dairy Products	Course No	DT-303 (Theory)
Course Credit:	3(2+1)	Semester	III (V Dean)

Lecture No.	Topics	Date
1.	Status of fat-rich dairy products in India and abroad	
2.	*Cream:* a) Definition & Legal standards	
3.	Efficiency of cream separation and factors affecting it; control of fat concentration in cream	
4.	Control of fat concentration in cream	
5.	Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream.	
6.	Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream	
7.	Preparation properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream)	
8.	Properties of different types of cream: table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream)	
9.	UHT processing of cream	
10.	Factors affecting quality of cream	
11.	Ripening of cream	
12.	Packaging, storage and distribution, defects (non-microbial) in cream and their prevention	
13.	Packaging, storage and distribution, defects (non-microbial) in cream and their prevention	
14.	*Butter:* a) Introduction to the butter making process	
15.	Composition, Classification and Legal standards	
16.	Theory of churning	
17.	Technology of Butter manufacture, Batch and continuous methods	
18.	Over-run in butter; control of fat loses in butter-milk	
19.	Packaging, storage and transportation	
20.	Defects in butter	
21.	Uses and Rheology of butter	
22.	Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator	
23.	Factory butter churn and continuous butter making machine	
24.	Special butters and related products:	
25.	Manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter	
26.	Renovated butter/fractionated and polyunsaturated milk fat products	
27.	Vegetable oil-blended products and low-fat spreads.	
28.	Manufacture, packaging, storage and characteristics of margarine of different types	
29.	Manufacture, packaging, storage and characteristics of margarine of different types.	
30.	*Ghee and butter oil:* Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee; utilization of substandard milk.	
31.	Ghee: Composition and changes during manufacture fat constants	
32.	Butteroil: Manufacture of butteroil, packaging and storage.	

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Fat Rich Dairy Products	Course No	DT-303 (Practical)
Course Credit:	3 (2+1)	Semester	III (V Dean)

Practical No.	Topics	Date
1.	Standardization, neutralization, pasteurization and cooling of cream	
2.	Preparation of sterilized cream.	
3.	Study of construction and operation of the power operated butter churn	
4.	Study of construction and operation butter packaging machine	
5.	Study of construction and operation butter packaging machine.	
6.	Preparation of cooking butter by the hand operated churn	
7.	Preparation of cooking butter by the hand operated churn	
8.	Manufacture of table butter using the power-driven churn.	
9.	Preparation of ghee from fresh cream	
10.	Preparation of ghee from fermented cream	
11.	Preparation of ghee from ripened butter	
12.	Preparation of ghee from butter (Desi method)	
13.	Preparation of ghee by prestratification method	
14.	Preparation of desi butter Study and operation of continuous ghee plant	
15.	Preparation of desi butter Study and operation of continuous ghee plant	
16.	Standardization, neutralization, pasteurization and cooling of cream	

Suggested Readings	
1	Outlines of Dairy Technology Sukumar De
2	Food Engineering and Dairy Technology H.G. Kessler
3	Modern Dairy Processing: Advances in Milk Processing R.K.Robinson
4	Technology of Indian milk products Aneja R.P., Mathur B.N., Chandan, R.C., and Banerjee, A.K.
5	Dairy Science and Technology Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts.
6	Dairy Technology: Dairy Products & Quality Control S. Singh
7	e- course NDRI Karnal

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Condensed & Dried Milk	Course No	DT-304 (Theory)
Course Credit:	4 (3+1)	Semester	III (Vth Dean)

Lecture No.	Topics	Date
1.	History, status and scope in India and abroad	
2.	Definition and legal standards for evaporated and condensed milks	
3.	Grading and quality of raw milk for condensed milks and evaporated milk	
4.	Pretreatments for Concentrated Milks	
5.	Manufacturing techniques: Basics of evaporators	
6.	Condensed milk	
7.	Manufacture of sweetened condensed milk	
8.	Manufacture of sweetened condensed milk- operations	
9.	Manufacture of evaporated milk	
10.	Pilot sterilization and heat stabilization for evaporated milk	
11.	Recombined concentrated milks-raw materials	
12.	Recombined concentrated milks-processing	
13.	Physico-chemical changes during manufacture of condensed milk:Changes Caused by Concentration, Effect of sterilization on viscosity of product, Increase in viscosity by progressive coagulation of milk proteins, Effect of storage on viscosity	
14.	Sweetened Condensed Milk :Age thickening , Maillard browning, Oxidative changes, Lactose crystallization	
15.	Heat stability of milk	
16.	Heat stability of condensed milk	
17.	Defects in sweetened condensed milks: Causes	
18.	Defects in sweetened condensed milks: Prevention	
19.	Defects in evaporated milks	
20.	Freeze concentration	
21.	Membrane concentration	
22.	Dried Milks: history and status in India and abroad Grading and quality of raw milk for dried milks	
23.	Technology of dried milks: Drum or roller drying Classification of Drum Dryers Flow of Product, Drums, Moisture Removal	
24.	Factors Affecting Production from a Drum Drier Operation and Maintenance	
25.	Freeze, vacuum and foam drying: Introduction, Advantages, Disadvantages, Vacuum Drying Foam Drying, Advantages and Limitations	
26.	Spray drying: Introduction Heating of the air, Atomizing the concentrate in the air	
27.	Mixing hot air and atomized liquid Separating powder and consumed drying air	
28.	Aggregation of powder particles: Second-stage drying Drying Functions	
29.	Classification of spray dryers, Characteristics of spray driers	
30.	Air heating: Air Filter, Air Heater ,The direct and semi direct heating systems , Counter Current versus Parallel Current Flow	
31.	Atomization: Introduction, Advantages of Atomization Types of Atomizers, Change of State of the Drying Air	
32.	Seperation of air and powder: Introduction, Methods, Types of Separators, Cyclone separators, Cloth collectors or bag filters	
33	Wet scrubber or liquid device Cooling the Powder	

34.	Technology of dry milks Instantization, Introduction, Products, Spray drying, agglomeration Rewet agglomeration	
35.	Factors affecting instantiztion:	
36.	Physico-chemical changes taking place during manufacture of dried milks: WPN index and heat denaturation	
37.	Manufacture of SMP, WMP	
38.	Manufacture of heat classified powders	
39.	Physical properties of dried milk	
40.	Defects in dried milk during manufacture and storage, their causes and prevention	
41.	PFA, BIS and International standards for dried milk	
42.	Manufacture of infant foods, malted milk foods and other formulated dried products	
43.	Manufacture of cheese spread powder	
44.	Manufacture of ice cream powder	
45.	Manufacture ofcream powder	
46.	Manufacture office butter powder	
47.	Manufacture office whey powder	
48.	Management of condensed and dried milk industry	

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Condensed & Dried Milk	Course No	DT-304 (Practical)
Course Credit:	4 (3+1)	Semester	III (Vth Dean)

Practical No.	Topics	Date
1.	Evaluation of milk quality for concentrated and dried milk preparation	
2.	Evaluation of milk quality for concentrated and dried milk preparation	
3.	Standardization of milk for preparation of condensed, evaporated and dried milk	
4.	Standardization of milk for preparation of condensed, evaporated and dried milk	
5.	Manufacture of plain skim conc. Milk	
6.	Manufacture of plain skim conc. Milk	
7.	Manufacture of sweetened condensed milk	
8.	Manufacture of sweetened condensed milk	
9.	Manufacture of evaporated milk	
10.	Manufacture of evaporated milk	
11.	Concentration of milk by membrane processing	
12.	Manufacture of SMP by spray drying	
13.	Manufacture of SMP by roller drying	
14.	Manufacture of SMP by roller drying	
15.	Manufacture of Instant milk powder	
16.	Manufacture of Instant milk powder	

Suggested Readings	
1	Technological Advances in Condensed & Dried Milk : Dr. J. David
2	Technology of Condensed & Dried milk : H.G Patel
3	Drying and Dehydration of Foods : H.W.V. Loesecke
4	Dairy Powder and Concentrated products : Tammine

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Cheese Technology	Course No	DT-405 (Theory)
Course Credit:	5 (3+2)	Semester	IV (Vth Dean)

Lecture No.	Topics	Date
1.	Origin and history of development of cheese manufacture,	
2.	Status and scope in dairy industry.	
3.	Definition, standards	
4.	classification of cheese.	
5.	Basic principle: Acidification	
6.	Coagulation of milk	
7.	Synersis and drainage of curd	
8.	Salting of cheese	
9.	Ripening of cheese	
10.	Cheese additives- legal usage	
11.	Cheese additives- legal usage	
12.	Cheese preservatives- Inhibitory salts	
13.	Milk quality in relation to cheese manufacture- Amount & composition	
14.	Factors affecting quality of milk	
15.	Changes in milk after production	
16.	Inhibitory substances	
17.	Treatment of milk for cheese making- Chilling and cold storage	
18.	Heat treatment, Homogenization , Concentration	
19.	Role of starter culture in relation to cheese quality- Defination , classification, Characteristic	
20.	Factors affecting performance of starter culture	
21.	Rennet preparation and its substitute	
22.	Factors affecting residual rennet activity	
23.	Role of rennet in cheese making	
24.	Role of milk constituents	
25.	Changes during ripening.	
26.	Action of rennet on milk in relation to cheese manufacture.	
27.	Manufacture of cheese: Cheddar	
28.	Manufacture of Gouda cheese,	
29.	Manufacture of Swiss cheese	
30.	Manufacture of Mozzarella cheese	
31.	Method and principal of Mozzarella cheese	
32.	Manufacture of Cottage cheese	
33.	Changes during manufacture and ripening of Cheddar cheese	
34.	Manufacture of processed cheese	
35.	Manufacture of cheese spread	
36.	Manufacture of processed cheese food	
37.	Manufacture of processed cheese spread	
38.	Manufacture of processed cheese food	
39.	Defects: their causes and prevention.	
40.	Defects: their causes and prevention.	
41.	Packaging of cheese	
42.	Storage and distribution of cheese	
43.	Recent advances in cheese industry	
44.	Mechanization of cheese	

45.	Acceleration of cheese	
46.	Methods of cheese acceleration	
47.	Automation in cheese industry	
48.	Cheese yield –Defination and formule	

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Cheese Technology	Course No	DT-405 (Practical)
Course Credit:	5 (3+2)	Semester	IV (Vth Dean)

Lecture No.	Topics	Date
1.	Familiarization with equipments, accessories, and cheese varieties	
2.	Standardization numerical	
3.	Standardization numerical	
4.	Preparation of starter cultures.	
5.	Study of factors affecting rennet action in relation to curd characteristic.	
6.	Manufacture of Quarg cheese	
7.	Manufacture of Cheddar cheese	
8.	Manufacture of Cottage cheese	
9.	Manufacture of Gouda cheese.	
10.	Manufacture of Cottage cheese.	
11.	Manufacture of swiss cheese.	
12.	Manufacture of Mozzarella cheese	
13.	Manufacture of processed cheese	
14.	Manufacture of processed cheese spread	
15.	Manufacture of gouda cheese.	
16.	Analysis of cheese : composition of cheese	

Suggested Readings	
1	Cheese making: KG Upadhyay
2	Modern Dairy Technology : Vol 2 RK Robinson
3	Dairy Science & Technology Handbook vol 2: YH Hui
4	Technology of Cheese Making II edition: Law & Tammine
5	Cheese making : A. Eck
6	Cheese: Chemistry, Physics & Microbiology II edition PF Fox
7	Process Cheese : Zehren & Nusbaum

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Ice cream & Frozen Dessert	Course No	DT-406 (Theory)
Course Credit:	3(2+1)	Semester	IV (V Dean)

Lecture No.	Topics	Date
1.	History and development of ice cream and frozen desserts industry.	
2.	Status of ice cream industry in India and abroad	
3.	Definition of ice cream	
4.	Classification of ice cream	
5.	Composition & standard of ice cream & other frozen dessert	
6.	Dairy ingredients in ice cream.	
7.	Stabilizers and emulsifiers – classification, types, properties and role in ice cream.	
8.	Stabilizers and emulsifiers – selection, mechanism of action, influence on mix and ice cream, proprietary stabilizer blends	
9.	Technology aspects of ice cream manufacture	
10.	Technology aspects of ice cream manufacture	
11.	Preparation of ice cream mix – standardization, blending, homogenization	
12.	Preparation of ice cream mix - pasteurization, cooling, ageing and flavour addition.	
13.	Thermodynamics of freezing and calculation of refrigeration loads	
14.	Types of freezers	
15.	Refrigeration control / instrumentation	
16.	Refrigeration control / instrumentation	
17.	Hygiene, cleaning and sanitation of ice cream plant,	
18.	Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream.	
19.	Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream	
20.	Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream,	
21.	Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream,	
22.	Processing and freezing of ice-cream mix.	
23.	Processing and freezing of ice-cream mix.	
24.	Control of over run,	
25.	Packaging, hardening, storage and shipping of ice-cream,	
26.	Packaging, hardening, storage and shipping of ice-cream,	
27.	Defects in ice cream, their causes and prevention,	
28.	Defects in ice cream, their causes and prevention,	
29.	Recent advances in ice-cream industry (flavorings, colorings, fat replacers, bulking agents).	
30.	Recent advances in ice-cream industry (flavorings, colorings, fat replacers, bulking agents).	
31.	Plant management	
32.	Nutritive value of ice-cream	

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Ice cream & Frozen Dessert	Course No	DT-406 (Practical)
Course Credit:	3(2+1)	Semester	IV (V Dean)

Lecture No.	Topics	Date
1.	Calculation of standardization of ice-cream mixes.1	
2.	Calculation of standardization of ice-cream mixes.2	
3.	Calculation of standardization of ice-cream mixes.3	
4.	Manufacture of plain and fruit flavored ice-cream.	
5.	Manufacture of chocolate.	
6.	Manufacture of fruit and nut ice cream.	
7.	Preparation of sherbets/ices.	
8.	Preparation of soft served and filled ice-cream.	
9.	Manufacture of kulfi.	
10.	Manufacture of kulfi.	
11.	Study of continuous and batch type freezers.	
12.	Study of continuous and batch type freezers.	
13.	Manufacture of ice-cream by continuous process.	
14.	Determination of overrun in ice cream	
15.	Factory visit.	
16.	Calculation of standardization of ice-cream mixes.1	

Suggested Readings	
1	Ice-Cream. 5thEdn. By H. Douglas Goff.
2	Handbook of Ice-Cream – Technology & Formulae by EIRI Board of Consultants and Engineers.
3	The Science of Ice-Cream. 2nd Revised Edn. By Chris Clarke.
4	Ice Cream by V. Bhandari
5	E – Course (NDRI)

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	By Product Technology	Course No	DT-507 (Theory)
Course Credit:	3 (2+1)	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	Status and availability in India and Abroad	
2.	Utilization of dairy by-products	
3.	Associated economic and pollution problems	
4.	Physico-chemical characteristics of whey, buttermilk and ghee residue	
5.	By-products from skim milk: Casein: types of commercial casein and their specifications	
6.	Manufacturing processes of casein with basic principles involved	
7.	Industrial and food uses of caseins	
8.	Manufacture of sodium and calcium caseinate	
9.	Physico-chemical properties of sodium and calcium caseinate	
10.	Functional properties of sodium caseinate and calcium caseinate	
11.	Food applications of sodium caseinate and calcium casienate	
12.	Manufacture of casein hydrolysates and its industrial application	
13.	*Co-precipitates:* types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications.	
14.	*Whey processing:*a) Fermented products from whey	
15.	*Whey processing:*a) Fermented products from whey	
16.	*Whey processing:*a) Fermented products from whey	
17.	b)Beverages from whey	
18.	b) Beverages from whey	
19.	c) Deproteinized and demineralized whey	
20.	d) Condensed whey	
21.	d) Condensed whey	
22.	e) Dried whey, types and their specification, manufacturing techniques..	
23.	F) Utilization of whey products. Application of membrane processing for whey processing.	
24.	*Whey protein concentrates:* a) Methods of isolation with basic principles involved, physico-chemical properties of whey proteins concentrates	
25.	b) Functional properties and food applications of WPC. *Lactose:* methods for the industrial production of lactose, refining of lactose, uses of lactose and hydrolysis of lactose.	
26.	b) Functional properties and food applications of WPC. *Lactose:* methods for the industrial production of lactose, refining of lactose, uses of lactose and hydrolysis of lactose.	
27.	Butter milk processing: a) Condensed butter milk b) Dried butter milk c) Utilization of butter milk products.	
28.	Butter milk processing: a) Condensed butter milk b) Dried butter milk c) Utilization of butter milk products.	
29.	*Ghee residue*: Composition, processing and utilization.	
30.	*Ghee residue*: Composition, processing and utilization.	
31.	Nutritional characteristics of by products	
32.	Nutritional characteristics of by products	

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	By Product Technology	Course No	DT-507 (Practical)
Course Credit:	3 (2+1)	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	Manufacture of edible casein from cow and buffalo milk	
2.	Manufacture of rennet casein	
3.	Manufacture of sodium caseinate	
4.	Manufacture of calcium caseinate	
5.	Manufacture of co-precipitate	
6.	Isolation of whey proteins by cold precipitation technique	
7.	Manufacture of whey proteins, concentration by ultra filtration process	
8.	Manufacture of whey drinks	
9.	Manufacture of dried whey	
10.	Manufacture of lactose	
11.	Chemical analysis of whey protein concentrates	
12.	Chemical analysis of lactose	
13.	Microbiological analysis of casein and dried whey	
14.	Incorporation of whey proteinconcentrates in processed cheese foods	
15.	Manufacture of coffee whitener	
16.	Manufacture of edible casein from cow and buffalo milk	

Suggested Readings	
1	Outlines of Dairy Technology by Sukumar De
2	Technological advances in dairy by-products (March 18- April 7,1997) - Dairy Technology Division, NDRI, Karnal
3	Concentrated and Dried Dairy Products by MarijanaCaric
4	E-Course by NDRI, Karnal

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Packaging of Dairy Products	Course No	DT-508 (Theory)
Course Credit:	3 (2+1)	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	History of Package Development	
2.	Importance Of Packaging	
3.	Selection Of Packaging Materials	
4.	Characteristics Of Paper, Corrugated Paper, Fiber Board And Wood	
5.	Characteristics Of Glass	
6.	Characteristics Of Metals And Metallic Containers	
7.	Characteristics Of Plastics	
8.	Sources Of Different Plastic Materials And Process Of Manufacture	
9.	Forms Of Different Plastic Materials	
10.	Newer Forms With Combination Of Two Or More Ingredients	
11.	Foils And Laminates - Characteristics And Importance In Food Industry	
12.	Characteristics Of Retort Pouches	
13.	Forms Of Packages Used For Packaging Of Food And Dairy Products.	
14.	Legal Requirements Of Packaging Materials And Product Information	
15.	Packaging Of pasteurized milk.	
16.	Packaging Of UHT Sterilized Milk.	
17.	Aseptic Packaging.	
18.	Packaging Of Fat Rich Dairy Products - Butter And Ghee.	
19.	Packaging Of Coagulated And Desiccated Indigenous Dairy Products and their Sweetmeats.	
20.	Packaging of concentrated and dried milks including baby food.	
21.	Packaging of functional dairy/food products	
22.	Vacuum And Modified Atmosphere Packaging (Map)	
23.	Eco Friendly Packaging.	
24.	Active Packaging	
25.	Different Methods Of Package Sterilization, Importance Of Such Methods And Principles	
26.	Different Methods Of Coding And Standards Of Labeling Of Food Packages	
27.	Scope Of Aseptic Packaging And Pre-Requisite Conditions For Aseptic Packaging. Description Of Equipments (Including Aseptic Tank) And Machines	
28.	Micro-Processor Controlled Systems Employed For Aseptic Packaging	
29.	Package condition and quality assurance aspects of aseptic packaging	
30.	Microbial aspects of Packaging Material As Sources Of Contamination	
31.	Disposal Methods Of Waste Packages	
32.	Packaging Systems. Hazards from packaging material in food.	

