B.TECH
DAIRY TECHNOLOGY

B.TECH SYLLABUS 2016

Pydah College of Dairy Technology

Kakinada | East Godavari District | Andhra Pradesh

AFFILIATED TO **Sri Venkateswara Veterinary University, Tirupati**

II. CURRICULUM

A. NORMS:

1. **Degree Nomenclature**
   B. Tech (Dairy Technology): Bachelor of Technology (Dairy Technology)
2. **System of Education**
   Formal Education with Semester System
3. **Program Duration**
   8 Semesters (4 Academic Years)
4. **Maximum Permissible Course Work Load**
   24 Evaluated Credits per Semester
5. **Course Curriculum and Credits Requirement**
   5.1 The course work should be completed in the 8 semesters with 170 Instructional Credits.
   5.2 The total credit requirement for the under-graduate degree programme shall be **182 credits** – 170 Instructional Credits + 12 Non evaluated credits consisting of Student READY Rural Dairy Work Experience Programme (0+10), and Physical Education (0+1) and NSS (0+1)
6. **Departments**
   1. Dairy Business Management
   2. Dairy Chemistry
   3. Dairy Engineering
   4. Dairy Microbiology
   5. Dairy Technology

7. Evaluated and Non-Evaluated Credits

Sl. No	Departments	Credits	
		T+P	Total
A. Evaluated Credits			
1	Dairy Business Management	17+09	**26**
2.	Dairy Chemistry	12+07	**19**
2	Dairy Engineering	23+15	**38**
3	Dairy Microbiology	11+6	**17**
4	Dairy Technology	26+14	**40**
	Student READY In- Plant Training	0+20	**20**
	Student READY Experiential Learning Module	0+10	**10**
	Total Instructional and evaluated Credits	**80+90**	**170**

B. Non-Evaluated Credits			
1.	Student READY Rural Dairy Work Experience Programme (Summer Break)	**0+10**	**10**
2.	Physical Education	**0+1**	**1**
3	NSS/NCC	**0+1**	**1**

	Total Non-evaluated Credits	**0+12**	**12**

B. DEPARTMENT-WISE COURSES

Dairy Technology

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DT 211	Market Milk	4 (3+1)
2	DT 212	Fat Rich Dairy Products	3 (2+1)
3	DT 213	Traditional Indian Dairy Products	3 (2+1)
4	DT 214	Condensed & Dried Milks	4 (3+1)
5	DT 221	Cheese Technology	4 (2+2)
6	DT 222	Ice-cream & Frozen Deserts	3 (2+1)
7	DT 311	Packaging of Dairy Products	3 (2+1)
8	DT 312	By Products Technology	3 (2+1)
9	DT 321	Sensory Evaluation of Dairy Products	3 (2+1)
10	DT 322	Food Technology - I	3(2+1)
11	DT 421	Dairy Plant Management	2 (1+1)
12	DT 422	Waste Disposal & Pollution Abatement	2 (1+1)
13	DT 423	Food Technology -II	3 (2+1)
		Total	**40 (26+14)**

Dairy Engineering

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DE 111	Engineering Drawing	1 (0+1)
2	DE 112	Workshop Practice	2 (1+1)
3	DE 113	Fluid Mechanics	3 (2+1)
4	DE 121	Heat & Mass Transfer	3 (2+1)
5	DE 122	Thermodynamics	2 (1+1)
6	DE 123	Basic Electrical Engineering	3 (2+1)
7	DE 124	Boilers and Steam Generation	2 (1+1)
8	DE 211	Refrigeration & Air-conditioning	3 (2+1)
9	DE 212	Dairy Engineering	3 (2+1)
10	DE 221	Dairy Process Engineering	3 (2+1)
11	DE 311	Instrumentation and Process Control	3 (2+1)
12	DE 312	Material Strength & Dairy Machine Design	3 (2+1)
13	DE 321	Food Engineering	3 (2+1)
14	DE 322	Energy Conservation and Management	2(1+1)
15	DE 323	Dairy Plant Design and Layout	2(1+1)

		Total	**38 (23+15)**

Dairy Chemistry

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DC 111	Physical Chemistry of Milk	3 (2+1)
2	DC 112	Biochemistry	2 (1+1)
3	DC 121	Chemistry of Milk	3 (2+1)
4	DC 221	Chemistry of Dairy Products	3 (2+1)
5	DC 222	Human Nutrition	2 (1+1)
6	DC 311	Chemical Quality Assurance	3 (2+1)
7	DC 321	Food Chemistry	3 (2+1)
		Total	**19 (12+7)**

Dairy Microbiology

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DM 111	Fundamentals of Microbiology	3 (2+1)
2	DM 121	Microbiology of fluid milk	3 (2+1)
3	DM211	Microbiology of Dairy Products	2 (1+1)
4	DM221	Starter Cultures and Fermented Milk Products	3 (2+1)
5	DM 311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
6	DM 321	Food and Industrial Microbiology	3 (2+1)
		Total	**17 (11+6)**

Dairy Business Management

S.N	Course No	Discipline and Title of the Course	Credit Hours
1	DB 111	Milk Production Management and Dairy Development	3 (2+1)
2	DB 112	Communication Skills	2 (1+1)
3	DB 113	Environmental Studies	2 (1+1)
4	DB 121	Economic Analysis	2 (2+0)
5	DB 122	Computer and Application Software Packages	2 (1+1)
6	DB 221	Fundamentals of Dairy Extension	3 (2+1)
7	DB 311	ICT in Dairy Industry and Operation Research	3 (1+2)
8	DB 321	Marketing Management & International Trade	2 (2+0)
9	DB 421	Financial Management and Cost Accounting	3 (2+1)
10	DB 422	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
11	DB 423	Industrial Statistics	2 (1+1)
		Total	**26 (17+9)**

C. SEMESTER WISE DISTRIBUTION OF COURSES

Semester – I

S.N	Course No	Title of the Course	Credit Hours
1	DB 111	Milk Production Management and Dairy Development	3 (2+1)
2	DB 112	Communication Skills	2 (1+1)
3	DB 113	Environmental Studies	2 (1+1)
4	DC 111	Physical Chemistry of Milk	3 (2+1)
5	DC 112	Biochemistry	2 (1+1)
6	DE 111	Engineering Drawing	1 (0+1)
7	DE 112	Workshop Practice	2 (1+1)
8	DE 113	Fluid Mechanics	3 (2+1)
9	DM 111	Fundamentals of Microbiology	3 (2+1)
10	SC 111	Physical Education	1 (0+1)
		Total	**22 (12+10)**

Semester – II

S.N	Course No	Title of the Course	Credit Hours
1	DB 121	Economic Analysis	2 (2+0)
2	DB 122	Computer and Application Software Packages	2 (1+1)
3	DC 121	Chemistry of Milk	3 (2+1)
4	DE 121	Heat & Mass Transfer	3 (2+1)
5	DE 122	Thermodynamics	2 (1+1)
6	DE 123	Basic Electrical Engineering	3 (2+1)
7	DE 124	Boilers and Steam Generation	2 (1+1)
8	DM 121	Microbiology of fluid milk	3 (2+1)
		Total	**20 (13+7)**
Student READY Rural Dairy Work Experience Programme-I (Summer Break)			**5 (0+5)**

Semester – III

S.N	Course No	Title of the Course	Credit Hours
1	DE 211	Refrigeration & Air-conditioning	3 (2+1)
2	DE 212	Dairy Engineering	3 (2+1)
3	DM 211	Microbiology of Dairy Products	2 (1+1)

4	DT 211	Market Milk	4 (3+1)
5	DT 212	Fat Rich Dairy Products	3 (2+1)
6	DT 213	Traditional Indian Dairy Products	3 (2+1)
7	DT 214	Condensed & Dried Milks	4 (3+1)
		Total	**22 (15+7)**