Department of Dairy Technology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Packaging of Dairy Products	Course No	DT-508 (Practical)
Course Credit:	3 (2+1)	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	Identification of packaging materials.	
2.	Flame Hot wire test.	
3.	Testing of papers/paperboards: Percentage moisture & Grease resistance.	
4.	Testing of papers/paperboards: Water absorptiveness & Grammage.	
5.	Testing of papers/paperboards:Tearing resistance and Bursting strength.	
6.	Testing of glass bottle – resistance tothermal shock	
7.	Testing of plastics – Thickness	
8.	Testing of laminates – Thickness	
9.	Water vapour transmission rate(WVTR),	
10.	Grease resistance.	
11.	Packaging of different dairy products by using prepak machines.	
12.	Packaging of different dairy products by vacuum packaging machines.	
13.	Identification of packaging materials.	
14.	Flame Hot wire test.	
15.	Testing of papers/paperboards: Percentage moisture & Grease resistance.	
16.	Testing of papers/paperboards: Water absorptiveness & Grammage.	

Suggested Readings	
1	Food Packaging: Facts and Principles by G. L. Robertson.
2	A Handbook on Food Packaging Buy P. Jacob John
3	Food Packaging by N. Khetrapal and D. Punia
4	Modern Packaging Technology by EIRI
5	Lessons from E- Courses by NDRI, Karnal.

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Sensory Evaluation of Dairy Products	Course No	DT-609 (Theory)
Course Credit:	3(2+1)	Semester	VI (V Dean)

Lecture No.	Topics	Date
1	Introduction, definition, importance and application of sensory evaluation in relation to consumer acceptability and economic aspects.	
2	Terminology related to sensory evaluation.	
3	Design and requirements of sensory evaluation.	
4	Basic Principles: senses and sensory perception.	
5, 7	Physiology of sensory organ-tongue, ear and nose.	
8	Classification of tastes and odour, threshold value Factor affecting senses, visual, auditory tactile & other responses	
9	Measurement of sensation intensity.	
10	Fundamental rules for scoring & grading of milk & milk products	
11	Procedure & type of texture	
12	Difference tests (paired comparison, due – trio, triangle), ranking, scoring, hedonic scale and descriptive tests.	
13	Panel selection, screening and training of judges;Requirement of sensory evaluation, sampling procedure, Factor influencing sensory measurements	
14	Judging and grading of milk	
15	Desirable and undesirable characteristics of fermented milks, sensory evaluation of *dahi, yoghurt, chakka, shrikhand, lassi* and other fermented drinks.	
16	Desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, *chakka, shrikhand, lassi* and other fermented drinks.	
17 - 18	Sensory attributes of fresh and ripened cheese.	
19	Sensory evaluation of cream	
20	Butter: specific requirements of high grade butter, undesirable attributes of butter, butter score card, sensory evaluation of butter.	
21	Ghee : grade of ghee special requirements of quality ghee, defects in ghee, ghee score card, sensory evaluation of ghee.	
22	Frozen ice cream: Desirable and undesirable characteristics of ice-cream, sensory evaluation of Ice cream.	
23	Desirable and undesirable characteristics of kulfi and milk sherbets. Sensory evaluation of *kulfi* and milk sherbets.	
24	Concentrated Milks: Desirable attributes and defects, judging and grading of evaporated and condensed milks.	
25	Dried Dairy Products: Desirable and undesirable characteristics of dried dairy products. Judging and grading of dried dairy products.	
26	Heat desiccated Indian dairy products & *Khoa* based sweets: Desirable and undesirable characteristics of different types of *khoa* based, i.e. *Peda, gulabjamun* etc.	
27	Sensory evaluation of *khoa* based sweetes.	

28	*Acid coagulated Indian milk products :* desirable characteristics of *panner* and defects, judging and grading of *panner*.	
29	*Chhana* and *chhana* based Sweets: Desirable and undesirable characteristics of *Chhana* and *Chhana* based sweets Sensory evaluation of *chhana*and *chhana*based sweets.	
30	Objectives, methods, types of questionnaires, development of questionnaires	
31, 32	Interrelationship between sensory properties of dairy products with instrumental and physic chemical tests.	

TEACHING SCHEDULE (V Dean)			
Course Title :	Sensory Evaluation of Dairy Products	Course No	DT-609 (Practical)
Course Credit:	3 (2+1)	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Determination of threshold value for basic tastes.	
2.	Determination of threshold value for various odours.	
3.	Selection of sensory evaluation panel	
4.	Training of judges, for recognition of certain common flavour and texture defects.	
5.	Sensory evaluation of milk	
6.	Sensory evaluation of cream.	
7.	Sensory evaluation of butter and ghee.	
8.	Sensory evaluation or condensed and evaporated milk.	
9.	Sensory evaluation of milk powders.	
10.	Sensory evaluation of cheese and related products.	
11.	Sensory evaluation of frozen products.	
12.	Sensory evaluation of khoa and khoa-based sweets.	
13.	Sensory evaluation of chhana and chhana based sweets.	
14.	Sensory evaluation of dahi and fermented dairy products.	
15.	Preparation of milk and milk products with defects, techniques for simulation.	
16.	Novel techniques of sensory evaluation.	

Suggested Readings	
1	The sensory evaluation of Dairy Products. 2nd Edn by SE Clarke
2	Advances in judging of Dairy products. Souvenir NDRI
3	Lessons from E-Course by NDRI

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Food Technology I	Course No	DT-610 (Theory)
Course Credit:	3(2+1)	Semester	VI (V Dean)

Lecture No.	Topics	Date
1.	Status of food processing industries in India and abroad	
2.	Magnitude and inter- dependence of dairy and food industry, prospects for future growth in India	
3.	Harvesting of fruits and vegetables	
4.	Transportation and storage of fruits and vegetables	
5.	Post harvest processing of fruits and vegetables	
6.	Peeling, blanching and sizing of fruits and vegetables	
7.	Canning, Drying and Freezing of fruits and vegetables	
8.	Juice processing- General steps in juice processing	
9.	Role of enzymes in fruit	
10.	Juice extraction, equipments and methods of fruit juice extraction	
11.	Preservation of fruit juices and fruit juice clarification,	
12.	Concentration of fruit juices and fruit juice powders	
13.	Fruit juice processing ; Orange and tangerine, Lemon and lime juice ,Apple juice and Grape juice	
14.	Fruit juice processing ; Nectars, pulpy juices and tropical blends, Vegetable juices	
15.	Jam, Jelly and Marmalade	
16.	Role played by pectin , sugar & acid in jellied fruit products	
17.	Fruits and vegetable preserves and Glazed and Crystallized fruits	
18.	Tomato base products: Juice, puree and paste	
19.	Tomato base products: Sauce and Ketchup	
20.	Pickles: Definition, Principle and Technology of pickles	
21.	Beverages – Classification, scope, carbonated non-alcoholic beverages	
22.	Manufacture of carbonated non-alcoholic beverages	
23.	Fruit beverages and drinks, additives for fruit based beverages	
24.	Coffee: Production practices and structure of coffee/cherry. Coffee processing including roasting, grinding, brewing extraction, dehydration and aromatization	
25.	Instant coffee	
26.	Tea-Introduction and Types: green, red and yellow. Tea leaf processing	
27.	Technology of confectionery foods- a) Candies, b) Chewing gums and bubble gums	
28.	c) Toffees, Caramels and Standards of confectionery products	
29.	Chocolate products: Cocoa bean processing	
30.	Chocolate liquor and Standards of confectionery products	
31.	Functional foods: Introduction-Phytochemicals	
32.	Milk ingredients as nutraceuticals. Fiber-rich food products	

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Food Technology I	Course No	DT-610 (Practical)
Course Credit:	3 (2+1)	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Manufacture of toffees and caramels	
2.	Testing the efficacy of blanching process	
3.	Drying of fruits and vegetables	
4.	Preparation of fruit based drinks and beverages: Ready-to-servedrink	
5.	Preparation of fruit based drinks and beverages: Nectar	
6.	Preparation of fruit based drinks and beverages: Squash	
7.	Whey-fruit based beverages	
8.	Manufacture of fruit jam	
9.	Manufacture of fruit jelly	
10.	Manufacture of chocolate confections	
11.	Manufacture of tomato ketchup/tomato sauce	
12.	Manufacture of soups.	
13.	Manufacture of fruit preserve	
14.	Manufacture of candied fruits	
15.	Manufacture of fruit bar	
16.	Manufacture of pickles	

Suggested Readings	
1	Food Science 5thedn. By B. Srilaxmi.
2	Foods: Facts and Principles by ShakuntalaManey
3	Fcience by H. Potter and JH Hotchkiss
4	A textbook of Food Science and Technology 2ndEdn by Avantina Sharma
5	Food Science by Experiments and Application by MohiniSethi and Eram Rao.

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Dairy Plant Management	Course No	DT-811 (Theory)
Course Credit:	2 (1+1)	Semester	VIII (V Dean)

Lecture No.	Topics	Date
1.	Production management, definition, function and structure of production management	
2.	Production planning and control, work study and measurement of motion and time study	
3.	Efficiency of plant operation: product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency.	
4.	Plant Operations: Energy conservation and Auditing,	
5.	Product and process control, Control charts, Process Sigma	
6.	Efficiency factors losses, Financial and Managerial efficiency.	
7.	Provision for Industrial Legislation in India, particularly in dairy industry, Factory Act & Regulations.	
8.	Human Resource Management: Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies	
9.	Job specifications, Job evaluation,	
10.	Job enhancement, Job enrichment,	
11.	MBO, working conditions	
12.	Safety hazards: hazards prevention,	
13.	Security for plant machinery and the employees	
14.	Plant Maintenance.	
15.	Prevention & Break-down maintenance: Spare parts inventory, tools & lubricants, etc	
16.	Food hygiene: personnel hygiene, plant hygiene, water quality, etc.	

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Dairy Plant Management	Course No	DT-811 (Practical)
Course Credit:	2 (1+1)	Semester	VIII (V Dean)

Practical No.	Topics	Date
1.	Flow process charts of different milk products. – Heat desiccated and Acid coagulated products	
2.	Flow process charts of different milk products. – Heat desiccated and Acid coagulated products	
3.	Flow process charts of different milk products – Fermented dairy products	
4.	Flow process charts of different milk products – Fermented dairy products	
5.	Flow process charts of different milk products- Frozen dairy products	
6.	Flow process charts of different milk products- Frozen dairy products	
7.	Flow process charts of different milk products- Concentrated & Dried Dairy Products	
8.	Identification of steps of material losses on Dairy plants.	
9.	Identification of steps of material losses on Dairy plants. – Factors affecting losses	
10.	Identification of hazardous processes and equipment's, safety and precautions.	
11.	Identification of hazardous equipment's.	
12.	Important steps for safety and precautions in dairy Industry	
13.	Identification of common lubricants- Types of common lubricants	
14.	Uses of common lubricants.	
15.	Lubricants used in Dairy Industry.	
16.	Lubricants used in Dairy Industry.	

Suggested Readings	
	1. E-Course, NDRI, Karnal
	2. Dairy Plant Management by D. B. Puranik
	3. Dairy Plant Operations by J. David.
	4. Dairy Plant Engineering & Management bu Tufail Ahemad

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Waste Disposal & Pollution Abatement	Course No	DT-812 (Theory)
Course Credit:	2 (1+1)	Semester	VIII (V Dean)

Lecture No.	Topics	Date
1.	Wastes discharged from dairy plants: An overview	
2.	Wastewater discharged from a) Milk reception dock	
3.	b) Liquid milk processing section,	
4.	. c) Butter and ghee manufacturing	
5.	d) Ice-cream and condensed milk manufacturing	
6.	e) Milk powder manufacturing	
7.	f) Cheese and paneer manufacturing	
8.	Packaging wastes.	
9.	Environmental issues in effluent discharge:	
10.	a) Effects on waterways	
11.	b) Effects on land	
12.	c) Effects on the atmosphere	
13.	d) Solid waste	
14.	Waste treatment process in a dairy processing plant:	
15.	Wastewater treatment options for A Dairy Processing Plant	
16.	Calculation of wastes discharged and the economics thereof	

TEACHING SCHEDULE (V Dean)			
Course Title :	Waste Disposal & Pollution Abatement	Course No	DT-812 (Practical)
Course Credit:	2 (1+1)	Semester	VIII (V Dean)

Practical No.	Topics	Date
1.	Waste Utilization processes - Introduction	
2.	Waste Utilization processes – Techniques & Preventive measures	
3.	Various treatments in waste disposal – Aerobic methods	
4.	Various treatments in waste disposal – Liquid Waste treatment	
5.	Analysis of cleaning agents and sanitizers.- Analysis of Hardness of Water	
6.	Analysis of cleaning agents and sanitizers. – Alkalinity determination	
7.	Reports and records maintenance of dairy plant. – Types of Records	
8.	Reports and records maintenance of dairy plant. – Quotation &Purchase Process	
9.	Operational precautions.	
10.	CIP cleaning. – Various methods of CIP used in Dairy	
11.	Centralized CIP System - Introduction	
12.	CIP System : Process and Specifications	
13.	Waste Utilization processes - Introduction	
14.	Waste Utilization processes – Techniques & Preventive measures	
15.	Various treatments in waste disposal – Aerobic methods	
16.	Various treatments in waste disposal – Liquid Waste treatment	

Suggested Readings	
1	E-Course, NDRI, Karnal
2	Dairy Plant Management by D. B. Puranik
3	Sewage Disposal and Air Pollution Engineering- S. K. Garg, Khanna Publications
4	Dairy Plant Engineering & Management bu Tufail Ahemad

Department of Dairy Technology

TEACHING SCHEDULE (V Dean)			
Course Title :	Food Technology II	Course No	DT-813 (Theory)
Course Credit:	3(2+1)	Semester	VIII (V Dean)

Lecture No.	Topics	Date
1.	Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds,	
2.	Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds,	
3.	Milling of paddy, quality factors of rice grains, processing of rice bran oil,	
4.	Milling of paddy, quality factors of rice grains, processing of rice bran oil,	
5.	Instant rice, quick cooking rice, canned rice	
6.	Milling technology of wheat,	
7.	Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour,	
8.	Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour,\	
9.	Milling technology of maize, wet milling of corn,	
10.	Milling technology of barley, malting of barley	
11.	and its utilization in manufacture of value added food products including malted milk foods,	
12.	Dehulling and processing technology of important pulses,	
13.	Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut,	
14.	Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut,	
15.	Vegetable protein concentrates/isolates,	
16.	Utilization of oil cake in food formulation.	
17.	Bakery and Snack technology: Technology of bread, biscuits, crackers and cakes,	
18.	Technology of manufacturing process of Pasta foods- Macaroni, Noodles and Spaghetti,	
19.	Technology of manufacturing process of Pasta foods- Macaroni, Noodles and Spaghetti,	
20.	Technology of breakfast cereals: corn flakes, puffed, extruded snacks, Potato chips.	
21.	Meat, fish and egg technology: Development of meat, poultry, egg and fish industry in India	
22.	Meat, fish and egg technology: Development of meat, poultry, egg and fish industry in India	
23.	Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques,	
24.	Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques,	
25.	Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughter house sanitation,	
26.	Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughter house sanitation	
27.	meat hygiene and zoonotic diseases, Processing of poultry meat,	
28.	Egg and egg products – quality assessment of egg, Cleaning and sanitation,	
29.	Egg and egg products – quality assessment of egg,	

30.	Types, handling, transportation and marketing of fish, Preservation of fish.,	
31.	Cleaning and sanitation, Waste management of food processing plants.	
32.	Cleaning and sanitation, Waste management of food processing plants	

TEACHING SCHEDULE (V Dean)			
Course Title :	Food Technology II	Course No	DT-813 (Practical)
Course Credit:	3 (2+1)	Semester	VIII (V Dean)

Practical No.	Topics	Date
1.	Manufacture of barley malt	
2.	Determination of cooking quality of rice.	
3.	Manufacture of bread and bun.	
4.	Manufacture of biscuits.	
5.	Manufacture of biscuits.	
6.	Preparation of noodles.	
7.	Preparation of cake.	
8.	Manufacture of potato chips.	
9.	Preparation of malt based food products	
10.	Manufacture of malted milk foods	
11.	Manufacture of soy beverage and tofu	
12.	Manufacture of soy beverage and tofu	
13.	Preparation of salami	
14.	Manufacture of chicken pickle.	
15.	Manufacture of chicken pickle.	
16.	Manufacture of barley malt	

Suggested Readings	
1	e-Courses NDRI, Karnal
2	Outlines of Dairy Technology Sukumar De
3	Food Engineering and Dairy Technology H.G. Kessler
4	Modern Dairy Processing: Advances in Milk Processing R.K.Robinson
5	Technology of Indian milk products Aneja R.P., Mathur B.N., Chandan, R.C., and Banerjee, A.K.
6	Dairy Science and Technology Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts.
7	Dairy Technology: Dairy Products & Quality Control S. Singh

ANNEXURE No. II

List of Teaching / Lecture Schedule Practical Schedule

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Workshop Practice	Course No.	DE-101 (Theory)
Course Credit:	1+1 = 2	Semester	I (V Dean)

Lecture No.	Topics	Date
1.	Introduction to workshop practice, Safety, care and precautions in workshop	
2.	Introduction to Wood working tools and their use, Carpentry.	
3.	Pattern making, Mould material and their applications	
4.	Heat treatment processes: importance and types, hardening, tempering	
5.	Heat treatment processes : Annealing, normalizing	
6.	Metal cutting , Welding: Principle and types, gas welding	
7.	Important terms related to welding, Techniques of welding	
8.	Arc welding, Importance of Welding rod and its types	
9.	Smithy and forging operations: Smithy and forging tools and equipment	
10.	The bench: Flat surface filing, Chipping, Scraping Marking out, Drilling and Screwing.	
11.	Use of jigs and fixtures in production	
12.	Introduction to Lathe machine, Operation on lather machine, Types of lathe machine	
13.	Milling machine: types and operation	
14.	Introduction to Shaper and planer	
15.	Introduction to Drilling and boring machines	
16.	Introduction to Grinder, CNC machines	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Workshop Practice	Course No.	DE-101 (Practical)
Course Credit:	1+1 = 2	Semester	I (V Dean)

Practical No.	Topics	Date
1.	Safety and precautions in workshop, Study of commonly used tools in workshop	
2.	Study of Lathe machine.	
3.	Study of radial drilling machine.	
4.	Study of milling machine.	
5.	Study of different operations on lathe machine (Turning, Tapering, Finishing).	
6.	Study of different operations on lathe machine (Facing, Threading, Reducing).	
7.	Study of chisels.	
8.	Study of Bench grinder.	
9.	Study of arc welding.	
10.	Study of inert gas welding.	
11.	Simple exercises in Soldering and brazing,	
12.	Study of carpentry tools.	
13.	Study of Basic joints in carpentry.	
14.	Study of saws and its operations.	
15.	Simple exercises in Filing.	
16.	Study of different operations on wood lathe	

Suggested Readings	
	A course in Workshop Technology and Practice By B. S. Raghuwanshi
	Elements of Work Shop Technology Vol I By Hajra Chodhary
	Elements of Work Shop Technology Vol II By Hajra Chodhary
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Fluid Mechanics	Course No.	DE-102 (Theory)
Course Credit:	2+1 = 3	Semester	I (V Dean)

Lecture No.	Topics	Date
1.	Introduction to fluid mechanics, Units and dimensions, Properties of fluids	
2.	Static pressure of liquids	
3.	Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid	
4.	Pressure on vertical rectangular surfaces	
5.	Compressible and non compressible fluids	
6.	Surface tension, capillarity	
7.	Pressure measuring devices, simple, differential, micro manometer	
8.	Inclined manometer, mechanical gauges, Piezometer	
9.	Numerical on determination of pressure exerted by liquid column	
10.	Fluid flow: Classification, steady uniform and non uniform flow, Laminar and turbulent	
11.	Numerical on Laminar and turbulent flow	
12.	Continuity equation, Bernoulli's theorem and its applications.	
13.	Numerical on Bernoulli's theorem	
14.	Flow through pipes: Loss of head, determination of pipe diameter.	
15.	Numerical on Loss of head, determination of pipe diameter.	
16.	Determination of discharge, friction factor, critical velocity	
17.	Flow through orifices, mouthpieces, notches and weirs	
18.	Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank.	
19.	Numericals on hydraulic coefficients, discharge losses, Time for emptying a tank.	
20.	Loss of head due to contraction, enlargement at entrance and exit of pipe.	
21.	Numericals on Loss of head due to contraction, enlargement at entrance and exit of pipe	
22.	External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs	
23.	Venturimeters, pitot tube	
24.	Rota meter : working, constructional features, advantages and disadvantages	
25.	Water level point gauge, hook gauge.	
26.	Dimensional analysis: Buckingham's theorem application to fluid flow phenomena	
27.	Dimensionless number : Reynolds number, Froude number, Weber Number	
28.	Pumps : Classification, reciprocating, centrifugal pump and their introduction	
29.	Centrifugal pump: Working, Classification and design	
30.	Reciprocating Pump: Working, Classification and design	
31.	PUMP: Pressure variation, work efficiency. Types of chambers, selection and sizing.	
32.	Calculation of NPSH	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Fluid Mechanics	Course No.	DE-102 (Practical)
Course Credit:	2+1 = 3	Semester	I (V Dean)

Practical No.	Topics	Date
1.	Study of basic of fluid mechanics	
2.	Study of U –tube manometer	
3.	Study of pressure losses in pipe and fittings	
4.	Verification of Bernoulli's theorem	
5.	Determination of critical Reynold's number by Reynold's apparatus	
6.	Determination of discharge coefficient for venturi, Orifice, V-Notch	
7.	Study of Rotameter	
8.	Study of reciprocating pump	
9.	Study of centrifugal pump	
10.	Study of gear pump	
11.	Study of different types of valves	
12.	Numerical on Pressure exerted by liquid column	
13.	Numerical on continuity equation and capillarity	
14.	Numerical on Bernoulii;s theorem	
15.	Numerical on emptying time for a tank	
16.	Numerical on Venturimeter, orifice, weir	

Suggested Readings	
	Text book of Fluid Mechanics by R. S. Khurmi
	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Mechanics by R. S. Khurmi
	A Textbook of Fluid Mechanics and Hydraulic Machines by R.K. Bansal
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Engineering Drawing	Course No.	DE-103 (Practical)
Course Credit:	0+1 = 1	Semester	I (V Dean)

Practical No.	Topics	Date
1.	Introduction to engineering drawing and Tools used for engineering drawing, Drawing of lines and its types,	
2.	Drawing of lettering and dimensioning, types of lettering, types of dimensioning.	
3.	Drawing of scales: Plain scale, diagonal scale,	
4.	Drawing of scales: Comparative scale	
5.	Drawing of scales: Vernier scale	
6.	Projection, Types of Projection	
7.	Orthographic Projection (First quadrant drawing),	
8.	Orthographic Projection (Third quadrant drawing)	
9.	Perspective Projection	
10.	Drawing of screw threads; Types of threads and terminologies used in lit	
11.	Screw fastening: Types of nuts, types of bolts, stud,	
12.	Drawing of rivets and riveted joints forms of rivet heads, types of riveted	
13.	Drawing of keys, types of keys,	
14.	Drawing of cotter joint, pin joints, types of cotter joints, pin joints	
15.	Drawing of shaft bearings.	
16.	Journal bearings, pivot bearings, collar bearings	

Suggested Readings	
	Engineering Drawing By N. D. Bhatt
	Machine Drawing V. N. Panchal
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Thermodynamics	Course No.	DE-204 (Theory)
Course Credit:	1+1 = 2	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Importance and applications of thermodynamics in Dairy/Food processing.	
2.	Basic concepts: Thermodynamic systems, properties.	
3.	State, processes, cycles, energy.	
4.	The Zeroth Law of Thermodynamics.	
5.	Ideal gases: Equation of state, Compression and expansion of gases	
6.	The first Law of Thermodynamics: Internal energy, enthalpy.	
7.	Analysis of non-flow processes	
8.	Analysis flow processes.	
9.	The second Law of Thermodynamics: Thermodynamic.	
10.	Temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability.	
11.	Air Cycles: Otto, Diesel, dual cycles and their efficiencies.	
12.	Plotting the air cycles on p-V, T-S, p-h diagram etc.	
13.	I.C. Engines: Concepts, Classification.	
14.	Working of two stroke and four stroke cycle.	
15.	S.I. engines and C.I. engines.	
16.	Parts of I.C. engine, Performance of IC engines.	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Thermodynamics	Course No.	DE-204 (Practical)
Course Credit:	1+1 = 2	Semester	II (V Dean)

Practical No.	Topics	Date
1.	A visit to dairy/ food processing plant showing the thermodynamics applications/ devices.	
2.	Study of 2-stroke engines	
3.	Study of 4-strokes IC engines working	
4.	Study of S.I. engines working	
5.	Study of C.I. engines working	
6.	Study of multi-cylinder IC engine	
7.	Study of modern fuel injection systems of I.C. engines.	
8.	Study of diesel fuel supply system (pump and fuel injector) of I.C. engine.	
9.	Study of fuel supply system of a petrol engine	
10.	Study of cooling system of an I.C. engine (air cooling).	
11.	Study of cooling system of an I.C. engine (water cooling).	
12.	Study of lubrication system of I.C. engine.	
13.	Study of Solar water heater and appliances,	
14.	Study of solar lighting system	
15.	Study of biogas plants and appliances	
16.	Study of air compressor	

Suggested Readings	
	A Textbook of Thermal Engineering By R. S. Khurmi and J.K. Gupta
	Fundamentals of Engineering Thermodynamics By Dr. R. Yadav
	Engineering Thermodynamics by P. K. Nag 4th edition
	e course material

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Heat & Mass Transfer	Course No.	DE-205 (Theory)
Course Credit:	2+1 = 3	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Basic heat transfer process: thermal conductivity, convective film co-efficient	
2.	Stefan Boltzman's constant and equivalent radiation co-efficient	
3.	Overall heat transfer co-efficient, physical properties related to heat transfer.	
4.	Working principles and application of various instruments for measuring temperature.	
5.	One-dimensional steady state conduction	
6.	Theory of heat conduction	
7.	Fourier's law, Derivation of Fourier's equation in Cartesian coordinates	
8.	Study of Linear heat flow through slab and cylinder.	
9.	Study of Linear heat flow through sphere.	
10.	Cylinder and sphere with non-uniform thermal conductivity.	
11.	Concept of electrical analogy and its application for thermal circuits	
12.	Heat transfer through composite walls and insulated pipelines.	
13.	Heat transfer through insulated pipelines.	
14.	Steady-state heat conduction with heat dissipation to environment	
15.	Introduction to extended surfaces (FINS) of uniform area of cross-section.	
16.	Equation of temperature distribution with different boundary conditions	
17.	Effectiveness and efficiency of the FINS.	
18.	Introduction to unsteady state heat conduction.	
19.	Convection: Forced and free convection	
20.	Use of dimensional analysis for correlating variables affecting convection heat transfer	
21.	Concept of Nusselt number Prandtl number	
22.	Reynolds number, Grashoff number.	
23.	Some important empirical relations used for determination of heat transfer coefficient.	
24.	Heat Exchangers: General discussion, fouling factors,	
25.	Jacketed kettles, LMTD,	
26.	Parallel and counter flow heat exchangers,	
27.	Shell and tube and plate heat exchangers,	
28.	Heat exchanger design.	
29.	Application of different types of heat exchangers in dairy and food industry	
30.	Mass transfer: Fick's Law of diffusion	
31.	Steady state diffusion of gases and liquids through solids	
32.	Equimolal diffusion Mass transfer co-efficient and problems on mass transfer.	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Heat & Mass Transfer	Course No.	DE-205 (Practical)
Course Credit:	2+1 = 3	Semester	II (V Dean)

Practical No.	Topics	Date
1.	Determination of thermal conductivity: milk, solid dairy & food products.	
2.	Determination of overall heat transfer co-efficient of Shell and tube heat exchangers used in Dairy & Food Industry.	
3.	Determination of overall heat transfer co-efficient of plate heat exchangers used in Dairy & Food Industry.	
4.	Determination of overall heat transfer co-efficient of Jacketted kettle used in Dairy & Food Industry.	
5.	Studies on heat transfer through extended surfaces.	
6.	Studies on temperature distribution and heat transfer in HTST pasteurizer.	
7.	Design problems on heat exchangers.	
8.	Study of various types of heat exchangers.	
9.	Design problems on Mass Transfer Heat transfer in tubular heat exchanger	
10.	Cocurrent/ counter flow Heat transfer through composite wall.	
11.	Cocurrent/ counter flow Heat transfer through composite wall.	
12.	Heat transfer through lagged pipes.	
13.	Heat transfer through natural convection	
14.	Heat transfer through forced convection.	
15.	Determination of thermal conductivity of metal rod.	
16.	Study of heat transfer through pin/fin	

Suggested Readings	
	A Course in Heat and Mass Transfer By Arora and Domkundwar
	Heat and Mass Transfer by P. K. Nag
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Boiler & Steam Generation	Course No.	DE-206 (Theory)
Course Credit:	1+1 = 2	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Fuels: Chemical properties, Calorific value and its determination	
2.	Fuel Burners, Fuel combustion analysis.	
3.	Renewable energy sources: Concepts, classification, Types and description of renewable energy sources	
4.	Properties of steam: Properties of wet, dry saturated, superheated steam	
5.	Use of steam tables.	
6.	Use of Mollier charts.	
7.	Analysis of energy input in steam generation and heat gain in steam consumption.	
8.	Steam generators: Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters	
9.	Boiler mountings and Boiler accessories.	
10.	Layout of steam pipe-line and expansion joints	
11.	Introduction to Indian Boiler Regulation Act.	
12.	Boiler Draught: Definition, importance and classification of draught,	
13.	Natural and artificial draught,	
14.	Calculation of Height of chimney, Draught analysis.	
15.	Air Compressors: Definition, classification	
16.	Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Boiler & Steam Generation	Course No.	DE-206 (Practical)
Course Credit:	1+1 = 2	Semester	II (V Dean)

Practical No.	Topics	Date
1.	To study the steam generation process using p-h chart.	
2.	Study of steam and its various types.	
3.	To study different types of boilers with the help of Lab models: Babcock Wilcox boiler	
4.	To study different types of boilers with the help of Lab models: Cochran boiler	
5.	To study Boiler mountings.	
6.	To study Boiler Accessories	
7.	To study steam-line layout	
8.	Study of different types of steam traps.	
9.	Industrial exposure visit to plant with steam utilization.	
10.	Study of Fire tube low pressure boiler installed in a dairy processing plant.	
11.	Study of Fire tube low pressure boiler installed in a dairy processing plant.	
12.	Study of water softening plant installed with boiler in a dairy processing plant.	
13.	Numericals on calculation of height of chimney.	
14.	Numericals on air required for burning the fuel.	
15.	Numerical on determination of calorific value of fuel.	
16.	Determination calorific value of fuel by using bomb calorimeter.	

Suggested Readings	
	A Text Book of Thermal Engineering by R. S. Khurmi and J. K. Gupta
	Fundamentals of Engineering Thermodynamics by R. Yadav
	Engineering Thermodynamics by P. K. Nag 4th edition
	e course material

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Basic Electrical Engineering	Course No.	DE-207 (Theory)
Course Credit:	2+1 = 3	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Alternating current fundamentals.	
2.	Generation of alternating current or voltage magnitude of induced E.M.F.	
3.	Alternating current, R.M.S value and average value of an alternating current.	
4.	Phase relation and vector representation.	
5.	Cycle, Time period, Frequency, Amplitude, Phase and Phase Difference.	
6.	Root – Mean Square Value, Average value, Form Factor, Crest or Amplitude Factor.	
7.	Poly-phase Circuit: - Generation of Poly-phase Voltage, Phase Sequence.	
8.	Interconnection of Three Phases such as Star Connection and Delta Connection and their respective value of current and voltages.	
9.	Energy Measurement by using Single and Two Watt-meters.	
10.	Transformers: - Working Principle of Transformer.	
11.	Construction features of Core and Shell type transformer, Elementary theory of an Ideal Transformer.	
12.	E.M.F. Equation of a Transformer, Vector diagram of transformer with and without load.	
13.	Transformer losses, voltage regulation and efficiency of transformer.	
14.	Construction and working on a Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer.	
15.	Three Phase Induction Motor: - Fundamental working principles, Production of rotating magnetic fields, construction.	
16.	Different types of Rotor such as Squirrel Cage and Phase wound rotors, Starting of induction motors using Direct on Line (DOL) and Star-Delta Starter.	
17.	Soft starter and variable frequency drives.	
18.	Single Phase Induction Motors: - Introduction, Different types of single phase induction motors such as Split Phase.	
19.	Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion – induction motor.	
20.	DC Machine:- Construction and operation of DC generator, types of generators and their various characteristics.	
21.	DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter.	
22.	Alternators: - Elementary working principles, Different parts of an Alternators.	
23.	Relation between Speed and Frequency, E.M.F. equation in Alternators.	
24.	Different types of Circuit Breaker and its use. Introduction to DG set system.	
25.	Electric Power Economics: - Economics of Generation of electrical energy and related important terms such as, load curve, connected load, Maximum Demand.	
26.	Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor.	
27.	Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariff used for calculation of electricity bill.	
28.	Lighting system: Introduction to industrial lighting system.	
29.	Energy Management and Power Factor Corrections: - Types of energy.	
30.	Energy Management, Concept of Energy Audit.	
31.	Concept of Power Factor, Disadvantages of low power factor, Causes of low power factor.	
32.	Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement.	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Basic Electrical Engineering	Course No.	DE-207 (Practical)
Course Credit:	2+1 = 3	Semester	II (V Dean)

Practical No.	Topics	Date
1.	Introduction to various basic circuits of parallel wiring, stair case wiring, fluorescent light fitting.	
2.	Study of voltmeter and ammeter.	
3.	Study of energy meter.	
4.	Study of voltage and current relationship in case of Star connected load.	
5.	Study of voltage and current relationship in case of Delta connected load.	
6.	Measurement of power in 3-phase circuit; for a balanced load, using watt meters.	
7.	Measurement of power in 3-phase circuit; for a unbalanced load, using watt meters.	
8.	Measurement of iron losses of Single Phase transformer by conducting open circuit test.	
9.	Measurement of Copper losses of Single Phase transformer by conducting short circuit test.	
10.	Starting and reversing the speed of a single phase induction motor.	
11.	Starting and reversing the speed of a three phase induction motor using Direct on Line (DOL) Starter.	
12.	Starting and reversing the speed of a three phase induction motor using manual Star Delta Starter.	
13.	Starting and reversing the speed of a DC shunt motor using 3-point DC Starter.	
14.	Starting of slip-ring induction motor by manual and automatic Slip-ring Induction Motor Starter.	
15.	To determine the relation between induced armature voltage and speed of separately /self excited DC Shunt Generator.	
16.	Study of generator: construction and operation.	

Suggested Readings	
	A Text Book of Electrical Technology Vol I and Vol II by Theraja B.L.
	A Textbook of Electrical Engineering by Sanjiv Kumar
	e course material

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Refrigeration & Air Conditioning	Course No.	DE-308 (Theory)
Course Credit:	2+1 = 3	Semester	III (V Dean)

Lecture No.	Topics	Date
1.	Basic refrigeration cycles and concepts : Standard rating refrigerating machines	
2.	Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors	
3.	Theoretical vapour compression cycle, departure from actual vapour compression cycle, representation on T- and p-h diagrams	
4.	Comparison of working of refrigerator, heat pump and heat engine	
5.	Numerical on COP of refrigerator, heat engine and heat pump	
6.	Mathematical analysis of vapour compression refrigeration system	
7.	Refrigerants: Primary and secondary refrigerants, common refrigerants (Ammonia, Freon, HFC, HCFC etc), Brine,	
8.	Properties of refrigerants and comparison	
9.	Multi-pressure refrigeration system: applications	
10.	Multiple vapour compression refrigeration system: for different conditions	
11.	Multiple vapour compression refrigeration system: for different conditions	
12.	Multiple vapour compression refrigeration system: for different conditions	
13.	Numerical on multiple vapour compression refrigeration system	
14.	Multi evaporators with single stage and multi stage compression and expansion system: concept and applications	
15.	Multi evaporator vapour compression refrigeration system : its types	
16.	Multi evaporator vapour compression refrigeration system : its types	
17.	Numerical on multiple evaporator vapour compression refrigeration system	
18.	Working , control and mathematical analysis of above systems	
19.	Compressor: Working, Construction, types and cycle	
20.	Condenser: Working, Construction and types	
21.	Evaporator : Working, Construction and types	
22.	Expansion Valve: Working, Construction and types	
23.	Controls and Safety Devices as used in different refrigeration applications. Capacity control methods,	
24.	Refrigeration Piping: Purpose, Types, Materials, Fittings and Insulation.	
25.	Design and Balancing of Refrigeration System: Basic elements of design of individual components and a complete refrigeration system. Input and Output design parameters, Balancing of components of refrigeration system for optimum performance.	
26.	Absorption Refrigeration Systems: Simple vapour absorption refrigeration systems, Actual Vapour absorption refrigeration system, Refrigerant absorbent pairs, Absorption cycle analysis.	
27.	Cryogenic Freezing: Cryogenics, cryogens, properties, applications, cryogenic freezers.	
28.	Psychrometry: Definition, properties of moist air, psychrometric charts, psychrometric processes; Cooling/ Heating coils, humidifiers and dehumidifiers, Temperature and humidity measurements and controls.	
29.	Air-conditioning Systems: Types of cooling loads and their calculation, Design conditions for Human and Industrial air conditioning systems,	
30.	Analysis of different air-conditioning systems with the help of psychrometric chart.	
31.	Cold Storage: Types of cold storages, Types of cooling loads in cold storages used for food/ dairy products;	
32.	Construction and operation of cold storage. Insulating materials and vapour barriers.	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Refrigeration & Air Conditioning	Course No.	DE-308 (Practical)
Course Credit:	2+1 = 3	Semester	III (V Dean)

Practical No.	Topics	Date
1.	Study of different types of Refrigeration tools generally used in installation and maintenance of a refrigeration plant/ equipment including charging and leakage-detection tools.	
2.	Study of specification, components, operation, control, maintenance and precautions taken during working of a Domestic refrigerator.	
3.	Study of specifications, components, operation, control, maintenance and precautions taken during working of a Water cooler.	
4.	Study of specifications, components, operation, control, maintenance and precautions taken during working of a Bulk milk cooler.	
5.	Study of specifications, components, operation, control, maintenance and precautions taken during working of a Walk-in-cooler.	
6.	Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant.	
7.	Estimation of installed cooling capacity with the help of observed working pressures.	
8.	Study of specifications, components, operation, control and maintenance of Ice Bank Tank (IBT).	
9.	Study of specifications, components, operation, control and maintenance of a Cold Storage.	
10.	Study of the Evaporative Cooling Devices like Cooling Tower, Spray Pond, Air-Washer or Room air-cooler etc.	
11.	Study of the parts and components of different types of refrigerant compressors used in various refrigeration applications.	
12.	Study of different types of capacity control devices used with compressors in a refrigeration plant.	
13.	Experimental study of a simple refrigeration system on refrigeration tutor or an experimental set-up. (Comparison of actual and theoretical performance).	
14.	Experimental study of an year-round air-conditioning system on an air-conditioning tutor or an experimental set-up. Determination of SHF and By-pass factor etc.	
15.	Study and plotting of psychrometric processes using refrigeration/air-conditioning tutor Measurement of psychrometric properties using psychrometric meters/gadgets	
16.	Industrial exposure visit to refrigeration/air-conditioning plant.	