Semester – IV

S.N	Course No	Title of the Course	Credit Hours
1	DB 221	Fundamentals of Dairy Extension	3 (2+1)
2	DC 221	Chemistry of Dairy Products	3 (2+1)
3	DC 222	Human Nutrition	2 (1+1)
4	DE 221	Dairy Process Engineering	3 (2+1)
5	DM 221	Starter Cultures and Fermented Milk Products	3 (2+1)
6	DT 221	Cheese Technology	4 (2+2)
7	DT 222	Ice-cream & Frozen Deserts	3 (2+1)
		Total	**21 (13+8)**
	Student READY Rural Dairy Work Experience Programme-II (Summer Break)		**5 (0+5)**

Semester – V

S.N	Course No	Title of the Course	Credit Hours
1	DB 311	ICT in Dairy Industry and Operation Research	3(1+2)
2	DC 311	Chemical Quality Assurance	3 (2+1)
3	DE 311	Instrumentation and Process Control	3 (2+1)
4	DE 312	Material Strength & Dairy Machine Design	3 (2+1)
5	DM 311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
6	DT 311	Packaging of Dairy Products	3 (2+1)
7	DT 312	By Products Technology	3 (2+1)
8	SC 311	NSS	1 (0+1)
		Total	**22 (13+9)**

Semester – VI

S.N	Course No	Title of the Course	Credit Hours
1	DB 321	Marketing Management and International Trade	2 (2+0)
2	DC 321	Food Chemistry	3 (2+1)
3	DE 321	Food Engineering	3 (2+1)
4	DE 322	Energy Conservation and Management	2(1+1)
5	DE 323	Dairy Plant Design and Layout	2 (1+1)

6	DM 321	Food and Industrial Microbiology	3 (2+1)
7	DT 321	Sensory Evaluation of Dairy Products	3 (2+1)
8	DT 322	Food Technology - I	3 (2+1)
		Total	**21 (14+7)**

Semester – VII

S.N	Course No	Title of the Course	Credit Hours
1	DT 411	Student READY In- Plant Training	20 (0+20)
		Total	**20 (0+20)**

Semester – VIII

S.N	Course No	Title of the Course	Credit Hours
1	DB 421	Financial Management & Cost Accounting	3 (2+1)
2	DB 422	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
3	DB 423	Industrial Statistics	2 (1+1)
4	DT 421	Dairy Plant Management	2 (1+1)
5	DT 422	Waste Disposal and Pollution Abatement	2 (1+1)
6	DT 423	Food Technology -II	3 (2+1)
7	DT 424	Student READY Experiential Learning Module	10 (0+10)
Total			**24 (9+15)**

D. DISTRIBUTION OF COURSE CREDITS

Year	Evaluated Credits	Non-Evaluated Credits
I Year	41	6
II Year	43	5
III Year	42	1
IV Year	44	0
Total	170	12

A. Year-Wise Course Credit Distribution

B. Semester-Wise Course Credit Distribution

Semester	Evaluated Credits	Non-Evaluated Credits

I	21	1
II	20	5
III	22	0
IV	21	5
V	21	1
VI	21	0
VII	20	0
VIII	24	0
	170	12

III. SYLLABUS

I. DAIRY BUSINESS MANAGEMENT

DB 111 Milk Production Management and Dairy Development 3 (2+1)

Theory

Introduction to Animal Husbandry. Distinguishing characteristics of India and exotic breeds of dairy animals and their performance. Systems of breeding and methods of selection of dairy animals. General dairy farm practices - Identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates. Management of lactating and dry cows and buffaloes. Methods of milking, milking procedure and practices for quality milk production. Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises. Common disease problems in dairy animals, their prevention and control. Feed nutrients required by animal body. Feed resources for milk production and their nutritive values. Digestive system of ruminants and measures of feed energy. Nutrients requirements for growth and milk production. Feeding standards, Structure and function of mammary system. Milk secretion and milk let-down. Male and female reproductive system. Estrus and reproductive cycle, Ovulation, fertilization, gestation, parturition, pregnancy diagnosis. Artificial insemination and embryo transfer and their role in animal improvement introduction to biotechniques in dairy animal production.

Practical

1-2. Handling and restraining of dairy animals
3-4. External body parts and judging of cattle and buffaloes
5-6. Feeding and managemental practices of calves
7-8. Identification of common feeds and fodders
9-11. Preparation of rations for adult animals
12-13. Milking of dairy animals and cleaning and sanitation of milking equipments
14-15. Identification of reproductive and digestive organs
16. Demonstration of semen collection, processing and artificial insemination

DB 112 Communication skills 2(1+1)

Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication. Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Précis writing /Abstracting/Summarizing; Style of technical communication Curriculum vitaé/resumé writing; Innovative methods to enhance vocabulary, analogy questions. *Structural and FunctionalGrammar:* Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

Practical

1. Listening
2. Note making
3. Writing skills
4. Writing skills
5. Précis writing
6. Summarizing and abstracting;
7. Reading and comprehension (written and oral) of general and technical articles 1
8. Reading and comprehension (written and oral) of general and technical articles 2
9. Micro-presentations and Impromptu Presentations:
10. Feedback on presentations;
11. Stage manners:grooming, body language, voice modulation, speed;
12. Group discussions;
13. Public speaking exercises;
14. Vocabulary building exercises;
15. Interview Techniques;
16. Organization of events.

DB 113 Environmental Studies
2(1+1)

Theory

Environmental Science: An introduction, Ecosystem: kinds, structure, characteristics, functioning, Biochemical cycles, Natural resources and their managements, Environmental pollution, Air pollution, Water pollution, Solid waste pollution, Noise pollution, Soil pollution, Radio active pollution, Food processing industry waste and its management, Management of urban waste water, Recycling of organic waste, Recycling of factory effluent, Control of environmental pollution through low, Composting of biological waste and Sewage, uses of water disposal effluent treatment, microbial examination.

Practical

1. Environment and its analysis.
2. Water quality parameters.
3. Collection of sample for pollution study.
4. Determination of pH from the sample.
5. Determination of acidity from the sample.
6. Determination of alkanity from sample.
7. Estimation of dissolved oxygen.
8. Estimation of BOD.
9. Estimation of COD.
10. Estimation of nitrates.
11. Estimation of phosphates.
12. Estimation of pollutant elements.
13. Estimation of heavy/toxic elements.
14. Estimation of lead/mercury.
15. Visit to industrial sewage disposal unit.
16. Visit to Dairy plant

Theory

Basic concepts-wants, goods, wealth, utility, consumption, demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer's behaviors. Theory of demand-law of demand, demand schedule, demand function, determinates of demand, individual consumer demand and market demand, demand forecasting, elasticity of demand, price elasticity, income elasticity and cross elasticity, Consumer's surplus. Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product, nature of production function, laws of returns. Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies of scale. Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition, monopoly, oligopoly and monopolistic competition. National income – GDP, GNP, NNP, disposable personal Income, per capita income, inflation.

DB 122 Computer and Application Software Packages 2(1+1)

Theory

History, features, classification and organization and I/O peripheral devices for computers; Features of modern operating systems; number systems and coding schemes; Basics of networking and communications; Internet, email concepts and application, Word-processing and desktop publishing, Electronic spreadsheet basics and operations, Database management system basics and operations; Fundamental of presentation-graphic packages. Recent strides in computing.