Suggested Readings	
	A Course in Refrigeration and air conditioning by Arora, S. C. and Domkundwar, S.
	Refrigeration and air conditioning by R.S. Khurmi
	Refrigeration and air conditioning by Prashad, M.
	Practical Manual on 'Refrigeration and Air Conditioning by S.S. Chopde
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Dairy Engineering	Course No.	DE-309 (Theory)
Course Credit:	2+1 = 3	Semester	III (V Dean)

Lecture No.	Topics	Date
1.	Introduction to course and its overview, importance of course considering B. Tech (DT) program, Material used for dairy equipment	
2.	Materials and sanitary features of the dairy equipment	
3.	Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets,	
4.	Installation, care and maintenance of pipes & fittings	
5.	Description, working and maintenance of can washers, bottle washers.	
6.	Factors affecting washing operations, power requirements of can the bottle washers	
7.	CIP cleaning and designing of system	
8.	Mechanical Separation: Fundamentals involved in separation and sedimentation,	
9.	Principles involved in filtration, Types, rates of filtration, pressure drop calculations	
10.	Gravity settling, principles of centrifugal separation,	
11.	Different types of Centrifuges and their application in dairy industry	
12.	Clarifiers, Tri Processors, Cream Separator, Cold and hot separator	
13.	Self-desludging centrifuge, Bacto-fuge, care and maintenance of separators and clarifiers	
14.	Homogenization: Classification, single stage and two stage homogenizer pumps, power requirement.	
15.	Homogenizer valves	
16.	Care and maintenance of homogenizers, Aseptic homogenizers	
17.	Pasteurization: Batch, flash and continuous (HTST) pasteurizers,	
18.	Heat regeneration concept and calculations	
19.	Flow diversion valve: Purpose and Types	
20.	Pasteurizer control, Care and maintenance of pasteurizers	
21.	Different type of sterilizers, in bottle sterilizers, autoclaves,	
22.	Continuous sterilization plant,	
23.	UHT sterilization	
24.	Aseptic packaging and equipment.	
25.	Care and maintenance of Sterilizers	
26.	Filling Operation: Principles and working of different types of bottle filters	
27.	Capping machine, pouch filling machine (Pre-pack) and aseptic filling bulk handling system, care and maintenance, Blow moulding machine,	
28.	Aseptic PET bottle filling machine, Cup filling system , care and maintenance	
29.	Mixing and agitation : Theory and purpose of mixing.	
30.	Equipments used for mixing solids, liquids and gases	
31.	Different types of stirrers, paddles and agitators, Power consumption of mixer-impeller	
32.	Selection of mixing equipment in dairy industry, mixing pumps	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Dairy Engineering	Course No.	DE-309 (Practical)
Course Credit:	2+1 = 3	Semester	III (V Dean)

Practical No.	Topics	Date
1.	Study of S. S. Pipes and fitting, milk filter, Gasket materials	
2.	Study and selection of Pump	
3.	Study of equipments at RMRD	
4.	Construction details, operation and maintenance of straight through Can washer	
5.	Milk tanker and milk storage tanks	
6.	Construction details, operation and maintenance of C.I.P. system	
7.	Construction details, operation and maintenance of Homogenizers	
8.	Construction details, operation and maintenance of Batch type pasteurizers	
9.	Construction details, operation and maintenance of Continuous type pasteurizers	
10.	Comparison of conventional and modern pasteurizer	
11.	Construction details, operation and maintenance of cream separator	
12.	Construction details, operation and maintenance of sterilization system	
13.	Construction details, operation and maintenance of Pouch filling machine	
14.	Construction details, operation and maintenance of types of agitators	
15.	Construction details, operation and maintenance of bottle filling an capping machine	
16.	Visit to a dairy processing plant	

Suggested Readings	
	Dairy Plant Engineering and Management By Tufail Ahamad
	Modern Dairy Technology Vol I and Vol II By R K Robinson
	Ultra-High Temperature Processing of Milk and milk Products By H. Burton
	Principles of Dairy Technology P. Walstra
	Unit operations of Chemical Engineering by McCabe, W., Smith, J. and Harriott, P.
	Handbook of Food Engineering Practice By Kenneth J. Valentas, Enrique Rotstein and R P Singh
	Food Engineering and Dairy Technology By H. G. Kessler
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Dairy Process Engineering	Course No.	DE-410 (Theory)
Course Credit:	2+1 = 3	Semester	IV (V Dean)

Lecture No.	Topics	Date
1.	Introduction to course and its overview, importance of course considering B. Tech (DT) program, Importance of evaporation and drying	
2.	Evaporation : Basic principles of evaporators, construction and operation	
3.	Different types of evaporators (Natural, forced, open, vaccum operated)	
4.	Different types of evaporators (Basket, rotary, horizontal, vertical, , plate type)	
5.	Different types of evaporators used in dairy industry (Rising film, falling film, single stage, multiple effect evaporator)	
6.	Calculation of heat transfer area	
7.	Water requirement of condensers	
8.	Multiple effect evaporator: Opeation and various feeding system, economy of operation boiling point elevation, steam consumption, Double and triple effect evaporator	
9.	Numericals on multiple effect evaporators	
10.	Thermo vapour compression	
11.	Mechanical vapour compression	
12.	Calculation of steam consumption in vacuum pan and double effect evaporators	
13.	Care and maintenance of evaporators	
14.	Types of Condensers	
15.	Drying : Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture,	
16.	Rate of drying- constant and falling rate, case hardening and effect of Shrinkage	
17.	Classification of dryers-spray and drum dryers, spray drying, etc.,	
18.	Air heating systems, Atomization and feeding systems	
19.	Factors affecting bulk density of powder,	
20.	Spray dryer controls	
21.	Theory of solid gas separation, cyclone separators, Bag Filters,	
22.	Care and Maintenance of drum and spray dryers	
23.	Numerical on drum and spray drying	
24.	Fluidization: Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity,	
25.	Fluidization bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers	
26.	Mechanization and equipment used in manufacture of indigenous dairy products	
27.	Mechanization and equipment used in manufacture of indigenous dairy products	
28.	Butter and Ghee making machine (Batch, semi-continuous and continuous)	
29.	Ice-cream and Cheese making equipments	
30.	Packaging machines for milk & milk products	
31.	Membrane Processing : Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction,	
32.	Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Dairy Process Engineering	Course No.	DE-410 (Practical)
Course Credit:	2+1 = 3	Semester	IV (V Dean)

Practical No.	Topics	Date
1.	Basic of evaporator and dehydration system	
2.	Construction details, operation and maintenance of Vacuum pan	
3.	Construction details, operation and maintenance of multiple effect evaporator	
4.	Study of construction and operation of : Double effect evaporator	
5.	Construction details, operation and maintenance of Spray dryer	
6.	Study of construction and operation of : Vacuum and atmospheric drum dryers	
7.	Construction details, operation and maintenance of Butter making equipments	
8.	Construction details, operation and maintenance of Ghee making equipments	
9.	Construction details, operation and maintenance of Ice-cream making equipments	
10.	Construction details, operation and maintenance of cheese making equipments	
11.	Construction details, operation and maintenance of Reverse Osmosis system	
12.	Construction details, operation and maintenance of Ultra filtration system	
13.	Design problems on Double effect evaporator and Vacuum pan	
14.	Design problems on Triple effect evaporator	
15.	Design problems on Vaccum pan	
16.	Visit to a milk product plant.	

Suggested Readings	
	Dairy Plant Engineering and Management By Tufail Ahamad
	Modern Dairy Technology Vol I and Vol II By R K Robinson
	Ultra-High Temperature Processing of Milk and milk Products By H. Burton
	Principles of Dairy Technology P. Walstra
	Unit operations of Chemical Engineering by McCabe, W., Smith, J. and Harriott, P.
	Handbook of Food Engineering Practice By Kenneth J. Valentas, Enrique Rotstein and R P Singh
	Food Engineering and Dairy Technology By H. G. Kessler
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Instrumentation and Process Control	Course No.	DE-511 (Theory)
Course Credit:	2+1 = 3	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	Basics of Instrumentation and process control and its application in the dairy and food industry	
2.	Instrumentation scheme & characteristics: Measurand Some basic discussion about electric field discussion about potential, capacitance, resistance etc	
3.	Definition of measurements, application and types of measurements Instrument classification,	
4.	Functional elements of an instrument standards calibration	
5.	Introduction to static characteristics –I class	
6.	Introduction to static characteristics- II	
7.	Introduction to dynamics characteristics	
8.	Selection of instruments, loading effects.	
9.	Dynamic characteristics of measurement systems.	
10.	Introduction to various types of sensors: Definition, principle of sensing & transduction modes	
11.	Classification, selection and applications of Sensors.	
12.	Measurement of parameter : Measurement of length ,angle, area , temperature ,	
13.	Measurement of parameter : Temperature	
14.	Measurement of parameter : Pressure class- I	
15.	Measurement of parameter : Pressure class- II	
16.	Measurement of parameter : Flow & speed	
17.	Measurement of parameter : force , torque, vibration , level ,	
18.	Measurement of parameter : Level	
19.	Measurement of parameter : Concentration (conductivity and ph) measurement	
20.	Flow measurement using magnetic flow measurement.	
21.	Piezoelectric transducer.	
22.	Micro-sensors: Construction, characteristics and applications	
23.	smart sensors: Construction, characteristics and applications	
24.	Electronic Instruments: Role and importance of general purpose test instruments, Electronic Millimeter, Cathode Ray Oscilloscope,	
25.	Measurement of amplitude, frequency and phase using CRO Advantages of digital meter over analog meters	
26.	Study of Digital voltmeter	
27.	Study of Resolution and sensitivity of digital meters	
28.	Study of Digital multimeter, Digital frequency meter	
29.	Introduction to the Signal generator	
30.	Introduction to the Display devices	
31.	Introduction to the Recorders like X-Y & X-T recorders	
32.	Automation: Introduction to plant automation, automation hierarchy, PLC, SCADA	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Instrumentation and Process Control	Course No.	DE-511 (Practical)
Course Credit:	2+1 = 3	Semester	V (V Dean)

Practical No.	Topics	Date
1.	Study of Strain gauge characteristics and weight measurement.	
2.	Measurement of pressure using bellows and diaphragm.	
3.	Preparation and calibration of thermocouple.	
4.	Study the construction and working of Bourden pressure gauge.	
5.	Test and calibration of pressure gauges using dead weight tester.	
6.	Study the mechanism of pH meter and its electrodes.	
7.	Study of Proximity sensor.	
8.	Study of the different parts and working of pressure switch.	
9.	Study of the different parts of an indicating instrument.	
10.	Study of RTD	
11.	Study of Thermister.	
12.	Study of different speed measurement sensor/ instruments.	
13.	Study of LVDT.	
14.	Study of level/flow controller.	
15.	Study of PLC.	
16.	Visit to a automatic controlled dairy plant.	

Suggested Readings	
	Fundamentals of Industrial Instrumentation and Process Control by William C. Dunn
	Process Control Instrumentation Technology by Curtis D. Johnson
	A course in Electrical and Electronic Measurements and Instrumentation By A. K. Sawhney
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Food Engineering	Course No.	DE-612 (Theory)
Course Credit:	2+1 = 3	Semester	VI (V Dean)

Lecture No.	Topics	Date
1.	Introduction to the food engineering and various unit operation in food industry	
2.	Introduction to concept of Rheology and its basics(Relation between force, deformation and time)	
3.	Rheology of processed food	
4.	Introduction to the Properties of fluid foods	
5.	Study of the various Rheological methods	
6.	Measurement of rheological parameters	
7.	Rheological Properties of granular food and properties of powders	
8.	Rheological Properties of solids foods	
9.	Rheological/Viscoelastic models.	
10.	Study of Kelvin model, Maxwell Model and Burger model	
11.	Measurement of food texture.	
12.	Introduction to the food freezing process and freezing curve	
13.	Thermal properties of frozen foods.	
14.	Predication of freezing rates & Plank's equation	
15.	Numerical on Plank's equation	
16.	Design of food freezing equipment (freezing rate, chamber size and total freezing time, capacity of refrigeration system etc.)	
17.	Design of Air blast freezers	
18.	Design of Plate freezers and spiral freezers	
19.	Design of immersion freezers and IQF,	
20.	Storage system of frozen foods.	
21.	Freeze concentration.	
22.	Introduction to Food dehydration and water activity, EMC, Moisture content on wet basis and dry basis and forms of water.	
23.	Estimation of drying time for food products	
24.	Constant rate period and falling rate period dehydration	
25.	Diffusion controlled falling rate period.	
26.	Use of heat and mass balanced in analysis of continuous dryers	
27.	Classification of driers, tray, vacuum, vacuum band, tunnel, bin, solar, drying, freeze drying, spin flash.	
28.	Freeze dehydration: Heat and mass transfer and Calculation of drying time	
29.	Freeze dehydration: Freezer dryer components and Industrial freeze drying	
30.	Study of food processing operations and equipments: Equipment for pulping, fruit juice extraction	
31.	Study of food processing operations and equipments: blanching, dehulling, size reduction,	
32.	Study of food processing operations and equipments: Milling, extrusion and distillation.	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Food Engineering	Course No.	DE-612 (Practical)
Course Credit:	2+1 = 3	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	To determine physical properties of food product.	
2.	To determine viscosity of food product.	
3.	To study batch food freezers.	
4.	To study continuous food freezers.	
5.	Study of designing of freezer.	
6.	To study tray dryer.	
7.	To study freeze dryer.	
8.	Numerical on food dehydration	
9.	To determine drying characteristics of food product.	
10.	To compare various drying methods.	
11.	To determination juice yield.	
12.	To compare hot water and steam blanching	
13.	To study construction and working of distillation system	
14.	To study various size reduction equipments.	
15.	Visit to cold storage.	
16.	Visit to food processing plant.	

Suggested Readings	
	Ultra-High Temperature Processing of Milk and milk Products By H. Burton
	Handbook of Food Engineering Practice By Kenneth J. Valentas, Enrique Rotstein and R P Singh
	Food Engineering and Dairy Technology By H. G. Kessler
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Material Strength & Dairy Machine Design	Course No.	DE-613 (Theory)
Course Credit:	2+1 = 3	Semester	VI (V Dean)

Lecture No.	Topics	Date
1.	Introduction to the Material Strength & Dairy Machine Design and its application dairy equipment designing	
2.	Introduction to Strength of Materials: Basic concepts in Statics and Dynamics.	
3.	Study of Force Systems.	
4.	Study of Equilibrium condition, friction and Law of friction.	
5.	Study of Second moments of inertia and Parallel axis theorem.	
6.	Numerical of Second moments of inertia and Parallel axis theorem.	
7.	Introduction to the Dynamics: Equation of motion.	
8.	Study of Translation and rotation of a Rigid body,	
9.	Introduction to the work and mechanics of materials	
10.	Study of Stress-Axial Load classification and Strain-Hooke's law	
11.	Study of stress-strain diagram	
12.	Study of Poisson's Ratio and Shearing Stresses	
13.	Study of Torsion, Torsion formula, Angle to Twist of circular members.	
14.	Numerical on torsion formula	
15.	Study of Power transmission, shear force and bending moments and Shear in Beams.	
16.	Study of Pure bending of beams, Flexural stress shearing stresses in beams relations between centre,	
17.	Torsional and flexural loads	
18.	Dairy Machine Design: Procedures	
19.	Dairy Machine Design: Specification and strength,	
20.	Dairy Machine Design: design factor, factor of safety selection of factor of safety.	
21.	Study of Materials selection.	
22.	Static strength, ductility, hardness, fatigue, designing for fatigue conditions.	
23.	Study of Properties of Static strength, ductility, hardness, fatigue, designing for fatigue conditions.	
24.	Theories of failure, Stresses in elementary machine parts,	
25.	Numerical on basics of mechanics (behaviour of material under stress)	
26.	Study of Design of a drive system.	
27.	Study of Design of length and thickness of belt.	
28.	Bearing: Journal and Anti-friction bearings.	
29.	Selection of ball, tapered roller and thrust bearing.	
30.	Study of Springs, helical and leaf springs.	
31.	Energy stored in springs.	
32.	Design and selection of springs.	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Material Strength & Dairy Machine Design	Course No.	DE-613 (Practical)
Course Credit:	2+1 = 3	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Design problems on applications of engineering statics and dynamics.	
2.	Design problems on applications of work and energy.	
3.	Design problems on applications of linear and angular momentum.	
4.	Design problems on stress-strain diagram evaluation of elastic constants.	
5.	Study on shear force and bending moment diagrams and its applications.	
6.	Design problems on applications of flexural stresses.	
7.	Design problems on applications of shearing stresses in beams.	
8.	Study on system of limits, fits and tolerances and their applications.	
9.	Design stresses in elementary machine parts.	
10.	Design features and applications of shafts.	
11.	Design features and applications of axles.	
12.	Design features and applications of keys.	
13.	Design features and applications of couplings.	
14.	Design problems on various types of power transmission systems.	
15.	Design features and applications of bearings. Design features and applications of springs.	
16.	Design problems on agitator/stirrer. Design features of milk silo.	

Suggested Readings	
	Principles of Dairy Machine Design by S. Ravi Kumar
	Machine Design By Dr. N. C. Pandya & Dr. C. S. Shah
	A Textbook of Machine Design by R.S. Khurmi
	Strength-of-material-by R K Bansal
	Engineering Mechanics of Solids By Egor P. Popov

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Dairy Plant Design and Layout	Course No.	DE-614 (Theory)
Course Credit:	1+1 = 2	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Introduction of Dairy Plant design and layout Type of dairies, perishable nature of milk, reception flexibility Classification of dairy plants	
2.	Study of Location of plant, location problems, selection of site.	
3.	Hygienic design considerations for dairy processing plants.	
4.	Planning: Dairy building planning and Process schedule	
5.	Study of factors affecting dairy layout	
6.	Importance of planning and principles of dairy layout	
7.	Study of Space requirements for dairy plants	
8.	Estimation of service requirements including peak load consideration.	
9.	Dairy plant design aspects: General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design.	
10.	Arrangement of different sections in dairy, sitting the process sections, utility/service sections, offices and workshop.	
11.	Arrangement of equipment, milk piping, material handling in dairies, Common problems, office layouts-flexibility.	
12.	Development and presentation of layout, model planning, use of planning table in developing plot plant and detailed layout	
13.	Building construction materials: Floors, general requirement of dairy floor finishes, floors for different section of dairy. Foundations, walls doors and windows.	
14.	Design aspects: Drains and drain layout for small and large dairies.	
15.	Study of building Ventilation, fly control, mold prevention, illumination in dairy plants	
16.	Computer aided Design: Introduction to CAD software.	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Dairy Plant Design and Layout	Course No.	DE-614 (Practical)
Course Credit:	1+1 = 2	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Building symbols and convention.	
2.	Symbols for equipments	
3.	Study of process schedule.	
4.	To draw layout of collection/chilling centre.	
5.	Visit to dairy processing plant for understanding of layout of different sections.	
6.	To draw layout of small dairy plant.	
7.	To draw layout of small dairy plant using CAD	
8.	To draw layout of medium dairy plant	
9.	To draw layout of large dairy plant	
10.	To draw layout of cheese plant.	
11.	To draw layout of ice-cream plant.	
12.	To draw layout of butter manufacturing unit.	
13.	To draw layout of ghee plant.	
14.	To draw layout of composite dairy plant	
15.	To determine the capacity of utility generating devices.	
16.	To determine the capacity of various basics dairy equipments for the given capacity	

Suggested Readings	
	Dairy Plant Design And Layout by Sunil M. Patel, A.G. Bhadania
	Textbook of Dairy Plant Layout and Design by Lalat Chander
	e course material

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Energy Conservation & Management	Course No.	DE-615 (Theory)
Course Credit:	1+1 = 2	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Introduction: Potential and opportunities of industrial energy conservation in dairy and food processing. Energy conservation Act 2001 and its important features, Schemes of Bureau of Energy Efficiency (BEE).	
2.	Electricity Act 2003, Integrated energy policy. Energy management & audit: Definition, energy audit, need, types of energy audit. Energy audit approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution. Energy balances and computation of efficiencies of equipment.	
3.	Role of Energy inspectors and Auditors in energy management.	
4.	Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques. Quality of power, Power factor and its improvement.	
5.	Transformers, losses in transformers. Energy savings in transformers.	
6.	Electric motor-selection and application, Energy efficient motors. Variable Speed Drives and Variable Frequency Drives (VFD) and their role in saving electric energy.	
7.	Bureau of Energy Efficiency (BEE): Power saving guide with "Star Ratings" of electrical appliances: Induction Motors, Air conditioners, Refrigerators and Water Heaters. Industrial Lighting: Quality of light, types of light sources, energy efficiency, Light controls.	
8.	High efficiency boilers, improved combustion techniques for energy conservation, Fluidized Bed Combustion and multi fuel capabilities.	
9.	Energy conservation in steam distribution systems, efficient piping layouts, protective & insulation coverings in utility pipes. Steam conservation opportunities. Upkeep and maintenance of steam auxiliaries and fittings.	
10.	. Energy conservation in Refrigeration and AC systems (HVAC), Cooling towers, Pumps and pumping systems, Fans, Blowers, Air compressors. Maintenance and upkeep of Vacuum lines and Compressed air pipe lines.	
11.	Conservation and reuse of water, water auditing. Energy conservation opportunities in Wastewater treatment.	
12.	Processing equipments: Improving efficiency and energy conservation opportunities in few important food processing operations like Thermal processes, Evaporation, Drying & Freezing. Role of steam traps in energy saving. Energy Savings methods in hot air generator, Thermic fluid heater, Steam radiator.	
13.	Energy conservation in buildings: Concepts of "Green Buildings". Waste-heat recovery and thermal energy storage in food processing facilities. Condensate recovery and reuse. Application of recuparator to recover energy from flue gases from boiler, DG exhaust, hot air from spray dryer, FBD etc.	
14.	Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets, Fuel and Oil conservation; important regular maintenance aspects.	
15.	Carbon credits and carbon trade: Concepts of CDM, economic and societal benefits.	
16.	Cleaner energy sources: Introduction to Solar, and Bio-mass Energy; Solar thermal and photo-voltaic energy options for food processing industries. Role of automation in conservation of energy in dairy and food processing: Incorporation of enhanced PLC based computer controls and SCADA.	