Practical

1. Create a document and format it with different styles
2. Create a bio-data form
3. Create an interview/call letter as the main document and create 4 records for 4 persons. Use mail merge to create a common letter to all these four
4. Prepare a Visiting Card for a Managing Director for the Company
5. To create an electronic spread-sheet in which you enter the following Decimal numbers and convert them into Octal, Hexa decimal and Binary numbers vice versa.
6. Create a database and use different mathematical / string functions
7. Create a suitable database to sort/filter the data in the worksheet
8. Create a suitable examination database and find the sum of the marks of each student and the respective class secured by the student
9. The KAL InfoTech company shows the sales of Different products for 5 years. Create Bar-graph, 3D and Pie Charts for the following
10. Prepare a Presentation about your Department using MS- PowerPoint.
11. Create a database called Student using MS ACCESS with at least 10 records
12. Create a query to extract the records based on certain criteria
13. Create an update query to modify the details in the database
14. Create a delete / append query to modify the database
15. Create a report called Student using MS ACCESS with at least 10 records
16. Create an e-mail id

DB 221 Fundamentals of Dairy Extension 3(2+1)

Theory

History, need, definition, philosophy, principles, approaches and objectives of extension education. Present status of dairy and animal husbandry development programme launched in pre and post-independence era. Teaching and learning process, Extension Teaching Methods, classification and selection of teaching methods. Importance of Audio-Visual-Aids. Identification of rural leaders, their characteristics, role and function in rural development, training of rural leaders. Principle of working with group and their mobilisation. Need, principle and step of programme planning. Evaluation of extension programmes. Diffusion of innovations and categories of farmers. Problems of different stake holders, Conceptual orientation about different terms, like- RRA, PRA, IVLP/TAR, ATMA, ATIC, PTD, etc.

Practical

1-2. Hands-on training on use of LCD projector,
3-4. Hands-on training on use of PA system,
5-6. Hands-on training on use of camera.
7-8. Script writing,
9-10. Preparation and use of audio-visual aids
11-12 Animation for dairy stakeholders.
13-14. Group discussion technique.,
15-16. Hands on learning of field problems in dairy and animal husbandry.

DB 311 ICT in Dairy Industry and Introduction to Operations Research 3 (1+2)

Theory

Introduction–Elementary concepts, objectives of operations research, Applications of OR in decision-making. Modeling in Operation Research. Linear Programming: Introduction, mathematical formulation of the problem, Graphical solution, Simplex technique for solving simple LP problems. Inventory Control – Introduction and general notations, Economic lot size models with known demand. Replacement – Introduction, Replacement of items whose efficiency deteriorates with time. Queuing – Introduction and general notions, Classification of queues and their problems, Probability distribution of queues. Various models in the queuing system. Sequencing – Statement of the problem, notations and assumptions, Problems with 'n' jobs and two machines. Generalization to 'm' machines. Transportation model – Definition and application of transportation model, Formulation of transportation problems and their solutions. Assignment problems and their solutions. Framework of PERT and CPM, Activities, events and network, PERT and activity time estimates, probability of project completion Critical path analysis.

Practical

1. LP problem – Mathematical formulation problem 1
2. LP problem – Mathematical formulation problem 2
3. LP problem – Graphical method – on Minimisation
4. LP problem – Graphical method – on Maximisation
5. LP Problem – Simplex method with ≤ problem 1
6. LP Problem – Simplex method with ≤ problem 2
7. LP Problem – Simplex method with ≥ problem 1
8. LP Problem – Simplex method with ≥ problem 1
9. Inventory control problems – Economic lot size 1
10. Inventory control problems – Economic lot size 2
11. Inventory control problems – EOQ - 1
12. Inventory control problems – EOQ - 2
13. Replacement problem1
14. Replacement problem2
15. Replacement problem3

16. Replacement problem4
17. Queuing Theory Problem 1
18. Queuing Theory Problem 2
19. Queuing Theory Problem 3
20. Queuing Theory Problem 4
21. Problem on sequencing – "n" jobs with two machines
22. Problem on sequencing – "n" jobs with two machines
23. Problem on sequencing – 'm' model 1
24. Problem on sequencing – 'm' model 2
25. Problem on formulation of Transportation model
26. Problem on transportation 1
27. Problem on transportation 1
28. Problem on transportation 1
29. Problem on Assignment 1
30. Problem on Assignment 2
31. PERT
32. CPM

DB 321 Marketing Management and International Trade 2 (2+0)

Theory

Concept of marketing; Functions of marketing; concepts of marketing management; scope of marketing management; marketing management. Process; concepts of marketing- mix, elements of marketing- mix. Market Structure and Consumer Buying Behaviour: Concept of market structure, marketing environment, micro and macro environments. Consumers buying behaviour, consumerism. Marketing Opportunities Analysis: Marketing research and marketing information systems; Market measurement- present and future demand; Market forecasting; market segmentation, targeting and positioning. Allocation and marketing resources. Marketing Planning Process. Product policy and planning: Product-mix; product line; product life cycle. New product development process. Product brand, packaging, services decisions. Marketing channel decisions. Retailing, wholesaling and distribution. Pricing Decisions. Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry. Promotion-mix decisions. Advertising; How

advertising works; Deciding advertising objectives, advertising budget and advertising message; Media Planning; Personal Selling, Publicity; Sales Promotion. Food and Dairy Products Marketing. International Marketing and International Trade. Salient features of International Marketing. Composition & direction of Indian exports; Trends ion International Dairy Trade, International marketing environment; Deciding which & how to enter international market; Exports- Direct exports, indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process, Deciding marketing Programme; Product, Promotion, Price, Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO)

DB 421 Financial Management and Cost Accounting 3 (2+1)

Theory

Introduction: Definition, scope and objectives of financial management. Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting. Doubles entry system of Book-Keeping. Preparation of Accounting Records: Journal, Purchases and Sales Book and Posting in Ledger, Cash Book. Preparation of Final Accounts and adjustments at the end of trading period. Preparation of Trial Balance Banking Transactions and Bank reconciliation statements. Statements of Financial Information: Accounting system: A source of financial statements, Classification of capital and revenue expenditure, Balance Sheet, Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making. *Financial Analysis:* Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Utility of Ratio analysis. Cost Volume – Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP analysis. Capital Structure: C.S Planning, risk return trade off, financial leverage. Cost of capital: Management of cost of capital, cost of debt, debentures, preference share capital, equity share capital & retained earning, overall cost of capital. *Investment decision:* Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay back period method, Accounting rate of return method. Capital budgeting: Complex Investment Decisions: Investment timing & duration Investment decisions under inflation, Investment decisions under capital rationing. *Project Report;* Feasibility Report Valuation. Working capital management- Concept & determinants of working capital, Estimating working capital needs. Depreciation – Concept and method. Introduction, Definition, Objectives, Common terms. *Costing:* Essentials of sound costing system. Different methods of costing, elements of cost: Labour- recording of time, idle time, methods of remunerating labour, Premium & Bonus Plans, Materials, Overheads. *Cost classification:* Direct and Indirect expenses, fixed and variable costs. Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing. Stores & storekeeping, scope & importance, purchase procedure, types of purchase, location of stores & materials, procedure for the movement of stores, different methods of pricing materials, store records. Cost Sheets-Different methods, Statement of cost and statement of profit estimates, Tenders or Quotations. Contract or Terminal costing. Process Costing: Process losses and inter-process profits, joint products and by products costing. Ascertainment of cost of milk production.

Preparation of Cost Account Information for managerial decisions.

Practical

1. Preparation of Profit and Loss account - 1
2. Preparation of profit and loss account - 2
3. Preparation of Balance Sheet.
4. Problem on Cash flow statement - 1
5. Problem on Cash flow statement - 2
6. Problem on Funds flow statement - 1
7. Problem on Funds flow statement – 2
8. Problem on Ratio analysis.
9. Problem on Break-Even Analysis.
10. Problem on Profit analysis.
11. Problem on Operating Analysis.
12. Problem on Financial leverage.
13. Problem on Cost of Capital.
14. Problem on Investment decisions.
15. Problem on Capital budgeting - 1
16. Problem on Capital budgeting – 2

DB 422 Entrepreneurship Development and Industrial Consultancy 2(2+0)

Theory

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business/ entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs)/SSIs. Export and Import. Policies relevant to dairy sector. Venture capital. Contract

farming and joint ventures, public-private partnerships. Overview of dairy inputs industry. Characteristics of Indian dairy processing and export industry. Social Responsibility of Business. *Industrial Consultancy:* Dairy plant management system- milk procurement from the rural milk producer, milk processing and products manufacturing. Pricing and marketing of milk and milk products. Survey on milk production potential and marketed surplus of milk for setting up of milk plants. Recruitment and training of manpower, Estimation of costs of product manufacture and energy utilization in food processing plants. Sources of finance for setting up of dairy farms and processing plants/ units. Guidelines for obtaining ISO/HACCP certification for dairy plants.Assessment of entrepreneurial skills and characteristics for successful entrepreneur. Consumer opinion surveys. Pricing of milk and milk products. Preparation of feasibility reports for setting of dairy farms, composite milk plants, collection centers, chilling units and processing units.

DB 423 Industrial Statistics 2 (1+1)

Theory

Definition and scope; sources of animal husbandry and dairy statistics. Measures of central tendency, Measures of dispersion, Moments, skewness and kurtosis. Elementary notions of probability, Laws of addition and multiplication probability. Theoretical frequency distributions: Binomial, Poisson and Normal distribution and their application. Concepts of sampling methods, Introduction to testing of hypotheses, Tests of significance-Z, t, F tests, and their application in the field of dairying. Analysis of variance- One-Way and two-way classification. Simple correlation coefficient and its test of significance, Linear regression, rank correlation. Basic concepts of statistical quality control, Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan.

Practical

1. Measures of central tendency – Mean
2. Measures of central tendency –Median
3. Measures of central tendency – Mode
4. Measures of dispersion – Mean deviation
5. Measures of dispersion – Quartile deviation
6. Measures of dispersion – Standard deviation
7. Problem on Skewness 1
8. Problem on Skewness 2
9. Fitting of binomial and Poisson distribution.
10. Application of ‘Z’ test for one and two sample problems.

11. Application of't' test for one and 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

II. DAIRY CHEMISTRY

DC 111 Physical Chemistry of Milk **3(2+1)**

Theory

Constituents and gross composition of milk of different species and breeds of milch animals, *Colloidal State:* Distinction between true and colloidal solution, lypophilie & lypophobic solution, properties of colloidal system. Properties of colloidal systems, Gels-their formation and properties. Milk as a colloidal system and its stability. Elementary idea about emulsion. Density : Density and specific gravity, pyknometer method, hydrometer lactometer. Density and specific gravity of milk, effect of various processing variables on the density and specific gravity of milk. *Liquid State:* Surface tension, surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it. Viscosity- Definition of viscosity, Newtonian and Non-Newtonian liquids, Stokes Law, influence of temperature and concentration of solute on viscosity. Viscosity of milk, evaporated milk and condensed milk. Refractive index. Colligative Properties of Dilute Solution: Vapour pressure, Raoults Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk. Osmosis and Osmotic pressure. Inter-relation of colligative properties. Aqueous solution of Electrolytes: Electrolytes; non-electrolytes, ionic mobility, electrical conductance, Ostwald Dilution Law, Kohlrawsch Law, Electrical conductance of milk. Ionic Equilibria: Dissociation of water, ionic product of water, concept of pH and pOH and their scale. Acids and bases: Bronsted Lewis concepts of acids and bases, dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation of Henderson – Hasselbach equation and it application, buffer capacity and buffer index, milk as a buffer system. Equilibrium of electrolytes. pH indicators. Oxidation- Reduction: Redox potential, Nernst equation, electrochemical cells. Hydrogen, glass and calomel electrodes. Redox system of milk. Nuclear Chemistry: The nature of isotopes, radio isotopes. Half-life period of radio isotopes. Some of the important radio isotopes. Occurrence of radio nuclide in milk & milk products. Molecular Spectroscopy: The spectrum of electromagnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope. Mention of mass, NMR spectroscopy.

Practical

1. Sampling of milk – principle – sampling methods from different sources – composite sample.
2. Determination of density and specific gravity of milk by using Pycknometer, hydrometer and lactometer
3. Determination of viscosity of milk using Ostwald's viscometer
4. Determination of surface tension of milk using Stalagmometer
5. Determination of interfacial tension between oil and water phase
6. Determination of freezing point of milk
7. Preparation of buffer solutions
8. Electrometric method for determination of pH of buffers and milk
9. Determination of acidity of milk by colorimetric and electrometric methods
10. Determination of electrical conductance of milk
11. Determination of redox potential of milk
12. Coagulation of milk by using electrolytes
13. Determination of refractive index of skm milk and whey
14. Determination of pk_{a1}, pk_{a2} and pl
15. Titration of amino acids in the presence and absence of formaline
16. Verification of Labert Beer's law

DC 112 Biochemistry **2 (1+1)**

Theory

Bio-Molecules: General structures, classification and functions of bio molecules-Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA. *Enzymes:* Activation energy /Transition state & Enzyme Classification, Coenzymes/Co-factors & Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes & Regulatory Enzymes, Immobilization of enzyme, Ribozymes & Zymogens. *Metabolism :*Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transaminase reactions, ATP and Electron transport chain.

Practical

1. Estimation of alkaline phosphatase by converting non – chromogenic substrate to chromogenic substrate
2. Study the effect of temperature on enzyme activity
3. Study the effect of pH on the enzyme activity
4. Study the influence of enzyme inhibitors on the enzyme activity
5. Estimation of catalase activity by spectrophotometric method
6. Determination of Michaeli Menten activity of an enzyme
7. Estimation of RNA by colorimetric method

8-9. Measurement of proteolysis in different proteins

10-11. Measurement of lipolysis in different fats and oils

12-13. Estimation of vitamin a in ghee

14-15. Estimation of vitamin C is blood plasma

16. Estimation of amylase activity

DC 121 Chemistry of Milk 3(2+1)

Theory

Definition and structure of milk, factors affecting composition of milk, Nomenclature and classification of milk proteins, Casein: Isolation, fractionation and chemical composition, physico-chemical properties of casein, Whey proteins: Preparation of total whey proteins: α-Lactalbumin and β-Lactoglobuline. Properties of α-Lactalbumin and β-lactoglobulin, Immmunoglobulin and other minor milk proteins and non proteins nitrogen constituents of milk, Hydrolysis and denaturation of milk proteins under different physical and chemical environments, Estimation of milk proteins using different physical and chemical methods, Importance of genetic polymorphism of milk proteins ,Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoperoxidase ,Milk carbohydrates their status and importance. Physical and chemical properties of lactose, Sugar amine condensation, amadori re arrangement, production of hydroxyl methyl furfural (HMF), Processing related degradation of lactose, Definition, general composition and classification of milk lipids. Nomenclature and general structure of glycerides, factors affecting the fatty acid composition. Milk phospholipids and their role in milk products, Unsaponifiable matter and fat soluble vitamins, Milk Salts: Mineral in milk (a) major mineral (b) Trace elements, physical equilibria among the milk salts and Milk contact surfaces and metallic contamination.

Practical

1. Milk Sampling techniques from different sources for chemical analysis
2. Determination of titratable acidity of milk
3. Determination of pH of milk
4. Determination of fat percent in milk by volumetric method
5. Determination of fat percent in milk by gravimetric method
6. Determination of fat percent in milk by electronic methods
7. Determination of Total solids and solids non fat in milk by gravimetric and calculation method
8. Determination of total milk proteins by kjeldahl and volumetric methods
9. Determination of casein, whey proteins and NPN in milk
10. Determination of lipase and phosphatase activity in milk
11. Determination of lactose content in milk by Lane And Eynon method
12. Determination of lactose content in milk by polarimetric method
13. Determination of Ash content in milk
14. Determination of calcium and phosphorus in milk
15. Determination of temporary and permanent hardness of water
16. Estimation of available chlorine from bleaching powder

DC 221 Chemistry of Dairy Products 3 (2+1)

Theory

Chemical composition and legal standards of milk products. Chemistry of creaming and

factors affecting the same. Ripening and neutralization of cream. Theories of churning and factors affecting the same. Butter colour. Ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants. Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand. Chemistry of cheese: milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening. Physico-chemical changes during preparation and storage of concentrated and dried milk products. Physico-chemical changes during processing and storage of ice cream and frozen desserts. Role and mechanism of stabilizers and emulsifiers in ice cream.