Department of Dairy Engineering

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Energy Conservation & Management	Course No.	DE-615 (Practical)
Course Credit:	1+1 = 2	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Study of Energy Conservation Act, 2001	
2.	Study of schemes of BEE	
3.	Study of concepts of Energy Balance in Unit Operations and System boundaries.	
4.	Solving examples on energy balances.	
5.	Solving problems on electrical energy	
6.	Use and management: Connected load, Maximum demand, Demand factor and Load curve.	
7.	Determination of Load factor of an installation.	
8.	Study of use of power factor meter and determination of true power and wattles power using pf meters, Watt meter, Ammeter and Volt meter.	
9.	Study of performances of a general type of induction motor and an energy efficient induction motor.	
10.	Study of use of VSD.	
11.	Study of various types of electrical appliances classified under different BEE Star Ratings.	
12.	Drawing Energy Balance on a boiler: Collection of data, Analysis of results and determination of efficiency.	
13.	Exercise on energy audit of Students Training Dairy Plant	
14.	Study on solar water heater	
15.	Study of Bio-gas plant.	
16.	Study of energy conservation in refrigeration system.	

Suggested Readings	
	Suggested Readings
	Energy Management and Conservation Handbook by Frank Kreith, D. Yogi Goswami
	Energy Conservation and Management by S. S. Thipse
	A Hand Book of Energy conservation and Management by Dr Hemant Pathak
	e course material

ANNEXURE No.III

List of Teaching / Lecture Schedule

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Biochemistry	Course No.	DC 101 (Theory)
Course Credit:	2 (1+1)	Semester	I (V Dean)

Lecture No.	Topics	Date
1	Structure, Classification and functions of Amino Acids	
2	Structure, Classification and functions of Proteins	
3	Structure, Classification and functions of Carbohydrates	
4	Structure, Classification and functions of Fats, Lipids	
5	Structure, Classification and functions of DNA	
6	Structure, Classification and functions of RNA	
7	Enzyme classification, Mechanism of enzyme action, factors affecting enzyme activity	
8	Activation energy, transition state energy, enzyme kinetics	
9	Enzyme Inhibition, Co-enzyme & Co-factors	
10	Isozyme & Regulatory enzymes, Ribozymes & Zymogens	
11	Immobilization of enzymes	
12	Glycolysis, Gluconeogensis	
13	TCA cycle, Pentose phosphate pathway	
14	Glycogen synthesis and Degradation, Fatty acid oxidation	
15	Urea cycle and transaminase reaction	
16	ATP and Electron transport chain	

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Biochemistry	Course No.	DC 101 (Practical)
Course Credit:	2 (1+1)	Semester	I (V Dean)

Practical No.	Topics	Date
1	Estimation of alkaline phosphatase by conversion of non-chromogenic substrate to a chromogenic substrate	
2	Effect of temperature on activity of alkaline phosphatase	
3	Effect of pH on activity of alkaline phosphatase	
4	Effect of inhibitors on activity of alkaline phosphatase	
5	Estimation of catalase by spectrophotometric method	
6	Effect of temperature on activity of catalase	
7	Effect of pH on activity of catalase	
8	Effect of inhibitors on activity of catalase	
9	Determination of MechalisMenten constant of an enzyme	
10	Estimation of RNA by colorimetric method	
11	Estimation of DNA by colorimetric method	
12	Estimation of Vitamin A in Ghee. Part A: Extraction of vitamin A in ghee	
13	Part B: preparation of standard Vitamin A and estimation of vitamin A in Ghee	
14	Estimation of Ascorbic acid in plasma	
15	Measurement of Proteolysis	
16	Measurement of lipolysis	

Suggested Readings	
	Biochemistry by- C. B. Powar and G. R. Chatwal
	Nutrition and Dietetics by Shubhangini A. Joshi
	Harper's illustrated Biochemistry by R. K. Murray, D. K. Granner, P. A. Mayes and V. W. Rodwell
	Lehninger Principles of Biochemistry by- Nelson and Cox
	Enzymes in Food Processing: Fundamental and Potential Applications by Panesar, Marwaha and Kuman
	Journal of Food Science volume 34 (1974)
	Advanced Human Nutrition by Denis M. Medeiros and Robert E. Wildman
	Wikipedia on Internet.

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Physical Chemistry of Milk	Course No.	DC 202 (Theory)
Course Credit:	3 (2+1)	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Definition and Composition of milk, Major and Minor constituents of milk	
2.	Collides: Classification of colloids on the basis of the physical state of dispersed phase and dispersion medium, Differences between the lyophyllic and lyophobic colloids, True and Colloidal Solutions	
3.	Milk as a colloidal system, Stability of the colloidal system in milk, Properties of colloidal system, Sedimentation and Coagulation of Colloidal System	
4.	Emulsions: Properties of Emulsions, Types of Emulsions, Functional Attributes of Food Emulsions, Physical Properties of Emulsions.	
5.	Gels: Definition and Types of Gels, Properties of Gels	
6.	Density and Specific Gravity: Definition, Difference Between the Density and Specific Gravity, Methods for the Determination of the Density and Specific Gravity of Milk	
7.	Factor affecting density and specific gravity of milk: Recknagel phenomenon	
8.	Liquid state: surface tension Definition and Concept of Surface Tension, Interfacial tension, Factors influencing surface tension determination of milk	
9.	Viscosity: Definition of Viscosity and its Units Types and Forms of Viscosity newtonian, and non-newtonian behavior of fluids, Stoke's Law	
10.	Viscosity of milk, Factors Influencing the Viscosity of Milk, Determination of Viscosity	
11.	Colligative properties of dilute solution: Concept and Definition	
12.	Colligative properties of dilute solutions: Raoult's Law, Lowering of Vapour Pressure	
13.	Colligative properties of dilute solutions: Boiling Point, Freezing Point	
14.	Electrolytes and non electrolytes , ionic mobility: Definition, Electrolytes Dissociation, Arrhenius Theory, Theory of Electrolytic Dissociation, Ionic Mobility	
15.	Kohlrawsch law, ostwald's dilution, Limitation of Ostwald's Dilution Law law and electric conductance of milk	
16.	Ionic equilibrium dissociation of ionic product of water: Dissociation of Water	
17.	pH and pOH scales: Definition, Comparison of the pH and pOH of acidity	
18.	Acid and Bases: Lewis concepts of acids, Lewis bases, Bronsted - Lowry Concept,	
19.	Dissociation constants of acids and bases, Dissociation Constant, Definition for Acids and Bases, Reaction of Acid and Bases with Water.	
20.	Acidity of milk: Titratable acidity and pH of milk, Types of Acidity, Methods of Determination of Acidity of Milk, Importance of Acidity of Milk	
21.	Salts and their hydrolysis: Definition of Salt, Hydrolysis of Salts, Neutralization, Types of Combinations for the Salt Formation	
22.	Buffers: Definition, types of buffer solutions, solutions of single substance of mixture, Importance of Buffers	
23.	Derivations of henderson and hasselbalch equation	
24.	Buffering capacity and buffering index	
25.	Electrolyte equilibrium and ph indicators	
26.	Oxidation reduction potential, Nernst equation and electrochemical cell	
27.	Redox system in milk	
28.	Nuclear chemistry, isotopes	
29.	Half life period of radio isotopes and measurement of radio activity	
30.	Occurrence of radio nuclides in milk products, Source of Radio Nuclides in Milk, Common Radio Nuclides Found in Milk, Distribution of radio-nuclides in milk and their half life	
31.	Spectrum of electromagnetic radiation: Classification of Electromagnetic Radiation, Electromagnetic Specturm, Lambert-Beer Law, Nuclear Magnetic Resonance	
32.	Visible and ultraviolet spectrophotomcter: Principle of Spectrophometers, Milk and Dairy Applications	

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Physical Chemistry of Milk	Course No.	DC 202 (Practical)
Course Credit:	3 (2+1)	Semester	II (V Dean)

Practical No.	Topics	Date
1.	Determination of density and specific gravity of milk using pycnometer, hydrometer and lactometer	
2.	Determination of density and specific gravity of milk using hydrometer and lactometer	
3.	Determination of viscosity of milk using Ostwald viscometer	
4.	Determination of surface tension of milk using Stalagmometer	
5.	Determination of Interfacial between water and oil phase	
6.	Determination of freezing point of milk	
7.	Preparation of buffer solution	
8.	Determination pH of buffer solution and milk electrometrically	
9.	Determination of acidity of milk titrimetrically	
10.	Determination of electrical conductance of milk	
11.	Determination of redox potential of milk	
12.	Coagulation of milk using electrolytes	
13.	Determination of refractive index of skim milk and whey	
14.	Titration of amino acid in the presence and absence of formaldehyde	
15.	Determination of pKa and pI value of amino acid (glycine)	
16.	Verification of Lambert Beer Law	

Suggested Readings	
	Principles of Physical chemistry by- Puri, Sharama and Pathania.
	Essential of Physical chemistry by BS Bhal, GD Tuli, and ArunBhal
	Principals of dairy chemistry by R. Jenness and S. Patton
	Physics, Chemistry of milk by- P. Walstra and R. Jenness
	A Text book of dairy chemistry by E. Ling
	Fundamentals of dairy chemistry by Web Jonson
	Fundamentals of dairy chemistry by – Wong
	Chemistry and testing of dairy products by- A.V. Atherton and J.A. Newlander

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Chemistry of Milk	Course No.	DC-203 (Theory)
Course Credit:	2+1 = 3	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Definition of milk	
2.	Structure of milk	
3.	Factors affecting composition of milk	
4.	Nomenclature and classification of milk proteins	
5.	Casein: Isolation and fractionation	
6.	Casein: Chemical composition,	
7.	Physicochemical properties of casein	
8.	Whey proteins: Preparation of total whey proteins: a-Lactalbumin and b-Lactoglobulin	
9.	Properties of a-Lactalbumin, b-lactoglobulin, bovine serum albumin	
10.	Properties of Immmunoglobulin , other minor milk proteins and non proteins nitrogen constituents of milk	
11.	Hydrolysis and denaturation of milk proteins under different physical and chemical environments	
12.	Estimation of milk proteins using different physical methods	
13.	Estimation of milk proteins using different chemical methods	
14.	Importance of genetic polymorphism of milk proteins	
15.	Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoperoxidase	
16.	Milk carbohydrates their status and importance	
17.	Physical properties of lactose	
18.	Chemical properties of lactose	
19.	Sugar amine condensation	
20.	Amadori rearrangement and production of hydroxyl methyl furfural (HMF)	
21.	Processing related degradation of lactose	
22.	Definition and general composition of milk lipids	
23.	Classification of milk lipids.	
24.	Nomenclature and general structure of glycerides,	
25.	Factors affecting the fatty acid composition	
26.	Milk phospholipids and their role in milk products	
27.	Unsaponifiable matter	
28.	Fat soluble vitamins	
29.	Milk Salts: Mineral in milk (a) major mineral (b) Trace elements	
30.	Physical equilibria among the milk salts	
31.	Milk contact surfaces	
32.	Metallic contamination	

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Chemistry of Milk	Course No.	DC-203 (Practical)
Course Credit:	2+1 = 3	Semester	II (V Dean)

Practical No.	Topics	Date
1.	Sampling Techniques for Chemical Examination of Milk	
2.	Determination of Fat in Milk by volumetric method	
3.	Determination of Total Solids (TS) And Solid-Not-Fat (SNF) in Milk by Formula	
4.	Estimation of Calcium in Milk	
5.	Determination of Total Ash Content in Milk	
6.	Determination of Chloride Content in Milk	
7.	Determination of Acidity and *pH* in Milk	
8.	Determination of Lactose Content in Milk	
9.	Estimation of Protein Content in Milk	
10.	Determination of Temporary and Permanent Hardness of Water	
11.	Determination of Fat in Milk by Gravimetric Method (Mojonnier and Rose Gottlieb).	
12.	Determination of the Percentage of Available Chlorine Present in Bleaching Powder	
13.	Nitrogen fractionation of milk by Rowland's analytical scheme	
14.	Estimation of Total Phosphorous Content in Milk	
15.	Estimation of Alkaline Phosphatase Activity in Milk (Aschaffenburg and Mullen's Method)	
16.	Determination of Lipase Activity in Milk	

Suggested Readings	
1.	Fundamentals of Dairy Chemistry by Webbs, Johnson and Alford.
2.	Principles of Dairy Chemistry by R. Jenness and S. Patton.
3.	Dairy chemistry By Richmond
4.	Milk hygiene, WHO, Monograph 4 (48)
5.	Nomenclature of milk proteins (4 and 5th Revision, J. Dairy Sci., 67 (1984)
6.	Advances in milk proteins by P. F. Fox, Vol.4.
7.	Dairy Science and Technology Handbook Edited by Y. H. Hui,
8.	Chemistry of milk and milk products by A. H. Verman and J.P. Sutherland
9.	Cleaning and Sanitization of bottles and other glass containers by J.C.L. Resuggan.
10.	Laboratory control of Dairy Plant by J.C. Davis.
11.	Text Book of Dairy Chemistry by E. R. Ling (Book is not Available in library).
12.	Fundamentals of Dairy chemistry by Wong , Nobel, P. Jenness ,Robert Keeney, Marth, Elaner,H
13.	Practical Dairy chemistry by Ling.
14.	Text Book of practical Dairy Chemistry by N. K. Ray and D .C. Sen
15.	Water supply and sanitary Engineering, Environmental Engineering by Rangawala.
16.	Development in Dairy Chemistry Vol.4 by P. F. Fox.
17	e-course NAIP, ICAR

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Human Nutrition	Course No.	DC-304(Theory)
Course Credit:	1+1 = 2	Semester	III (V Dean)

Lecture No.	Topics	Date
1.	Fundamentals of human nutrition	
2.	Concept of balanced diet and nutrient requirements of different age groups.	
3.	Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk.	
4.	Biochemical composition and energy value of foods with special reference to milk and dairy products.	
5.	Role of Nutrients, Assimilation	
6.	Digestion and absorption	
7.	Vitamins: Fat soluble Vitamins (structure and function)	
8.	Vitamins: Water soluble Vitamins (structure and function)	
9.	Hormones (structure and function)	
10.	Milk intolerance and hypersensitivity	
11.	Safety aspects of food additives	
12.	Toxic elements, antibiotics	
13.	Antioxidants, Radionuclide's in milk and milk products	
14.	Nutraceutical, probiotics and cultured dairy products	
15.	Food toxins, anti-nutritional factors	
16.	Biochemical aspect of post-harvest storage specifically food spoilage	

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Human Nutrition	Course No.	DC-304 (Practical)
Course Credit:	1+1 = 2	Semester	III (V Dean)

Practical No.	Topics	Date
1.	Estimation of serum Protein (Biuret method /Lowry method).	
2.	Estimation of Blood Glucose (Folin Wu method).	
3.	Estimation of Serum inorganic phosphorus (Fiske and SubbaRow method).	
4.	Estimation of blood creatinine levels.	
5.	Estimation of blood triglyceride levels.	
6.	Estimation of blood cholesterol levels.	
7.	Estimation of calorific value of food items.	
8.	Diet and nutrition surveys: (a) Identification of vulnerable and risk groups (b) Diet survey for breast-feeding and weaning practices of specific groups.	
9.	(c) Use of anthropometric measurement in children.	
10.	Preparation of visual aids for nutritional disorders.	
11.	Field visit to (a) Observe the working of nutrition and health oriented programmes (survey based result).	
12.	Field visit to (b) Hospitals to observe nutritional deficiencies.	
13.	Identification of Mono, Di and Polysaccharides.	
14.	Identification of Proteins (albumin, gelatin, peptone).	
15.	Planning and preparation of high protein, low fat and specialized diets.	
16.	Detection of antibiotic/toxin in food products	

Suggested Readings	
1.	Principles of biochemistry. Leninger, A. L., Nelson, D. L., & Cox, M. M. Worth, USA.
2.	The tools of biochemistry. Cooper, T. G., & Cooper, T. G.
3.	Fundamentals of Nutrition by Loroyd Mc Donald, Cremton, W.H., Freeman and Co (LMC)
4.	Essentials of Nutrition by M. Swaminathan, Ganesh and Co Karnataka.
5.	Annual bulletin: Nutritive value of milk and D. Products, part II (Bull.)
6.	Vitamins in milk and milk products by Hartman and Drylen(H D).
7.	Food Nutrition Diet Therapy by Krause and Mahan W.B. Saunders Co. New York.
8.	Nutrition and Food Science by Santos, Lopes, Bardosa, Chaves, Plenum press New York.
9.	Nutrition and Dietics by Shubhangini Joshi.
10.	Advance Text Book on food and Nutrition, Vol. II Applied aspects Bangalore printing and Pub. Co Mysore.
11.	Hand book of Food and Nutrition by M. Swaminathan, Bangalore printing pub. Co. Mysore.
12.	Fundamentals of Biochemistry by Deb, A.C., New Central book Agency Colkata.
13.	Encyclopedia of Food Science, Food Technology and Nutrition, Vol.4.

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Chemistry of Dairy Products	Course No.	DC-405 (Theory)
Course Credit:	2+1 = 3	Semester	IV (V Dean)

Lecture No.	Topics	Date
1.	Chemical composition of milk products.	
2.	Legal standards of milk products.	
3.	Chemistry of creaming and factors affecting the same.	
4.	Ripening and neutralization of cream.	
5.	Theories of churning and factors affecting the churning	
6.	Butter colour.	
7.	Ghee: Physico-chemical changes during manufacture.	
8.	Physico-chemical constant of milk fat	
9.	Hydrolytic deterioration of milk lipids, their causes, prevention	
10.	Oxidative deterioration of milk lipids, their causes, prevention	
11.	Role of antioxidants.	
12.	Physico-chemical changes in milk constituents during manufacture of traditional dairy products: Khoa,	
13.	Physico-chemical changes in milk constituents during storage of traditional dairy products: Khoa and khoa based sweets.	
14.	Physico-chemical changes in milk constituents during manufacture of traditional dairy products: Paneer and Channa,	
15.	Physico-chemical changes in milk constituents during storage of traditional dairy products: Paneer and Channa	
16.	Physico-chemical changes in milk constituents during manufacture of traditional dairy products: Dahi and Lassi,	
17.	Physico-chemical changes in milk constituents during storage of traditional dairy products: Dahi and Lassi,	
18.	Physico-chemical changes in milk constituents during manufacture of traditional dairy products: Chakka and Shrikhand	
19.	Physico-chemical changes in milk constituents during storage of traditional dairy products: Chakka and Shrikhand	
20.	Physico-chemical changes during preparation of cheese	
21.	Milk clotting enzymes	
22.	Enzymatic coagulation of milk	
23.	Biochemical changes during ripening	
24.	Heat stability of milk	
25.	Physico-chemical changes during preparation of concentrated (SCM and Evaporated milk) milk products	
26.	Physico-chemical changes during storage of concentrated (SCM and Evaporated milk) milk products	
27.	Physico-chemical changes during preparation of dried milk products	
28.	Physico-chemical changes during storage of dried milk products	
29.	Physico-chemical changes during processing of ice cream and frozen desserts	
30.	Physico-chemical changes during storage of ice cream and frozen desserts	
31.	Role of stabilizers and emulsifiers in ice cream	
32.	Mechanism of stabilizers and emulsifiers in ice cream	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Chemistry of Dairy Products	Course No.	DC-405 (Practical)
Course Credit:	2+1 = 3	Semester	IV (V Dean)

Practical No.	Topics	Date
1.	Estimation of fat and acidityof Cream.	
2.	Estimation of fat and moisture content in Butter	
3.	Estimation of curd and salt content of Butter	
4.	Estimation of moisture, acid value and Butyro-refractive reading of Ghee	
5.	Estimation of Reichert Meissl value and Polenske value of Ghee	
6.	Determination of lactose in sweetened condensed milk.	
7.	Determination of sucrose in sweetened condensed milk.	
8.	Estimation of moisture and fat content of Milk powder	
9.	Estimation of acidity and ash content of Milk powder	
10.	Estimation of solubility and bulk density of Milk powder	
11.	Estimation of fat and total solids of Ice cream	
12.	Estimation of moisture, fat and salt content in cheese.	
13.	Estimation of moisture and fat content of Khoa.	
14.	Estimation of moisture and fat content in paneer and channa .	
15.	Estimation of protein content in milk products using Kjeldahl method.	
16.	Estimation of protein content in protein rich dairy products using Kjeldahl method.	

Suggested Readings	
1.	Principles of dairy chemistry by R. Jenness and S. Patton
2.	Physics, Chemistry of milk by- P. Walstra and R. Jenness
3.	A Text book of dairy chemistry by E. Ling
4.	Fundamentals of dairy chemistry by Web Jonson
5.	Fundamentals of dairy chemistry by – Wong
6.	Chemistry and testing of dairy products by- A.V. Atherton and J.A. Newlander
7.	Buffalo milk chemistry and Technology by Deepak Sahai
8.	Milk and Dairy Products as Functional Foods. A. Kanekanian. John Wiley & Sons, Ltd.,UK
9.	Milk Processing and Quality Management. Adnan Y. Tamime. Blackwell Publishing Ltd., UK
10.	Dairy Science and Technology, Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts., 2nd Ed. CRC Press, Boca Raton, FL, USA
11.	Outlines of Dairy Technology. Sukumar De. Oxford University Press, New Delhi
12.	Dairy Science and Technology Handbook, Vol. I, II and III. Y.H. Hui. 1993. Wiley-VCH, USA.
13.	Textbook of dairy chemistry, by M. P. Mathur
14.	Cheese and Fermented milk foods, Frank Kosikowski
15.	Condensed and dried dairy products, Marijana and Caric
16.	Milk and Milk products technology, Edger and Speer
17	Dairy Chemistry and Biochemistry, by P. F. Fox

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Chemical Quality Assurance	Course No.	DC- 506(Theory)
Course Credit:	2+1 = 3	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	Importance of chemical quality control	
2.	Importance of quality assurance	
3.	Importance of total quality management	
4.	Importance of total quality management in dairy industry	
5.	Role of national food regulatory systems and standards with respect to quality of milk and milk products: FSSAI and PFA	
6.	Role of national food regulatory systems and standards with respect to safety of milk and milk products: AGMARK and BIS	
7.	Role of international food regulatory systems and standards with respect to quality of milk and milk products: ISO	
8.	Role of international food regulatory systems and standards with respect to safety of milk and milk products: IDF and Codex, etc.	
9.	Application of food safety management system (ISO: 22000) Part I	
10.	Application of food safety management system (ISO: 22000) Part II	
11.	Hazard analysis and critical control points (HACCP) system	
12.	Hazard analysis and critical control points (HACCP) system application in dairy industry with respect to chemical quality.	
13.	Setting up quality control laboratories and testing facilities	
14.	Mobile testing laboratories.	
15.	Accreditation of analytical laboratories.	
16.	Preparation and standardization of reagents required in the analysis of milk and milk products. Part I	
17.	Preparation and standardization of reagents required in the analysis of milk and milk products. Part II	
18.	Preparation and standardization of reagents required in the analysis of milk and milk products. Part III	
19.	Sampling procedures	
20.	Sampling and labeling of samples for analysis	
21.	Choice of analytical tests for milk and milk products for chemical analysis and instrumental methods of analysis.	
22.	Calibration of dairy glassware Butyrometer, pipettes,	
23.	Calibration of dairy glassware hydrometers, lactometers	
24.	Calibration of dairy burettes, Freezing point thermometer	
25.	Testing methods for the detection of adulterants in milk and milk products.	
26.	Testing methods for the detection of preservatives in milk and milk products.	
27.	Testing methods for the detection of neutralizers in milk and milk products.	
28.	Environmental contaminants such as pesticides, antibiotics	
29.	Environmental contaminants such as heavy metals in dairy products	
30.	Importance of milk contact surfaces, metallic contamination in dairy industry	
31.	Chemical quality of water in dairy industry.	
32.	Prediction of shelf life behavior of milk and milk products.	

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Chemical Quality Assurance	Course No.	DC-506(Practical)
Course Credit:	2+1 = 3	Semester	V (V Dean)

Practical No.	Topics	Date
1.	Calibration of Pipette and Burette	
2.	Calibration of Volumetric Flasks and Hydrometer	
3.	Calibration of Butyrometer and Thermometer	
4.	Preparation and standardization of Sulphuric acid (H_2S0_4) and Hydrochloric acid (HCL)	
5.	Preparation and standardization of Sodium Hydroxide (NaOH) and Sodium Thiosulphate ($Na_2S_2O_3$)	
6.	Preparation and standardization of Silver Nitrate ($AgN0_3$) and EDTA solution	
7.	Preparation and standardization of Fehling's solution	
8.	Preparation and testing of Gerber H_2S0_4 used in fat determination	
9.	Testing the Amyl Alcohol used for fat determination.	
10.	Chemical analysis of permissible additives used in milk and dairy products	
11.	Chemical analysis of detergents and sanitizers	
12.	Detection of adulterants, preservatives, and neutralizers in milk and milk products.	
13.	Detection of vegetable oils and animal body fat adulteration in ghee.	
14.	Analysis of market samples of milk and milk products.	
15.	Determination of temporary and permanent hardness of water	
16.	Estimation of available chlorine from bleaching powder	

Suggested Readings	
	Quality Assurance Monograph
	E-Course NAIP-ICAR
	Laboratory Manual : Methods of analysis of Milk & Milk products by Milk Industry
	Prevention of food adulteration act 1955.
	ISI hand book of food Analysis, BIS :oo18 (Part II) Dairy Products (1981)
	The fluid milk Industry by Henderson
	Milk Hygiene : WHO Monograph series 48
	Chemical Analysis of food & food Products by MB Jacob
	Chemistry and testing of Dairy products by AVA Atherton and JN New land
	ISI Specification.
	Quality Control in the food Industry by SM Henderson.

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Food Chemistry	Course No.	DC- 607 (Theory)
Course Credit:	2+1 = 3	Semester	VI (V Dean)

Lecture No.	Topics	Date
1.	Water: Water binding	
2.	Chemical reactions mediated by water	
3.	Food proteins: classification and physico-chemical properties	
4.	Food proteins: Structural properties	
5.	Definition and classification of lipids	
6.	Lipids-reaction involved during deep frying of foods	
7.	Unsaponifiable matter:classification and chemical composition	
8.	Unsaponifiable matter contents in various fats and oils	
9.	Carbohydrates: Classification of carbohydrates	
10.	Carbohydrates: polysaccharides, viz. linear, branched and modified	
11.	Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicelluloses, pectin.	
12.	Food Enzymes: Hydrolases and lipases	
13.	Utilization of food enzymes in food chemistry	
14.	Minerals in foods: Main elements, trace elements in eggs, cereals and cereal products	
15.	Minerals in foods: Main elements, trace elements in vegetables and fruits.	
16.	Aroma compounds in foods: Threshold value and off-flavours.	
17.	Food additives: Vitamins, Amino acids and Minerals,	
18.	Aroma Substances/flavour enhancers- Monosodium glutamate, 5-nucleotides sugar	
19.	Sugar substitutes	
20.	Sorbitol sweeteners- saccharin, and cyclamate	
21.	Food colours	
22.	Food preservatives	
23.	Antinutritional factors and Food contaminants: Toxic trace elements	
24.	Antinutritional factors and Food contaminants: Radio nucleotides.	
25.	Cereal and cereal products: Individual constituents like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making	
26.	Dough making: Physico-chemical changes during dough making Chemical composition, influence of additives on baking properties	
27.	Legumes: Classification, composition and physico-chemical properties	
28.	Vegetables and fruits: classification, general properties	
29.	Chemical changes during ripening and storage	
30.	Jams and Jellies: Classification, composition and preservation	
31.	Pickles: Classification, composition and preservation	
32.	Preservation of foods, general principal of food preservation	

Department of Dairy Chemistry

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Food Chemistry	Course No.	DC-607 (Practical)
Course Credit:	2 +1 = 3	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Determination of moisture and acidity in flour.	
2.	Determination of gluten content in flour	
3.	Determination of total ash and acid insoluble ash in flour.	
4.	Determination of starch in flour	
5.	Determination of total nitrogen in cereal products- Part 1	
6.	Determination of total nitrogen in cereal products- Part 2	
7.	Determination of acidity and vitamin C in citrus fruits.	
8.	Analysis of tomato ketchup for total solids and acidity	
9.	Analysis of tomato ketchup for ash and salt content	
10.	Determination of total sugar in tomato ketchup.	
11.	Determination of total ash and alkalinity of soluble ash in tea.	
12.	Determination of water extractive in tea leaves.	
13.	Determination of presence of Chicory incoffee powder.	
14.	Determination of reducing sugars in Jam- Part 1	
15.	Determination of reducing sugars in Jam- Part 2	
16.	Determination of iron in infant foods.	

Suggested Readings	
1.	Food Chemistry by L.H. Mayer Acc.No. 2680
2.	Foods facts and principal By N.S.Manay and M. Shalaksharaswamy Acc. No. 2595
3.	Food Chemistry by Belitz and GroschAcc.No. 1546
4.	Food Chemistry by O.R.Fenema.(Book not available in library)
5.	E-Course NAIP-ICAR
6.	Technology of food preservation by Norman W. Desrosier
7.	Food Science by Norman Potter
8.	Chemical changes in food during processing by Richardson and Finley
9.	Food toxicology by Taylor and Scanlan
10.	Food proteins by P.F.Fox
11.	Protein structure-function relationship in foods by Yada, Jackman and Smith
12.	New methods of food preservation by G.W. Gould
13.	Food oils and fats by Harry Lawson
14.	Lipid oxidation in food by Allan L. Anjielo

ANNEXURE No. IV

List of Teaching / Lecture Schedule Practical Schedule

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Fundamentals of Microbiology	Course No	DM-101 (Theory)
Course Credit:	3 (2+1)	Semester	I (V Dean)

Lecture No.	Topics	Date
1.	Microbiology: history and scope	
2.	Discovery of Microorganisms & Discovery of Microscopy	
3.	Types, working principles of microscope and Applications of microscope & Theories of Biogenesis and abiogenesis	
4.	Contributions of Contributions of Leeuwenhoek and Pasteur, Tyndal, Joseph Lister and Robert Koch,	
5.	Contributions of Koch, Edward Jenner and Alexander Fleming Leeuwenhock,	
6.	Scope and application of microbiology in fields like Dairy and Food, Pharmaceutical and Industrial, Medical and agriculture	
7.	Classification of Microbes: Microbial classification systems and numerical taxonomy.	
8.	General properties and principles of microbial classification	
9.	Whittaker's five kingdom and Carl Woese's three domain classification system, Systematic of bacteria and Bergey's manual of systematic bacteriology, Phylogenetic tree	
10.	Procaryotic and Eucaryotic microorganisms:	
11.	Structure and functions of prokaryotic cells; Differences between prokaryotes and eukaryotes	
12.	Differences between cell wall of Gram positive and Gram negative bacteria, Structure of Archeal cell wall.	
13.	Microbial growth and nutrition: Bacterial growth curve;	
14.	Factors affecting growth of bacteria,	
15.	Direct and indirect methods of measurement of bacterial growth;	
16.	Common nutrient requirements and nutritional types of microorganisms.	
17.	Diversity of Microorganisms: Viruses: Structure and Classification;	
18.	Bacteriophages; Differences between viruses and bacteria;	
19.	Fungi: Classification of Fungi; Reproduction in Fungi; Protozoa and algae.	
20.	Microbial Ecology and Environmental Microbiology:	
21.	Microflora of air	
22.	Microflora soil and water	
23.	Microbes of Extreme environment like Archea.	
24.	Basics of Microbial Genetics and Host-Microbe interactions:	
25.	DNA as the genetic material, Structure of DNA	
26.	Structure of DNA	
27.	DNA replication	
28.	Transcription	
29.	Translation	
30.	Basic concepts of immunology	
31.	Role of immune system in governing host-microbe interactions	
32.	Microbial Commensalism, Colonization, Infection, Disease and Vaccines	

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Fundamentals of Microbiology	Course No	DM-101 (Practical)
Course Credit:	3 (2+1)	Semester	I (V Dean)

Practical No.	Topics	Date
1.	General instruction for microbiological laboratory.	
2.	To study microscope- simple and compound;	
3.	Microbiological equipments; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter	
4.	To perform simple staining	
5.	To perform negative staining	
6.	To perform differential staining (Gram).	
7.	To perform differential staining (spore and acid fast).	
8.	To study motility of microorganisms - hanging drop technique.	
9.	Measurement of size of microorganisms by micrometry (ocular and stage).	
10.	Preparation of commonly used growth liquid media & solid media	
11.	Preparation of commonly used growth differential media	
12.	Isolation techniques for microorganisms – Streak plate methods	
13.	Isolation techniques for microorganisms – Pour plate methods	
14.	Enumeration of micoorganisms in air	
15.	Enumeration of microorganisms in soil.	
16.	Enumeration of microorganisms in water: total viable count & coliform (MPN).	

Suggested Readings	
	Dairy Bacteriology – Hammer
	Microbiology- Prescott LM, Harley JP & Klein DA.
	Microbiology: An Introduction- Tortora GJ, Berdell RF & Christine L Case.
	Microbiology- M. P. Arora
	Microbial Physiology and Metabolism- Caldwell DR..
	Experiments in Applied Microbiology- Singer S.
	ICAR-NDRI e-course Notes- National Dairy Research Institute, Karnal

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Microbiology of Fluid Milk	Course No	DM-202 (Theory)
Course Credit:	2 (1+1)	Semester	II (V Dean)

Lecture No.	Topics	Date
1.	Microbes associated with raw milk: Significance of specific groups of microorganisms in milk i.e. psychrotrophic, mesophilic, thermoduric and thermophillic bacteria.	
2.	Morphological and biochemical characteristics and classification.	
3.	Their sources during various stages of production - milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms.	
4.	Microbiological changes in bulk refrigerated raw milk.	
5.	Sources of contamination and microbial spoilage of raw milk	
6.	Types of microbial spoilage - souring, curdling, bitty cream, proteolysis, lipolysis, abnormal flavors and discolouration.	
7.	Mastitis milk - types of mastitis, causative micro-flora of mastitis. Compositional and microbiological changes during mastitis infection, their processing and public health	
8.	Concept of clean milk production: Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipments and dairy farm environment;	
9.	Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world	
10.	Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoproxidase (LP) system.	
11.	Microbiological aspects of fluid milk: Pasteurization, boiling, sterilization, ultra high temperature (UHT), non thermal (pulsed field) micro-filtration, bactofugation, standardization and homogenization.	
12.	Significance of heat resistant and post processing contaminants in fluid milk with special reference to proteases and lipase enzymes and their role in spoilage of processed milk.	
13.	Bio-film formation during processing and their control measures.	
14.	Public health aspects of fluid milk: Microbial zoonotic diseases transmitted through fluid milk;	
15.	Milk borne diseases -food infection, intoxication and toxi- infection caused *E. coli, Salmonella typhi, Staphylococcus aureus, Bacillus cereus, Listeria monocytogenes, Shigella species, Campylobacter etc.*	
16.	Microbiological grading and legal standards of raw and processed milk.	

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Microbiology of Fluid Milk	Course No	DM-202 (Practical)
Course Credit:	2 (1+1)	Semester	II (V Dean)

Practical No.	Topics	Date
1.	Morphological examination of common dairy microorganisms (size and shape, arrangement and sporulation).	
2.	Estimation of microbial load in raw milk by standard plate count (SPC).	
3.	Estimation of microbial load in raw milk by dye reduction tests (MBRT, RRT).	
4.	Grading of processed / market milk by total viable count, coliform count and methylene blue reduction time.	
5.	Enumeration of psychrotrophic bacteria in raw and market milk.	
6.	Enumeration of thermophillic bacteria in raw and market milk.	
7.	Enumeration of thermoduric bacteria in raw and market milk	
8.	Enumeration of spore forming bacteria in raw and market milk	
9.	Detection of sources of contamination: Air and water.	
10.	Detection of sources of contamination: utensils, equipment, personnel and line testing.	
11.	Spoilage of milk caused by microorganisms: souring, sweet curdling, gassiness and discolouration.	
12.	Spoilage of milk caused by microorganisms: lipolysis, ropiness and proteolysis.	
13.	Detection of mastitis milks: pH, SLST and somatic cell count.	
14.	Detection of mastitis milks: chloride content, Hotis test and CAMP test.	
15.	Detection and estimation of coliforms: presumptive, rapid coliform Test.	
16.	Detection and estimation of coliforms: IMViC Test.	