Practical

1. Determination of fat percent in cream by volumetric method
2. Determination of fat percent in cream by gravimrtric method
3. Analysis of butter: Estimation of moisture, fat and salt content in butter
4. Analysis of ghee – estimation of moisture
5. Analysis of ghee – determination of Reichert Meissel value/ polenske value
6. Analysis of ghee – determination of Butyro Refractometer reading
7. Analysis of ghee – determination of acid value
8. Determination of sucrose and lactose in sweetened condensed milk
9. Analysis of milk powder – estimation of moisture and acidity, and ash content
10. Analysis of milk powder – estimation of fat percentage, solubility and bulk density
11. Analysis of Ice cream : estimation of fat and total solids
12. Analysis of cheese – estimation of moisture and fat percent
13. Analysis of cheese – estimation of salt content
14. Analysis of khoa and paneer – estimation of moisture and fat percent
15. Estimation of protein content in milk powder by kjeldhal method
16. Estimation of protein content in cheese powder by kjeldhal method

DC 222 Human Nutrition 2(1+1)

Theory

Fundamentals of human nutrition, concept of balanced diet, nutrient requirements of different age groups. Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk, biochemical composition and energy value of foods with special reference to milk and dairy products. Nutrition, digestion and absorption, Vitamins (structure and function), Hormones (structure and function), Milk intolerance and hypersensitivity, Safety aspects of food additives, toxic elements, antibiotics, radionuclides in milk and milk products. Nutraceutical, antioxidants, food toxins, anti-nutritional factors, probiotics and cultured dairy products. Biochemical aspect of post-harvest storage specifically food spoilage.

Practical

1. Estimation of serum proteins by Biuret method / Lowry)method

2. Estimation of blood glucose by Folin Wu method
3. Estimation of serum phosphorus content by Fiske and Subba Row method
4. Estimation of blood Creatinine , triglyceride and cholesterol levels
5. Estimation of calorific value of foods
6. Diet and nutritional survey a) identification of vulnerable and risk groups
7. Diet and nutritional survey b) breast feeding and weaning practices
8. Use of anthropometric measurement in children
9. Preparation of visual aids for nutritional disorders
10. Field visit for observing the working of nutrition and health oriented programs based on survey visitsts
11. Field visit to hospitals for observing the nutritional deficiencies
12. Identification of mono, di and poly saccharides
13. Identification of proteins (Albumin, gelatine and peptone)
14. Detection of antibiotics/ in food products
15. Planning of high protein, low fat , and specialized diets
16. Detection of toxin in food products

DC 311 Chemical Quality Assurance 3 (2+1)

Theory

Importance of chemical quality control, quality assurance and total quality management in dairy industry. Role of national and international food regulatory systems and standards with respect to quality and safety of milk and milk products: FSSAI, PFA, AGMARK, BIS ISO, IDF, Codex, etc., Application of food safety management system (ISO: 22000). Hazard analysis and critical control points (HACCP) system and its application in dairy industry with respect to chemical quality. Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories. Accreditation of analytical laboratories. Preparation and standardization of reagents required in the analysis of milk and milk products. Sampling procedures; labeling of samples for analysis; choice of analytical tests for milk and milk products for chemical analysis and instrumental methods of analysis. Calibration of dairy glassware; including butyrometer, pipettes, burettes, hydrometers, lactometers and thermometer. Testing methods for the detection of adulterants, preservatives and neutralizers in milk and milk products. Environmental contaminates such as pesticides, antibiotics, heavy metals in milk and milk products and their chemical testing methods**.** Importance of milk contact surfaces, metallic contamination in dairy industry. Chemical quality of water in dairy industry. Prediction of shelf life behavior of milk and milk products.

Practical

1. Calibration of dairy glass ware - hydrometers – butyrometers
2. Calibration of dairy glass ware – volumetric flasks, burettes and pipettes
3. Preparation and standardization of dairy reagents – alkalies and acids
4. Preparation and standardization of dairy reagents – sodium thiosulphate and silver nitrate
5. Preparation and standardization of dairy reagents – Fehlings and EDTA solution
6. Preparation and standardization of dairy reagents – Gerber’s acid

7. Testing of amyl alcohol for fat estimation
8. Chemical analysis of permissible additive in milk
9. Chemical analysis of permissible additive in milk products
10. Chemical analysis of detergents and sanitizers
11. Detection of adultrants, preservatives and neutralizers in milk and milk products
12. Detection of adulteration of ghee with vegetable oil
13. Detection of adulteration of ghee with animal body fat
14. Analysis of market samples milk and milk products
15. Determination of temporary and permanent hardness of water
16. Estimation of available chlorine in bleaching powder

DC 321 Food Chemistry 3(2+1)

Theory

Water: Water binding and chemical reaction mediated by water. *Food proteins:* Classification and physico-chemical and structural properties. *Lipids:* Definition, classification of lipids, Unsaponifiable matter contents in various fats and oils, classification and chemical composition. *Carbohydrates:* Classification of carbohydrates, polysaccharides, viz. linear, branched and modified. Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicelluloses, pectin. *Food Enzymes:* Hydrolases and lipases, utilization in food chemistry. *Minerals in foods:* Main elements, trace elements in eggs, cereals and cereal products, vegetables and fruits. *Aroma compounds in foods:* Threshold value, off-flavours. *Food additives:* Vitamins and Amino acids, Minerals, Aroma Substances/flavour enhancers-Monosodium glutamate, 5-nucleotides sugar substitutes, sorbitol sweeteners- saccharin, and cyclamate, Food colours and food preservatives. *Antinutritional factors and Food contaminants:* Toxic trace elements, radio nucleotides. Cereal and cereal products: Individual constituents like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making, influence of additives /minor ingredients on baking properties: physico-chemical changes during baking. *Legumes:* Classification, general composition and physico-chemical properties. *Vegetables and Fruits:* Classification, general composition, chemical changes during ripening and storage. Jams, *Jellies and Pickles:* Classification, composition and preservation. Preservation of foods, general principles of food preservation.

Practical

1. Determination of gluten content in wheat flour
2. Determination of total ash and acid insoluble ash in wheat flour
3. Determination of starch in wheat flour
4. Determination of nitrogen in cereal products
5. Determination of acidity in citrus fruits
6. Determination of vitamin C in citrus fruits
7. Determination of total solids in tomato ketchup
8. Determination of acidity in tomato ketchup
9. Determination of total sugar, in tomato ketchup
10. Determination of ash and salt content in tomato ketchup
11. Estimation of alkalinity of soluble ash in tea

12. Determination of water extractive in tea leaves
13. Detection of chicory in coffee powder
14. Determination of reducing sugars in jam
15. Determination of iron content in infant foods

III. DAIRY ENGINEERING

DE 111 Engineering Drawing 1(0+1)

Practical

1. Drawing of lines, lettering and types of lettering.
2. Dimensioning types of lines, types of dimensioning.
3. Drawing of scales: Plain Scale
4. Drawing of scales: diagonal scale, comparative scale and Vernier scale.
5. Drawing of Projection: methods of projections, Orthographic projection.
6. Drawing of screw threads: Types of threads and terminologies used in lit.
7. Screw fastening: Types of nuts, types of bolts, stud, locking arrangements for nuts and foundation bolt.
8. Drawing rivets and riveted joints, forms of rivet heads, Types of riveted joints, failure of riveted joints.
9. Drawing of welded joints: Forms of welds, location and dimensions of welds.
10. Drawing of Keys, types of keys
11. Drawing of cotter joint, types of cotter joints
12. Drawing of pin joints, types of pin joints
13. Drawing of shaft couplings, rigid couplings, loose couplings, flexible couplings and universal couplings
14. Drawing of shaft bearings, journal bearings
15. Drawing of pivot bearings, collar bearings.