Suggested Readings	
	Dairy Microbiology - K.C. Mahanta
	Dairy Bacteriology – Hammer
	Fundamentals of Dairy Microbiology - J.B. Prajapati
	Comprehensive Dairy Microbiology - Yadav, Batish and Grover
	Chemical & Microbiological Analysis of - Ramakant Sharma. Milk & milk products.
	Dairy Microbiology Handbook (I,II & III edition)- Richard K. Robinson
	Dairy Microbiology – H. A. Modi
	ICAR-NDRI e-course Notes- National Dairy Research Institute, Karnal

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Starter Cultures and Fermented Milk Products	Course No	DM-403 (Theory)
Course Credit:	3 (2+1)	Semester	IV (V Dean)

Lecture No.	Topics	Date
1.	History, classification and importance of starter cultures in dairy industry	
2.	Types, of starter cultures: Single, multiple, defined and mixed strain starters; Probiotics and Special cultures like exopolysaccharide production	
3.	Metabolism of Lactic Acid Bacteria and diacetyl production	
4.	Metabolism of Lactic Acid Bacteria and diacetyl production	
5.	Production of antibacterial substances by lactic starter cultures	
6.	Mixed and define strain starter culture	
7.	Propagation of starter cultures	
8.	chemical and mechanically protected systems of Propagation of starter cultures	
9.	Factors affecting propagation of starter cultures	
10.	Starter concentrates: direct bulk and direct vat starter cultures	
11.	Methods of starter distillates their merits/demerits.	
12.	Bacteriophages. Phages-life cycle, sources, prevention	
13.	Quality and activity of starter cultures	
14.	defects in starters and their control	
15.	starter failures; antibiotic residues, sanitizers and bacteriophages	
16.	Preservation of starter cultures: freezing and freeze-drying	
17.	Factors affecting the survival of cultures during preservation	
18.	Role of starter cultures in the preparation of various fermented milks	
19.	Classification of fermented milks: Microbiology of dahi and yoghurt	
20.	different types of dahi and yoghurt; preparation defects and their control	
21.	Microbiology of milk products; their nutritional and therapeutic significance	
22.	Kefir and Kumiss: origin and characteristics: microbiology of Kefir grains	
23.	Microbiology of other fermented milks such as Bugarian milk, cultured buttermilk; their significance	
24.	Microbiology of other fermented milks such as Leben and Yakult; their significance	
25.	Concept of probiotic starters	
26.	Application of probiotic dairy foods	
27.	Cheese Starters:Classification, desirable properties, Artisanal and adjunct cheese cultures	
28.	Primary and secondary flora of cheese	
29.	biochemical changes during ripening	
30.	bacterial and mold ripened cheeses:	
31.	soft, semi-soft, semi-hard, hard, Brick and Brie cheese, Camembert and Roquefort cheese	
32.	Rennet: rennet substitutes, microbial rennet and recombinant chymosin	

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Starter Cultures and Fermented Milk Products	Course No	DM-403 (Practical)
Course Credit:	3 (2+1)	Semester	IV (V Dean)

Practical No.	Topics	Date
1.	Testing for purity of starter cultures; gram's staining, catalase test; creatine test	
2.	Starter activity tests: die reduction tests, Horrall-Elliker test, Whitehead and Cox test	
3.	Preparation of single and mixed starter cultures.	
4.	Evaluation of homo-fermentation and hetero-fermentation separately and in combination	
5.	Preservation of starter cultures by freeze-drying techniques	
6.	Preparation of concentrated starter (DVS)	
7.	Effect of physical factors on dairy starter: temperature, pH, salt, sugar	
8.	Testing milk for the presence of inhibitory substance using *B. stearothermophilus* and *S. thermophilus* as indicator organisms	
9.	Effect of antibiotic residues in milk on starter activity	
10.	Associative growth Starter cultures in milk	
11.	Detection of bacteriophages in cheese whey by plaque assay	
12.	Preparation and microbial examination of dahi	
13.	Preparation and microbial examination of yoghurt	
14.	Preparation and microbial examination of cultured butter milk	
15.	Preparation and microbial examination of acidophilus milk and kefir	
16.	Analysis of cheese for total spore and anaerobic spore count Microbiological analysis of cheddar cheese at different stages of manufacture of (storage and ripening)	

Suggested Readings	
	Fundamentals of Dairy Microbiology
	Comprehensive Dairy Microbiology
	Chemical & Microbiological Analysis of Milk & milk products
	Dairy Microbiology Handbook (I, II & III edition)
	Standard Methods for the Examination of Dairy Products
	Food Safety and Quality Assurance
	ICAR-NDRI e-course Notes- National Dairy Research Institute, Karnal

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Microbiology of Dairy Products	Course No	DM-404 (Theory)
Course Credit:	2 (1+1)	Semester	IV (V Dean)

Lecture No.	Topics	Date
1.	Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream	
2.	Microbiological aspects including defects in pasteurized (ripened/unripened cream), sterilized and UHT cream	
3.	Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in butter	
4.	Factors influencing the microbial growth during batch/continuous butter making process	
5.	Microbial Defects in butter - Bacterial/mold discoloration, enzymatic deterioration and their control measures	
6.	Type of microorganisms associated with condensed milk, their growth/ survival during manufacture and storage	
7.	Microbial defects - Bacterial thickening / Mold button formation in SCM	
8.	Type of microorganisms associated with evaporated milk, their growth/ survival during manufacture and storage	
9.	Gassiness/bloating, Bacterial coagulation (Sour and sweet), Bitterness, Fishy flavor in evaporated milk	
10.	Type of microorganisms associated with dried products	
11.	pre-heating/DSI temperature and their impact on microflora of dried products;	
12.	Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards	
13.	Microenvironment in ice cream, microbiological quality of ingredients, critical process factors and their impact on entry of pathogens in ice cream and frozen desserts, their survival during storage, food poisoning out breaks and legal standards	
14.	Predominance of spoilage and pathogenic organisms in khoa and khoa based sweets – burfi, peda, gulabjamun, etc., paneer, Chhanna and Chhanna based sweets – rasogulla; kheer, shrikhand, dahi, kulfietc.	
15.	Factors affecting the microbiological quality in reference to production, processing, storage and distribution; Microbial safety in relation to potential pathogens and their public health significance	
16.	Microbial defects, control measures and legal standards; Active packaging concepts and role in bio-preservation	

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Microbiology of Dairy Products	Course No	DM-404 (Practical)
Course Credit:	2 (1+1)	Semester	IV (V Dean)

Practical No.	Topics	Date
1.	Microbial Analysis of Cream (Raw, Pasteurized, Sterilized And UHT)	
2.	Microbial Analysis of Butter (Salted And Unsalted)	
3.	Microbial Analysis of Ice-Cream	
4.	Microbial Analysis of Kulfi	
5.	Microbial Analysis of Sweetened Condensed Milk	
6.	Microbial Analysis of Milk Powder	
7.	Microbial Analysis of Dahi	
8.	Microbial Analysis of Shrikhand	
9.	Microbial Analysis of Paneer	
10.	Microbial Analysis of Rasogolla	
11.	Microbial Analysis of Sandesh	
12.	Microbial Analysis of Khoa	
13.	Microbial Analysis of Gulabjamun	
14.	Microbial Analysis of Peda	
15.	Microbial Analysis of Kalakand	
16.	Microbial Analysis of packaging material	

Suggested Readings	
	Dairy Microbiology - K.C. Mahanta
	Dairy Bacteriology – Hammer
	Fundamentals of Dairy Microbiology - J.B. Prajapati
	Comprehensive Dairy Microbiology - Yadav, Batish and Grover
	Chemical & Microbiological Analysis of - Ramakant Sharma. Milk & milk products.
	Dairy Microbiology Handbook (I,II & III edition)- Richard K. Robinson
	Dairy Microbiology – H. A. Modi
	NDRI e course Notes- National Dairy Research Institute, Karnal

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Quality and Safety Monitoring in Dairy Industry	Course No	DM-505 (Theory)
Course Credit:	3 (2+1)	Semester	V (V Dean)

Lecture No.	Topics	Date
1.	Consumer Awareness about Microbiological Quality and Safety of Dairy Foods:	
2.	Changing scenario; Concepts of quality control	
3.	Quality assurance and food safety	
4.	Global quality and food safety standards	
5.	Global quality and food safety standards	
6.	Integrated food law, its main features and functions	
7.	Introduction to FoodSafety Management System	
8.	Concepts of Quality Management System (QMS)–ISO: 9000:2000	
9.	Principles of QMS; Standard requirements for QMS	
10.	HACCP concept and principle with special reference to biological hazards in dairy foods	
11.	TQM tools and techniques	
12.	Microbiological RiskAnalysis Concepts:Risk assessment, risk management and risk communication	
13.	Risk profiling of dairy products	
14.	Microbiological criteria and two and three class sampling plan / guidelines	
15.	Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant	
16.	Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant	
17.	Rapid Enumeration Techniques: Enumeration principles	
18.	Procedure for rapid detection of predominant hygiene indicator organisms and pathogens like *E. coli* (E. coli 0157:H7)	
19.	Procedure for rapid detection of predominant hygiene indicator organisms and pathogens like*Salmonella, Shigellaand Listeria monocytogenes*	
20.	Procedure for rapid detection of predominant hygiene indicator organisms and pathogens like*Salmonella, Shigellaand Listeria monocytogenes*	
21.	Procedure for rapid detection of predominant hygiene indicator organisms and pathogens like*Staphylococcus aureus*	
22.	Procedure for rapid detection of predominant hygiene indicator organisms and pathogens like*Staphylococcus aureus*	
23.	Role of Biosensors for monitoring hygiene and safety of dairy food	
24.	Detection of antibiotic residues in milk –Delvo SP, MDR test	
25.	Detection of antibiotic residues in milk-penzyme test, charm assay, lateral flow assay (ROSA test) etc	
26.	Detection of aflatoxins, pesticides other inhibitors etc. and their public health importance in dairy food	
27.	Plant and equipment hygiene:Concepts of hygiene and sanitation	
28.	Microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply	
29.	Microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply	
30.	Microbial quality of air and personnel hygiene	
31.	Treatment and disposal of waste water and effluents	
32.	Treatment and disposal of waste water and effluents	

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Quality and Safety Monitoring in Dairy Industry	Course No	DM-505 (Practical)
Course Credit:	3 (2+1)	Semester	V (V Dean)

Practical No.	Topics	Date
1.	Rapid detection ofColiform, E. coli, Enterococci, Enterobacteriacae count using D- count and 3M Petrifilm kits	
2.	Rapid detection ofColiform, E. coli, Enterococci, Enterobacteriacae count using D- count and 3M Petrifilm kits	
3.	Rapid detection of pathogenic bacteria based on antigen antibody principle:Staphylococcal enterotoxins	
4.	Rapid detection of pathogenic bacteriaE. coli O157:H7	
5.	Rapid detection of pathogenic bacteriaListeria monocytogenes	
6.	Rapid detection of pathogenic bacteriaSalmonella	
7.	Microbiological tests for assessing Environmental, equipment and personnel hygiene by swab method	
8.	Microbiological tests for assessing Environmental, equipment and personnel hygiene by rinse methods	
9.	Rapid detection of antibiotic residues in milk usingDelvo SP,MDR test	
10.	Rapid detection of antibiotic residues in milk usingCharm assay, Lateral flow assay (ROSA test).	
11.	Rapid detection of aflatoxin M1/ pesticides residues in milk usingCharm Assay, Lateral Flow Assay (ROSA test) / Enzyme Inhibition Assay using Luminometer.	
12.	Rapid detection of aflatoxin M1/ pesticides residues in milk usingCharm Assay, Lateral Flow Assay (ROSA test) / Enzyme Inhibition Assay using Luminometer	
13.	Evaluation of common sanitizing agents used in dairy plants by suspension	
14.	Evaluation of common sanitizing agents used in dairy plants by capacity test	
15.	Determination of BOD in dairy waste water.	
16.	Quality evaluation by HACCP in the preparation of dairy products	

Suggested Readings	
	Dairy Microbiology –K.C. Mahanta
	Dairy Bacteriology – Hammer
	Fundamentals of Dairy Microbiology - J.B. Prajapati
	Comprehensive Dairy Microbiology - Yadav, Batish and Grover
	Chemical & Microbiological Analysis of Milk & milk products-Ramakant Sharma.
	Dairy Microbiology Handbook (I,II & III edition)- Richard K. Robinson
	Dairy Microbiology – H. A. Modi
	Standard Methods for the Examination of Dairy Products- Marshall RT.
	Food Safety and Quality Assurance- Morgan MRA, Smith CJ & William PA.
	Practical Manual: FSSAI

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Food and Industrial of Microbiology	Course No	DM-606 (Theory)
Course Credit:	3 (2+1)	Semester	VI (V Dean)

Lecture No.	Topics	Date
1.	Basic aspects and scope of food microbiology	
2.	Intrinsic factors that affect microbial growth in foods	
3.	Extrinsic factors that affect microbial growth in foods	
4.	Microbial spoilage of fruits	
5.	Microbial spoilage of fruit juices	
6.	Microbial spoilage of vegetables	
7.	Microbial spoilage of cereals	
8.	Microbial spoilage of meat	
9.	Microbial spoilage of poultry	
10.	Microbial spoilage of sea foods	
11.	Microbial spoilage of carbonated soft drinks	
12.	Microbial spoilage of canned foods	
13.	Food preservation by physical methods	
14.	Food preservation by chemical preservatives	
15.	Food preservation by natural antimicrobial compounds and	
16.	Biology based preservation system	
17.	Fermentation: History and Scope	
18.	Fermentation processes: the range and components	
19.	Fermentation processes: types (submerged, surface and solid state fermentation)	
20.	Criteria for selection of industrially important microorganism	
21.	Media for industrial and inoculums development	
22.	Up stream and down stream processing of fermented products.	
23.	Fermenters: types	
24.	Fermenters: functionsl	
25.	Fermenters: design and control	
26.	Chemostat and turbidostat.	
27.	Microorganism and processes involved in the production of industrial alcohol	
28.	Microorganism and processes involved in the production of organic acids (citric lactic)	
29.	Microorganism and processes involved in the production of enzymes (protease, lipase and rennet)	
30.	Microorganism and processes involved in the production of vitamin (B-12)	
31.	Microorganism and processes involved in the production of antibiotic (nisin)	
32.	Microbiology of effluent treatment in food industry	

Department of Dairy Microbiology

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Food and Industrial of Microbiology	Course No	DM-606 (Practical)
Course Credit:	3 (2+1)	Semester	VI (V Dean)

Practical No.	Topics	Date
1.	Microbiological examination of fresh fruits	
2.	Microbiological examination of fresh vegetables	
3.	Microbiological examination of wheat flour and bread	
4.	Microbiological examination of skim milk powder	
5.	Evaluation of MBRT of raw and pasteurized milk	
6.	Microbiological examination of fruit juice	
7.	Microbiological examination of fruit pulp	
8.	Design and control of a tabletop and 10 liter lab fermenter (Demonstration)	
9.	Production of microbial biomass	
10.	Production of ethyl alcohol from molasses and whey by yeasts	
11.	Production of lactic acid from whey	
12.	Isolation of psychrophile microorganisms from foods	
13.	Isolation salt and sugar tolerant microorganisms from foods	
14.	Isolation of industrially important microorganisms from environment	
15.	Production and assaying of microbial enzymes (protease/ lipase)	
16.	Production of nisin and assaying the antimicrobial activity of the culture	

Suggested Readings	
	Food Microbiology. (Third Ed.) Martin Adam & Maurice Moss
	Modern Food Microbiology (Seventh Ed.) James Jay, Loessner & Golden
	Fundamental Food Microbiology (Third Ed.) Bibek Ray
	Encyclopedia of Food Microbiology- Robinson RK, Batt CA & Patel PD.
	Robinson RK. 1998. Developments in Food Microbiology. Vols. I-III. Elsevier.
	Biotechnology. Food Fermentation. (2 Vol. set) Joshi VK & Pandey A.
	Principles of Fermentation Technology- Stanburry PP & Whitker A.
	Modern Industrial Microbiology and Biotechnology- Nuduka Okafor
	Handbook of Industrial & Hazardous Wastes Treatments- Wang, Yung, & Yapijakis
	ICAR-NDRI e-course Notes- National Dairy Research Institute, Karnal

ANNEXURE No. V

Department Of Dairy Business Management

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Milk Production Management & Dairy Development	Course No.	DBM-101 (Theory)
Course Credit:	3(2+1)	Semester	I (V Dean)

Lecture No.	Topics	Date
1.	Introduction to Animal husbandry	
2.	Scope & importance of Animal Husbundary.	
3.	Distinguish characteristics of Indian and exotic breeds.	
4.	Different systems of breeding	
5.	Selection of dairy animals for breeding.	
6.	General farm practices: Dehorning and Castration, identification etc.	
7.	General farm practices: Grooming & Weighing	
8.	Care of animal at calving and management of neonates.	
9.	Management of lactating and dry cow and Buffalo.	
10.	Milking: Methods, Procedure and practice for quality milk production.	
11.	Machine Milking for clean milk production	
12.	Dairy farm records and their maintenance	
13.	Housing system of Animal: Importance and hygiene and sanitation etc.	
14.	Selection of site for housing of animals	
15.	Common disease: Diagnosis, Prevention and control	
16.	Feed nutrient required by the animal, Sources of feed stuff.	
17.	Sources of feed: Green, Dry and concentrates	
18.	Feed resources for milk production and their nutritive values.	
19.	Nutrients requirements for growth and milk production.	
20.	Digestive system of ruminants.	
21.	Feeding Standard and measurement of feed energy	
22.	Structure and function of mammary System.	
23.	Milk Secretion and milk letdown.	
24.	Male reproductive System	
25.	Female reproductive System	
26.	Estrus to reproductive cycle.	
27.	Ovulation, fertilization, gestation, parturition, pregnancy diagnosis.	
28.	Artificial insemination: Importance and application.	
29.	Embryo transfer and their role in Animal improvement.	
30.	Introduction to bio-techniques in animal production.	
31.	Post independence development in dairying	
32.	Operation flood programme	

Department Of Dairy Business Management

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Milk Production Management & Dairy Development	Course No.	DBM-101 (Practical)
Course Credit:	3(2+1)	Semester	I (V Dean)

Practical No.	Topics	Date
1.	Handling and restraining of dairy animals	
2.	External Body parts and judging of Dairy Cows and Buffalos	
3.	Feeding and Management practices of calves.	
4.	Identification of common feeds and fodder.	
5.	Estimation of balance ration	
6.	Demonstration on preparation of silage	
7.	Preparation of ration for adult animals.	
8.	Milking of Dairy animals.	
9.	Cleaning and sanitation of milking equipments.	
10.	Demonstration on machine milking.	
11.	Identification of reproductive organ.	
12.	Identification of digestive organ.	
13.	Demonstration of semen collection, processing and artificial insemination	
14.	Visit to veterinary clinic	
15.	Visit to dairy Farm	

References:	
	Animal husbandry by GC Banerjee
	Dairy Farming by Reddy & Ramkrishna
	Dairy Farm Management by Jagdish Prasad
	Dairy India -Handbook
	Handbook of Dairy farming

Department Of Dairy Business Management

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Communication Skills	Course No.	DBM-102
Course Credit:	2(1+1)	Semester	I (V Dean)

THEORY

Lecture No.	Topics	Date
1	Communication Process: Scope and importance	
2	Nature and significance of communication process	
3	The magic of effective communication	
4	Building self-esteem and overcoming fears	
5	Meaning, types and models of communication	
6	Verbal and non-verbal communication	
7	Linguistic and non-linguistic barriers to communication	
8	reasons behind communication gap/ miscommunication	
9	Basic Communication Skills: Listening, Speaking, Reading	
10	Basic Communication Skills: Writing Skills; Précis writing	
11	Style of technical communication Curriculum vitaé/resumé	
12	writing; Innovative methods to enhance vocabulary, analogy questions.	
13	Structural and Functional Grammar: Sentence structure, modifiers,	
14	Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles;	
15	Agreement of verb with the subject: tense, mood, voice;	
16	Writing effective sentences; Basic sentence faults	

PRACTICAL

Practical No.	Topics	Date
1.	Listening and note taking	
2.	Writing skills	
3.	Reading and comprehension (written and oral) of general and technical	
4.	Oral Presentation	
5.	Stage manners: grooming, body language	
6.	Stage manners: voice modulation, speed;	
7.	Indexing, Bibliography and footnotes	
8.	Micro Presentation	
9.	An impromptu speech/presentation	
10.	Feedback on presentation	
11	Public speaking	
12.	Preparation for Group Discussion	
13.	Improving vocabulary	
14.	vocabulary building exercises	
15.	improve interview technique	
16.	Organization of events	

References:	
	Communication Skill by Malviy and Shukla
	Communication Skill by Pathak
	Communication Skill by Ghousia Khatoon and Kamini Dhurva
	Developing Communication Skill by Krishna and Meera Banerii

Department Of Dairy Business Management

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Computer and Application Software Packages	Course No.	DBM-103
Course Credit:	2(1+1)	Semester	I (V Dean)

THEORY

Lecture No.	Topic	Date
1.	Introduction to computers and PCs: History. Features, Classification,	
2.	Types & Components of computer, use in organization.	
3.	I/O devices / peripheral devices for computers	
4.	Features of modern operating systems	
5.	Number Systems with conversion	
6.	Computer coding schemes.	
7.	Introduction to Networking, topology, types	
8.	Communication system: use, type, working.	
9.	Internet system : Online surfing making email-ID, composing & mailing	
10.	Word-processing and desktop publishing	
11.	Electronic spreadsheet basics and operations, Worksheet basics and	
12.	Commands Formulae, Function, Graph and macro.	
13.	Database Management System: Concept of DBMS, RDBMS	
14.	Creating, Searching and sorting of Database	
15.	Fundamentals of Graphic packages for preparation of presentation	
16.	Recent strides in computing.	

PRACTICALS

Practical No.	Topic	Date
1.	Study of use of PC in Lab, Overview of computers, How to operate PC,	
2.	Study of Disk Operating System (DOS)	
3.	Introduction to Window Operating System	
4.	Features & types of Window Operating System	
5.	Study of Word processing: Types, Feature, Getting Started with MS-	
6.	Overview of MS- Word: elements, Saving a File	
7.	Working in Word Processing	
8.	Spread sheet	
9.	Solution through Spreadsheet package	
10.	Introduction & Overview DBMS	
11.	Commands of DBMS	
12.	Presentation Graphics software	
13.	Overview of MS Power Point Presentation	
14.	Working with PPT operations, Graph, Table, etc.	
15.	Working with PPT operations, Graph, Table, etc.	
16.	Internet Surfing/Email usage	

Department of Dairy Business Management

TEACHING SCHEDULE (Vth Dean)			
Course Title :	Environmental Studies	Course No.	DBM-104
Course Credit:	2(1+1)	Semester	I (V Dean)

Lecture No.	Topics (Theory)	Date
1	Introduction about ecosystem	
2	Characteristics and kinds of ecosystem	
3	Functions of ecosystem	
4	Introduction about Biochemical cycles	
5	Water cycle, Nitrogen cycle, Carbon cycle	
6	Phosphorus cycle, sulphur cycle	
7	Introduction about natural resources	
8	Renewable and non-renewable resource	
9	Management of natural resources	
10	Air pollution:- sources. Effects, control measures	
11	Water pollution, Solid waste pollution, Noise pollution	
12	Soil pollution, Radioactive pollution	
13	Food processing industry waste and its management,	
14	Recycling of factory effluent,	
15	Management of urban waste water, Recycling of organic waste,	
16	Control of environmental pollution, Composting of biological waste and	

PRACTICAL

Practical No.	Topics (Practical)	Date
1	Environment and it's analysis	
2	Determination of water quality parameters	
3	Collection of sample for pollution study.	
4	Determination of P^{H} from water sample	
5	Determination of acidity from water sample	
6	Determination of of alkalinity from water sample	
7	Estimation of dissolved oxygen	
8	Estimation of BOD	
9	Estimation of COD	
10	Estimation of Nitrate	
11	Estimation of Phosphates	
12	Estimation of pollutant elements	
13	Estimation of heavy/toxic elements	
14	Estimation of Lead	
15	Estimation of Lead	
16	Visit to industrial sewage disposal unit	

References:	
	Ecology and Environment by PD Sharma
	Environment Science & Engineering by P.Anandan
	Waste water engineering
	Environmental Studies by RJ Ranjit & Daniels
	E-Courses NDRI by Jagdish Krishnaswami
	Environment Management by Viajay Kulkarni
	Environmental Surveillance by Dilip Kumar

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Economic Analysis	Course No.	DBM-205
Course Credit:	2(2+0)	Semester	II (V Dean)

THEORY

Lecture No.	Topics	Date
1	Introduction to Economics, Basic terminology	
2	Scope & importance of economics.	
3	Needs, Wants, Utility and Goods	
4	Assumptions of cardinal utility analysis of economics.	
5	Concept of micro economics and its application	
6	Concept of macro economics and its application	
7	Law of diminishing marginal utility.	
8	Law of Demand, its type. Demand schedule and demand function.	
9	Practical applications of law of demand.	
10	Factors affecting/ determinants law of demand.	
11	Elasticity of demand. Its type.	
12	Practical importance of elasticity of demand.	
13	Consumer surplus.	
14	Practical importance of consumer surplus.	
15	Theory of Production.	
16	Concept of firm & industry.	
17	Law of variable proportion,.	
18	Increasing return, constant return, decreasing return	
19	Law of return.	
20	Concept of cost, Fixed cost ,Variable cost and Total cost	
21	Short Tern & Long Term Cost	
22	Economies & diseconomies of scale.	
23	Concept of market. Scope & importance of marketing management.	
24	Monopoly, Duopoly, Oligopoly	
25	Monopolistic competition.	
26	Perfect market & imperfect market.	
27	National income	
28	Different methods of apportioning national income.	
29	GNP, GDP, NNP, Direct income and.	
30	Personal Income ,disposable income	
31	Per Capita income	
32	Inflation	

References:	
	Modern Economic Theory by A Koutsoyainnis
	Micro economic Theory by M.C.Vaish
	Macroeconomic Analysis by Shapirio
	Macroeconomic Analysis by Brathwal
	Microeconomic Theory by H.L.Ahuja
	Modern Economic Theory by K.K.Devid
	Agricultural Economics-At a Glance by Sidharth Bhardwaj

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Fundamentals of Dairy Extension	Course No.	DBM-406
Course Credit:	2(2+1)	Semester	IV (V Dean)

THEORY

Practical No.	Topics covered (Theory)	Date
1	History and need of Extension Education	
2	Definition and philosophy of Extension Education	
3	Principles of Extension Education	
4	Approaches of Extension Education	
5	Objectives of extension education.	
6	Present status of dairy and animal husbandry development programme	
7	Pre and post-independence era of Extension Education	
8	Teaching process	
9	Result demonstration and method demonstration	
10	Learning process	
11	Extension Teaching Methods	
12	Classification of teaching methods	
13	Selection of teaching methods	
14	Importance of Audio-Visual-Aids.	
15	Classification of AV aids	
16	Identification of rural leaders,	
17	Characteristics of rural leader	
18	Role and function in rural development	
19	Training of rural leaders	
20	Principle of working with group and their mobilisation.	
21	Need, principle and step of programme planning.	
22	Evaluation of extension programmes.	
23	Diffusion of innovations	
24	categories of farmers	
25	Problems of different stake holders	
26	Conceptual orientation about different orientation	
27	RRA	
28	PRA	
29	IVLP/TAR	
30	ATMA	
31	ATIC	
32	PTD	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Fundamentals of Dairy Extension	Course No.	DBM-406
Course Credit:	2(2+1)	Semester	IV (V Dean)

PRACTICALS

Sr. No.	Topics covered	Date
1	Use of audio-visual and other aids in Extension Education.	
2	Preparation of MS Powerpoint Slides	
3	Hands on LCD projector	
4	Handling and Operation of Public Address System	
5	Hands-on training on use of Camera	
6	Preparation and presentation of Radio Script	
7	Preparation of Television /Video Script	
8	Preparation of Leaflet	
9	To acquaint with preparation and presentation of posters	
10	To acquaint with the preparation and presentation of charts	
11	Preparation of News stories and circular letter	
12	Group discussion technique	
13	To acquaint with conducting the method demonstration	
14	To acquaint with conducting the result demonstration	
15	Use of audio-visual aids including animation for dairy stakeholders	
16	Hands on learning of field problems in dairy and animal husbandry	
17	Field Visit	

References:	
	Extension Education by GL Ray
	An introduction to Extension Education by SV Supe
	Extension & Communication by OP Dhama

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	ICT in Dairy Industry and Introduction to Operations Research	Course No.	DBM-507
Course Credit:	4(2+2)	Semester	V (V Dean)

THEORY

Lecture No.	Title	Date
1.	Introduction–Elementary concepts, objectives of operations research,	
2.	Applications of OR in decision-making.	
3.	Modelling in Operation Research.	
4.	Linear Programming: Introduction, mathematical formulation of the problem,	
5.	Graphical solution, Simplex technique for solving simple LP problems.	
6.	Inventory Control – Introduction and general notations,	
7.	Economic lot size models with demand.	
8.	Problem solving with EOQ	
9.	Replacement – Introduction, Replacement of items whose efficiency deteriorates with time.	
10.	Queuing – Introduction and general notions,	
11.	Classification of queues and their problems,	
12.	Introduction to Probability problem & their types	
13.	Probability distribution of queues.	
14.	Various models in the queuing system.	
15.	Sequencing – Statement of the problem, notations and assumptions,	
16.	Types of Sequencing	
17.	Problems with 'n' jobs and two machines.	
18.	Generalization to 'm' machines.	
19.	Transportation model – Definition and application of transportation model,	
20.	Introduction to types of Transportation model	
21.	Formulation of transportation problems and their solutions by NWCM	
22.	Formulation of transportation problems and their solutions by Least Count Method	
23.	Formulation of transportation problems and their solutions by Vogel's Approximation Method	
24.	Introduction to Assignment problems and their types	
25.	Formulation of Assignment problems and their solutions	
26.	MODI method	
27.	Introduction & framework of PERT and CPM	
28.	Introduction & concept activities, events and network	
29.	Formulation of Network diagram	
30.	PERT and activity time estimates,	
31.	Probability of project completion	
32.	Formulation and solution of Critical path method	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	ICT in Dairy Industry and Introduction to Operations Research	Course No.	DBM-507
Course Credit:	4(2+2)	Semester	V (V Dean)

PRACTICALS

Practical No.	Title	Date
1 & 2	Formulation of Linear Programming by simplex technique	
3 & 4	Formulation of Linear Programming by graphical method	
5 & 6	Inventory Control problems	
7	Replacement model problems	
8	Formulation of Assignment Problems by Hungarian Method	
9	Formulation of transportation problems	
10	Problems and their solutions by queuing theory	
11	Problems and their solutions by sequencing problem	
12	Problems and their solutions by Replacement model problems	
13	Introduction & framework of PERT and CPM	
14	Scheduling a project with PERT/CPM	
15 & 16	Formulation and solution of Critical path method	

References:

Churchman, C.W., Ackoff R. L. and Arnoff, E.L. 1957. Introduction to Operations Research. John Wiley and Sons, New York.

Gocl, B.S. and Mittal, S.K. 1974. Operations Research. Pragati Prakashan, Meerut.

Kapoor, V.K. and Kapoor, S. 2001. Operations Research Techniques for Management. Sultan Chand and Sons, New Delhi.

Saatty, T.L. 1961. Elements of Queuing Theory. McGraw-Hill, New York.

Sasieni, M.A., Yaspan and Friedman, L. 1959. Operations Research: Methods and Problems. John Wiley and Sons, New York.

Sharma , S.D. 1999. Operations Research. Kedar Nath Ram Nath & Co., Mereut.

Swarup, K., Gupta, P.K. and Mohan, M. 1989. Operations Research. Sultan Chand and Sons, New Delhi.

Taha, H.A. 2005. Operations Research: An Introduction. Prentice Hall of India Private Limited, New Delhi.

Wagner, H.M. 1982. Principles of Operations Research, with Applications to Management Decisions. Prentice Hall of India, New Delhi

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Marketing Management and International Trade	Course No.	DBM-508
Course Credit:	2(2+0)	Semester	V (V Dean)

THEORY

Lecture	Topics covered	Date
1	Concept of marketing, Functions of marketing	
2	Concept, scope and process of marketing management	
3	Concept and elements of marketing mix	
4	Concept of market structure	
5	Marketing environment: Micro and macro environments	
6	Consumer buying behavior, consumerism	
7	Market research and market information system	
8	Market measurement – present and future demand	
9	Market forecasting, Market segmentation, targeting and positioning	
10	Allocation and marketing resources	
11	Marketing Planning Process	
12	Product mix, product line, product life cycle	
13	New product development process	
14	Product brand, packaging, services decisions	
15	Marketing channel decisions: Retailing	
16	Wholesaling and distribution	
17	Pricing Decisions. Price determination	
18	Pricing policy of milk products in organized and unorganized sectors of dairy	
19	Promotion-mix decisions	
20	Advertising; How advertising works; Deciding advertising objectives,	
21	Media Planning, Personal Selling,	
22	Publicity, Sales	
23	Food and Dairy Products Marketing	
24	Salient features of International Marketing	
25	Composition & direction of Indian exports;	
26	Trends in International Dairy Trade	
27	International marketing environment; Deciding which	
28	Exports- Direct exports, indirect exports, Licensing, Joint	
29	Direct investment & internationalization process,	
30	Deciding marketing Programme; Product, Promotion, Price, Distribution	
31	Deciding the Market Organization	
32	World Trade Organization (WTO)	

References:

	Kotler, P. (1988). Marketing Management: Analysis planning Planning and Control
	Varshney, R.L. and Gupta, S.L. (2005). Marketing Management: Text and ases.Sultan Chand & Sons, New Delhi.
	SA Sherlekar and R.Krishnamoorthy :Marketing Management
	http://www.agmarknet.nic.in

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Entrepreneurship Development and Industrial Consultancy	Course No.	DBM-809
Course Credit:	2(2+0)	Semester	VIII (V Dean)

THEORY

Lecture No	Topics (Theory)	Date
1	Assessing overall business environment in the Indian economy	
2	Overview of Indian social, political and economic systems and their	
3	Globalisation and the emerging business/ entrepreneurial environment	
4	Concept of entrepreneurship, entrepreneurial and managerial characteristics	
5	managing an enterprise	
6	motivation and entrepreneurship development	
7	importance of planning, monitoring, evaluation and follow up	
8	managing competition, entrepreneurship development programs	
9	SWOT analysis	
10	Generation, incubation and commercialization of ideas and innovations	
11	Government schemes and incentives for promotion of entrepreneurship	
12	Government policy on Small and Medium Enterprises (SMEs)/SSIs	
13	Export and Import	
14	Policies relevant to dairy sector	
15	Venture capital. Contract farming and joint ventures	
16	public-private partnerships	
17	Overview of dairy inputs industry.	
18	Characteristics of Indian dairy processing and export industry	
19	Social Responsibility of Business	
20	Dairy plant management system- milk	
21	Milk processing and products manufacturing	
22	Pricing and marketing of milk and milk products	
23	Survey on milk production potential and marketed surplus of milk for setting up	
24	Recruitment and training of manpower	
25	Estimation of costs of product manufacture and energy utilization in food	
26	Sources of finance for setting up of dairy farms and processing plants/ units	
27	Guidelines for obtaining ISO/HACCP	
28	Assessment of entrepreneurial skills and characteristics for successful	
29	Consumer opinion surveys	
30	Pricing of milk and milk products	
31	Preparation of feasibility reports for setting of dairy farms, composite milk	
32	collection centres, chilling units, processing units	

References:	
	Dynamics of entrepreneurial development and Management, Dr. Vasant Desai, Himalayan Publishing Entrepreneurship development, Moharanas and Dash C.R., RBSA Publishing, Jaipure
	Beyond entrepreneurship, Collins and Lazier W, Prentice Hall, New Jersey, 1992
	Entrepreneurship, Hisrich Peters Sphephard, Tata McGraw Hill
	Fundamentals of entrepreneurship, S.K. Mohanty, Prentice Hall of India
	A Guide to Entrepreneurship, David Oates, Jaico Publishing House, Mumbai, Edn 2009

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Financial Management and Cost Accounting	Course No.	DBM-810
Course Credit:	3(2+1)	Semester	VIII (V Dean)

THEORY

Lecture No.	Topics	Date
1	Introduction to Financial Management: Definition, scope and objectives	
2	Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting.	
3	Doubles entry system of Book-Keeping.	
4	Preparation of Accounting Records: Journal, Purchases and Sales Book	
5	Preparation of Final Accounts and adjustments at the end	
6	Preparation of Trial Balance Banking Transactions and Bank reconciliation	
7	Statements of Financial Information	
8	Accounting system: A source of financial statements, Classification of	
9	Balance Sheet, Profit and Loss Account, Statement of changes in the	
10	funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making	
11	Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, activity ratios, Utility of Ratio analysis ratios, Profitability activity	
12	Cost Volume – Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP	
13	Capital Structure: C.S Planning, risk return trade off, financial leverage	
14	Management of cost of capital, cost of debt, debentures, preference share	
15	equity share capital & retained earnings, overall cost of capital	
16	Time value of money, Net present value, Investment evaluation	
17	NPV method, Internal rate of return method, Profitability index method, Payback period, Accounting rate of return method.	
18	Capital budgeting: Complex investment decisions, Investment timing & duration Investment decisions under inflation. Investment decisions under	
19	Feasibility Report Valuation. Working capital management-	
20	Depreciation – Concept and method. Introduction, Definition, Objectives,	
21	Essentials of sound costing system. Different methods of costing,	
22	elements of cost: Labour- recording of time, idle time, methods of	
23	Premium & Bonus Plans, Materials, Overheads	
24	Direct and Indirect expenses, fixed and variable costs	
25	Various methods of apportioning indirect expenses	
26	Inventory Management: Planning, control and costing	
27	Stores & storekeeping, scope & importance	
28	purchase procedure, types of purchase, location of stores	
29	different methods of pricing materials, store records	
30	Cost Sheets-Different methods, Statement of cost and statement of profit	
31	Contract or Terminal costing. Process Costing: Process losses and inter	
32	Ascertainment of cost of milk production, Preparation of Cost Account	

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Financial Management and Cost Accounting	Course No.	DBM-810
Course Credit:	3(2+1)	Semester	VIII (V Dean)

PRACTICAL

Lecture No.	Topics	Date
1.	Preparation of Profit and Loss account Part I	
2.	Preparation of Profit and Loss account Part II	
3.	Preparation of Balance Sheet Part I	
4.	Preparation of Balance Sheet Part II	
5.	Preparation of Cash flow statements	
6.	Preparation of Funds flow statements	
7.	Problems on Ratio analysis Part I	
8.	Problems on Ratio analysis Part II	
9.	Problems on Break-Even Analysis Part I	
10.	Problems on Break-Even Analysis Part II	
11.	Problems on Profit analysis	
12.	Problems on Operating Analysis	
13.	Problems on Financial leverage	
14.	Problems on Cost of Capital	
15.	Problems on Investment decisions	
16.	Problems on Capital budgeting	

References:

Bhattacharyya. 2007. Essential of Financial Accounting. S. Chand and Co., New Delhi.

Gupta, S.K. and Sharma, R.K.1996. Financial Management: Theory and Practice. Kalyani Puhl., Ludhiana.

Khan, M.Y. and Jain, P. K. 2011. Financial Management: Text, Problems and Cases. Tata Mc Graw-Hill Puhl., New Delhi.

Maheswari, S.N. 2010. Management Accounting and Financial Contorl. Sultan Chand and Sons, New Delhi.

Pandey, I.M. 1989. Financial Management. Vikas Puhl., New Delhi.

Pandey, I.M. 2006. A Management Guide for Managing Company Funds and Profits. Tata Mc Graw-Hill Puhl., New Delhi.

Reddy, P.N. and Appaniah, H.R. 1997. Essential of Mangement Accounting. Himalaya House, Bombay.

Shukla, M.C. and Grewal, T.S. 1979. Advanced Accou nts. S. Chand and Co., New Delhi.

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TEACHING SCHEDULE (Vth Dean)			
Course Title :	Industrial Statistics	Course No.	DBM-811
Course Credit:	2(1+1)	Semester	VIII (V Dean)

THEORY

Lecture No.	Title	Date
1	Definition and scope; sources of animal husbandry and dairy statistics.	
2	Measures of central tendency	
3	Measures of dispersion, Moments, skewness and kurtosis	
4	Elementary notions of probability, Laws of addition and multiplication	
5	Theoretical frequency distributions:	
6	Binomial, Poisson and Normal distribution and their application	
7	Concepts of sampling methods	
8	Introduction to testing of hypotheses,	
9	Tests of significance-Z,	
10	t, F tests, and their application in the field of dairying.	
11	Analysis of variance- One-Way and two-way classification.	
12	Simple correlation coefficient and its test of significance,	
13	Linear regression, rank correlation.	
14	Basic concepts of statistical quality control,	
15	Control charts for variables and attributes,	
16	Fundamental concepts of acceptance sampling plan.	

PRACTICALS

Practical No.	Title	Date
1	Measures of central tendency,	
2	Measures of dispersion,	
3	Moments, Skewness and Kurtosis	
4	Kurtosis	
5	binomial & Poisson distribution	
6	Fitting of binomial distribution	
7	Fitting of Poisson distribution	
8	Application of 'Z' test for one sample problems.	
9	Application of 'Z' test for two sample problems.	
10	Application of 't' test for one sample problems.	
11	Application of 't' test for two sample problems.	
12	Application of Chi-square test and F-test.	
13	Correlation	
14	Regression	
15	Rank correlation coefficient.	
16	Control chart for variables& attributes	

References:-	
	Agarwal, B.L. 1991. Basic Statistics. Wiley Eastern Ltd., New Delhi.
	Amble,V.N. 1975. Statistical Methods in Animal Sciences. Indian Society of Agril. Statistics, New Delhi.
	Goon, A.M., Gupta, M.K. and Gupta, B. D. 1979. Fundamental of Statistics. Vol. I and II. The World Press Pvt. Ltd., Kolkata.
	Goulden, C.H. 1959. Methods of Statistical analysis. John Wiley and Sons, New York.
	Gupta, S.C. 1987. Fundamental of Statistics. Himalaya Publishing House, New Delhi.
	Gupta, S.C. and Kapoor, V.K. 1990. Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.
	Gupta, S.P. 2010. Statistical Methods. Sultan Chand and Sons, New Delhi.
	Handbook on Statistical Quality Control. 1986 . Indian Standards Institute, New Delhi.
	Snedecor, G.W. and Cochran, W.G. 1967. Statistical Methods. Oxford and IBH Publishing Co., New Delhi.