DE 112 Workshop Practice 2(1+1)

Theory

Introduction: workshop practice, safety, care and precautions in workshop. *Wood working* tools and their use, Carpentry. *Heat treatment process:* Hardening, tempering, annealing and normalizing etc. *Metal work:* Metal cutting. Soldering, Brazing. *Welding:* Electric arc and Gas welding. *Smithy and forging operations*: tools and equipments. *Bench work:* The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing. *Introduction to following tool machines:* (a) Lathe Machine (b) Milling Machine (C) Shaper and Planner (d) Drilling and Boring machines (e) Grinder (f) CNC Machines etc.

Practical

1. To Study different types of measuring tools used in metrology and determine least counts of Vernier callipers, micrometers and Vernier height gauges.
2. Job work on filing and chipping.

3. To Study different types of fitting tools
4. To marking tools used in fitting practice.
5-6. To Study various types of carpentry tools and prepare simple types of at least two wooden joints.
7. Job work on hand hack and power hack saw.
8. Job work on metal sheet working.
9. Job work on butt and lap welding.
10-12. To study different types of metal tools (lathe machine, drilling, milling machines.).
13. To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making, threading.
14. Simple exercises in Arc, gas, &Argon welding.
15. Simple exercises in soldering, Brazing.

DE 113 Fluid Mechanics 3(2+1)

Theory

Units and dimensions, Properties of fluids. *Static pressure of liquids:* Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid. Pressure on vertical rectangular surfaces. Compressible and non compressible fluids. Surface tension, capillarity. Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical gauges, Piezometer. *Fluidflow:* Classification, steady uniform and non uniform flow, Laminar and turbulent, continuity equation, Bernolli's theorem and its applications. *Flow through pipes:*Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity. Flow through orifices, mouthpieces, notches and weirs, Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge. *Dimensional analysis:*Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude. *Pumps:*Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Pump selection and sizing.

Practical

1. Study of various types of pipes and pipe fittings.
2. Study of different types of valves.
3. Study of reciprocating pump.
4. Study of rotary gear pump.
5. Study of piezometer.
6. Study of 'U' Tube manometer.
7. Study of Inclined tube manometer.
8. Study of Venturimeter.
9. Determination of frictional coefficient of given pipe.
10. Determination of minor head loss.
11. Study of Pitot tube.

12. Study the construction and working principle of centrifugal pump.
13. Study of reciprocating pump.
14. Study and measurement of flow of liquid by V- notch.
15. Visit to dairy plant.

DE 121 Heat & Mass Transfer 3(2+1)

Theory

Basic heat transfer process: thermal conductivity, convective film co-efficient, Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. *One-dimensional steady state conduction:* Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, Linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines. *Steady-state heatconduction with heat dissipation to environment:* Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions. Effectiveness and efficiency of the FINS. Introduction to unsteady state heat conduction. *Convection:* Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient. *Heat Exchangers:* General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. *Mass transfer:* Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer.

Practical

1. Determination of thermal conductivity: milk, solid dairy and food products.
2. Determination of overall heat transfer coefficient of: shell and tube.
3. Determination of overall heat transfer coefficient of plate heat exchangers.
4. Determination of overall heat transfer coefficient of jacketed kettle used in dairy and food industry.
5. Studies on heat transfer through extended surfaces.
6. Studies on temperature distribution and heat transfer in HTST pasteuriser.
7. Design problems on heat exchangers.
8. Study of various types of heat exchangers.
9. Design problems on mass transfer.
10. Heat transfer in tubular heat exchanger: co-current/counter flow.
11. Heat transfer through composite wall.
12. Heat transfer through lagged pipes.
13. Heat transfer through natural convection.
14. Heat transfer through forced convection.

15. Visit to dairy plant.

DE 122 Thermodynamics 2(1+1)

Theory

Importance and applications of thermodynamics in Dairy/Food processing. **Basic concepts:** Thermodynamic systems, properties, state, processes, cycles, energy, The Zeroth Law of Thermodynamics. *Ideal gases:* Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. Analysis of non-flow and flow processes. *The second Law of Thermodynamics:* Thermodynamic temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability. *Air Cycles:* Otto, Diesel, dual cycles and their efficiencies, Plotting the air cycles on p-V, T-S, p-h diagram etc. *I.C. Engines:* Concepts, Classification, Working of two stroke and four stroke cycle S.I. engines and C.I. engines. Parts of I.C. engine, Performance of IC engines.

Practical

1. Application of thermodynamics in engineering problems.
2. Study of 2-stroke IC engine.
3. Study of 4-stroke IC engine.
4. Study of working of SI engine.
5. Study of working of CI engine.
6. Study of modern fuel injection system of IC engine.
7. Study of diesel fuel supply system-pump type.
8. Study of diesel fuel supply system-fuel injector type.
9. Study of fuel supply system of a petrol engine.
10. Study of air cooling system of an IC engine.
11. Study of water cooling system of an IC engine.
12. Study of lubrication system of IC engine.
13. Study of solar water heater.
14. Study of bio gas plant and appliances.
15. Visit to dairy plant.

DE 123 Basic Electrical Engineering 3(2+1)

Theory

Alternating current fundamentals: Generation of alternating current or voltage, magnitude of induced E.M.F. Alternating current, R.M.S value and average value of an alternating current. Phase relation and vector representation. Cycle, Time period, Frequency, Amplitude, Phase and Phase Difference, Root – Mean Square Value, Average value, Form Factor, Crest or Amplitude Factor. *Poly-phase Circuit:* - Generation of Poly-phase Voltage, Phase Sequence, Interconnection of Three Phases such as Star Connection and Delta Connection and their respective value of current and voltages, Energy Measurement by using Single and Two Watt-meters. *Transformers:* - Working Principle of Transformer, Construction features of Core and Shell type transformer, Elementary theory of an Ideal Transformer, E.M.F. Equation

of a Transformer, Vector diagram of transformer with and without load, Transformer losses, voltage regulation and efficiency of transformer, Construction and working on an Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer. *Three Phase Induction Motor:* - Fundamental working principles, Production of rotating magnetic fields, construction, 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. Soft starter and variable frequency drives. *Single Phase Induction Motors:* - Introduction**,** Different types of single phase induction motors such as Split Phase, Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion – induction motor. *DC Machine:* - Construction and operation of DC generator, types of generators and their various characteristics. DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter. *Alternators:*- Elementary working principles, Different parts of an Alternators, Relation between Speed and Frequency, E.M.F. equation in an Alternators. Different types of Circuit Breaker and its use. Introduction to DG set system. *Electric Power Economics:* - Economics of Generation of electrical energy and related important terms such as, load curve, connected load, Maximum Demand, Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor, Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariff used for calculation of electricity bill. *Lighting system:* Introduction to industrial lighting system. *Energy Management and Power Factor Corrections:* - Types of energy, Energy Management, Concept of Energy Audit. Concept of Power Factor, Disadvantages of low power factor, Causes of low power factor, Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement.

Practical

1. Introduction to various basic circuits of parallel wiring, stair case wiring, fluorescent light fitting.
2. Study of voltage and current relationship in case of Star connected load.
3. Study of voltage and current relationship in case of Delta connected load.
4. Measurement of power in 3- phase circuit: for a balanced load, using watt meters
5. Measurement of power in 3- phase circuit: for a unbalanced load, using watt meters
6. Measurement of Iron losses of Single Phase transformer by conducting open circuit test
7. Measurement of Copper losses of Single Phase transformer by conducting short circuit test
8. Starting and reversing the speed of a single phase induction motor
9. Starting and reversing the speed of a 3- phase induction motor using Direct on Line (DOL) starter
10. Starting and reversing the speed of a 3- phase induction motor using manual Star Delta starter.
11. Starting and reversing the speed of a DC shunt motor using 3-point DC Starter.
12. Starting of slip-ring induction motor by manual Slip-ring Induction Motor Starter.
13. Starting of slip-ring induction motor by automatic Slip-ring Induction Motor Starter
14. To determine the relation between induced armature voltage and speed of separately

DC Shunt Generator.

15. To determine the relation between induced armature voltage and speed of self excited DC Shunt Generator

DE 124 Boilers and Steam Generation 2(1+1)

Theory

Fuels: Chemical properties, Calorific value and its determination, Fuel Burners, Fuel combustion analysis. *Renewable energy sources:* Concepts, classification, Types and description of of renewable energy sources. *Properties of steam:* Properties of wet, dry saturated, superheated steam, Use of steam tables and Mollier charts, Analysis of energy input in steam generation and heat gain in steam consumption. *Steam generators:* Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters, Boiler mountings and Boiler accessories. Layout of steam pipe-line and expansion joints. Introduction to Indian Boiler Regulation Act. *Boiler Draught:* Definition, importance and classification of draught, Natural and artificial draught, Calculation of Height of chimney, Draught analysis. *Air Compressors:* Definition, classification, Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.

Practical

1. To Determine dryness fraction of steam
2. To study different types of boilers with the help of Lab models.
3. To study Boiler mountings
4. To Study of different Boiler accessories.
5. To study boiler de-scaling operations
6. To study steam-line layout
7. To study steam traps.
8. Hydraulic testing of boiler pipes and fittings
9. To study boiler maintenance operations
10. Industrial exposure visit to plant with steam utilization.
11. Study of Package boiler installed in a dairy processing plant.
12. To Study of water softening plant installed with boiler in a dairy processing plant.
13. To Study the construction and working of vertical fire tube boiler.
14. Study of Horizontal water tube boiler.
15. Visit to dairy plant

DE 211 Refrigeration and Air-Conditioning 3(2+1)

Theory

*Basic refrigeration cycles and concepts:*Standard rating refrigerating machines; Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors; Theoretical vapour compression cycle; Departure from theoretical vapour compression cycle, representation on *T-S* and p-h diagrams; Mathematical analysis of vapour

compression refrigeration system. *Refrigerants:*Primary and secondary refrigerants; common refrigerants (Ammonia, Freon, *HFC, HCFC etc*); Brine, their properties and comparison.*Multi-Pressure Refrigeration Systems:*Applications; Multi-evaporators with single stage and multi-stage compression and expansion systems; Working, Control and mathematical analysis of above systems. *Refrigeration Equipments and Controls:*Introduction to the types, construction, operation and maintenance of Refrigeration Components, Controls and Safety Devices as used in different refrigeration applications. Capacity control methods, Refrigeration Piping**:** Purpose, Types,Materials, Fittings and Insulation. *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. *Absorption Refrigeration Systems:*Simple vapour absorption refrigeration systems, Actual Vapour absorption refrigeration system, Refrigerant absorbent pairs, Absorption cycle analysis.*Cryogenic Freezing:*Cryogenics, cryogens, properties, applications, cryogenic freezers. *Psychrometry:*Definition, properties of moist air, psychrometric charts, psychrometric processes; Cooling/ Heating coils, humidifiers and dehumidifiers, Temperature and humidity measurements and controls. *Air-conditioning Systems:*Types of cooling loads and their calculation, Design conditions for Human and Industrial air conditioning systems, Analysis of different air-conditioning systems with the help of psychrometric chart. *Cold Storage:*Types of cold storages, Types of cooling loads in cold storages used for food/ dairy products; Construction and operation of cold storage. Insulating materials and vapour barriers.

Practical

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 Bulk Milk cooler.
4. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Walk-in-cooler.
5. Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant.
6. Estimation of installed cooling capacity with the help of observed working pressures.
7. Study of specifications, components, operation, control and maintenance of Ice Bank Tank (IBT).
8. Study of specifications, components, operation, control and maintenance of a Cold Storage.
9. Study of the Evaporative Cooling Devices like Cooling Tower, Spray Pond, Air-Washer or Room air-cooler etc.
10. Study of the parts and components of different types of refrigerant compressors used in various refrigeration applications.

11. Study of different types of capacity control devices used with compressors in a refrigeration plant.
12. Experimental study of a simple refrigeration system on refrigeration tutor or an experimental set-up. (comparison of actual and theoretical performance).
13. Experimental study of an year-round air-conditioning system on an air-conditioning tutor or an experimental set-up.
14. Study and plotting of psychrometric processes using refrigeration/air-conditioning tutor.
15. Measurement of psychrometric properties using psychrometric meters/gadgets
16. Industrial exposure visit to refrigeration/air-conditioning plant.

DE 212 Dairy Engineering 3(2+1)

Theory

Sanitization: Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations, power requirements of can the bottle washers, CIP cleaning and designing of system. *Mechanical Separation:* Fundamentals involved in separation. Sedimentation, Principles involved in filtration, Types, rates of filtration, pressure drop calculations. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, self-desludging centrifuge, cold and hot separators, Bactofuge, in-line standardization system, care and maintenance of separators and clarifiers. *Homogenization:* Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers**.** *Pasteurization:*Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers. *Sterilization:*Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers. *Packaging machines:*Pouch filling machine pre-pack and aseptic filling bulk handling system Principles and working of different types of bottle filters and capping machine, Blow molding machines, Aseptic PET bottle filling machine. Cup filling system. Care and maintenance. *Mixing and agitation:* Theory and purpose of mixing. Equipments used for mixing solids, liquids and gases. Different types of stirrers, paddles and agitators. Power consumption of mixer-impeller, selection of mixing equipment in dairy industry, mixing pumps.

Practical

1. Study of S. S. pipes, fitting and gaskets.
2. Study and selection of pump.
3. Study of different types of milk filter.
4. Study of equipment at raw milk reception dock. Constructional details, operation and maintenance of straight through can washer.
5. Constructional details, operation and maintenance of C.I.P. system.
6. Constructional details, operation and maintenance of homogenizers.

7. Constructional details, operation and maintenance of batch pasteurizer.
8. Constructional details, operation and maintenance of HTST pasteurizer.
9. Comparison of conventional and modern pasteurizer.
10. Constructional details, operation and maintenance of Open type cream separators.
11. Constructional details, operation and maintenance of Hermetic type cream separators.
12. Constructional details, operation and maintenance of sterilization systems. Constructional details, operation and maintenance of pouch filling machine.
13. Constructional details, operation and maintenance of different types of agitators.
14. Constructional details, operation and maintenance of bottle filling and capping machine.
15. Visit to a dairy processing plant.

DE 221 Dairy Process Engineering 3(2+1)

Theory

Evaporation: Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Basic concepts of multiple effect evaporators, Operations and various feeding systems, Economy of operation, Thermo processor and MVR system, Care and maintenance of evaporators. *Drying:* Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers-spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Factors affecting bulk density of power, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers. *Fluidization:* Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers. *Processing equipments:* Mechanization and equipment used in manufacture of indigenous dairy products, Ice-cream and Cheese making equipments. *Packaging equipments:* Packaging machines for milk & milk products. *Membrane Processing:* Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.

Practical

1. Study of construction and operation of: Vacuum pan.
2. Study of construction and operation of Double effect evaporator.
3. Study of construction and operation of different types of condensers.
4. Study of construction and operation of single stage spray dryer using nozzle type atomizer.
5. Study of construction and operation of spray drier with centrifugal atomizer and twp stage drier.
6. Study of construction and operation of vacuum and atmospheric drum dryers
7. Study and operation of Butter.
8. Study and operation of Ghee
9. Study and operation of Batch Ice cream freezer.

10. Study and operation of continuous ice cream freezer.
11. Study and operation of cheese making equipments.
12. Study of Reverse osmosis.
13. Study of Ultra filtration system.
14. Design problems on Double effect evaporator.
15. Design problems on vacuum pan.
16. Visit to a milk product plant.

DE 311 Instrumentation and Process Control 3(2+1)

Theory

Instrumentation scheme & characteristics: Measurands. Some basic discussion about electric field, potential, capacitance, resistance etc. Definition, Application and types of measurements, instrument classification, Functional elements of an instrument, standards, calibration, introduction to static characteristics and dynamics characteristics, selection of instruments, loading effects. Dynamic characteristics of measurement systems. *Introduction to various typesof sensors:*Definition, principle of sensing & transduction, classification, selection and applications of Sensors., Measurement of parameter : Measurement of length ,angle, area , temperature , pressure flow , speed, force , torque, vibration , level , concentration (conductivity and ph) measurement . Flow measurement using magnetic flow measurement. Piezoelectric transducer. *Micro-sensors and smart sensors:*Construction, characteristics and applications. *Electronic Instruments:*Role and importance of general purpose test instruments, Electronic Millimeter, Cathode Ray Oscilloscope, Measurement of amplitude, frequency and phase using CRO Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator. Display devices and recorders like X-Y & X-T recorders. *Automation:*Introduction to plant automation, automation hierarchy, PLC, SCADA

Practical

1. Strain gauge characteristics and weight measurement.
2. Measurement of pressure using bellows and diaphragm.
3. Preparations and calibration of thermocouple.
4. Study the construction and working Bourdon 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 the different parts and working of pressure switch.
9. Study the different parts of an indicating instrument.
10. Study of RTD and Thermister.
11. Study of different speed measurement sensor/ instruments.
12. Study of LVDT.
13. Study of level/ flow controller.
14. Study of PLC.
15. Visit to an automatic controlled dairy plant**.**

DE 312 Material Strength & Dairy Machine Design 3(2+1)

Theory

*Strength of Materials:*Basic concepts in Statics and Dynamics. Force Systems. Equilibrium condition, friction, Law of friction, Second moments of inertia, Parallel axis theorem. Dynamics: Equation of motion. Translation and rotation of a Rigid body, work and mechanics of materials: Stress-Axial Load classification Strain-Hooke's law, stress-strain diagram, Poisson's Ratio: Shearing Stresses. Torsion, Torsion formula, Angle to Twist of circular members. Power transmission shear force and bending moments, Shear in Beams, Bending Moment in beams. Pure bending of beams, Flexural stress shearing stresses in beams relations between centre, Torsional and flexural loads. *Dairy Machine Design:*Procedures, Specification, strength, design factor, factor of safety selection of factor of safety. Materials and properties. Static strength, ductility, hardness, fatigue, designing for fatigue conditions. Theories of failure, Stresses in elementary machine parts, Design of a drive system. Design of length and thickness of belt. *Bearing:* Journal and Anti-friction bearings. Selection of ball, tapered roller and thrust bearing. Springs, helical and leaf springs. Energy stored in springs. Design and selection of springs.

Practical

1. Study of Resultant forces.
2. Stress-strain diagram evaluation of elastic constants.
3. Study of pulley, gears and V-belts in power transmission.
4. Shear force and bending moment diagrams – I (Ferrous Metals).
5. Shear force and bending moment diagrams – II (Non-Ferrous Metals).
6. Shear force and bending moment diagrams – III (Non- Metals).
7. Study of flexural stresses.
8. Study of shearing stresses in beams.
9. Study of fits and tolerances.
10. Design stresses in elementary machine parts.
11. Design of shafts.
12. Design of axles.
13. Design of keys.
14. Design of springs.
15. Design of couplings.
16. Design of bearings.

DE 321 Food Engineering 3(2+1)

Theory

Rheology: Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rheological parameters, properties of granular food and powders, Properties of solids foods, Viscoelastic models. Measurement of food texture. *Food Freezing:* Thermal properties of frozen foods. Predication of freezing rates. Plank's equation, Design of food freezing equipment, Air blast freezers, Plate freezers, spiral freezers, and immersion freezers, IQF, storage of frozen foods. Freeze concentration. *Food dehydration:* Estimation of drying

time for food products, constant rate period and falling rate period dehydration. Diffusion controlled falling rate period. Use of heat and mass balanced in analysis of continuous dryers, Classification of driers, tray, vacuum, vacuum band, tunnel, bin, solar, drying, freeze drying, spin flash. *Freeze dehydration:* Heat and mass transfer, Calculation of drying time, Industrial freeze drying. *Other food processing operations and equipments:* Equipment for pulping, fruit juice extraction, blanching, dehulling, size reduction, milling, extrusion and distillation.

Practical

1. To determine physical properties of food product
2. To determine viscosity of food product.
3. To study size reduction equipment
4. To study food freezers.
5. To study freeze drier.
6. To determine drying characteristics of food product.
7. To study Tray driers.
8. To study solar driers.
9. To study juice extraction equipment
10. To compare hot water and steam blanching.
11. To study construction and working of distillation system.
12. To study various size reduction equipment.
13. Design problems of Cold Store.
14. Visit to cold storage.
15. Visit to food processing plant.

DE 322 Energy Conservation and Management 2(1+1)

Theory

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). 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. Role of Energy inspectors and Auditors in energy management. Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques. Quality of power, Power factor and its improvement. Transformers, losses in transformers. Energy savings in transformers. Electric motor-selection and application, Energy efficient motors. Variable Speed Drives and Variable Frequency Drives (VFD) and their role in saving electric energy. 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.

Energy efficiency and conservation in utilities:

High efficiency boilers, improved combustion techniques for energy conservation, Fluidized

Bed Combustion and multi fuel capabilities. Energy conservation in steam distribution systems, efficient piping layouts, protective & insulation coverings in utility pipes. Steamconservation opportunities. Upkeep and maintenance of steam auxiliaries and fittings. 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. Conservation and reuse of water, water auditing. Energy conservation opportunities in Wastewater treatment.

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.

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. Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets, Fuel and Oil conservation; important regular maintenance aspects. Carbon credits and carbon trade: Concepts of CDM, economic and societal benefits. 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.

Practicals

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 balance.
5. Solving problems on electrical energy use and management: Connected load, Maximum demand, Demand factor and Load curve.
6. Solving problems on electrical energy use and management: Maximum demand.
7. Solving problems on electrical energy use and management: Demand factor.
8. Solving problems on electrical energy use and management: Load curve.
9. Determination of load factor of an installation.
10. Study of use of power factor meter.
11. Determination of true power and wattles power using pf meters, Watt meter, Ammeter and Volt meter.
12. Study of performances of a general type of induction motor and energy and an energy efficient induction motor.
13. Study of use of VSD.
14. Study of various types of electrical appliances classified under different BEE star ratings.
15. Drawing energy Balance on a boiler. Collection of data, Analysis of results and determination of efficiency.
16. Exercise on energy audit of Students Experimental Dairy Plant.

DE 323 Dairy Plant Design And Layout 2(1+1)

Theory

Introduction of Dairy Plant design and layout: Type of dairies, perishable nature of milk, reception flexibility. Classification of dairy plants, Location of plant, location problems, selection of site. Hygienic design considerations for dairy processing plants. *Planning:* Dairy building planning, Process schedule, basis of dairy layout, importance of planning, principles of dairy layout. Space requirements for dairy plants, estimation of service requirements including peak load consideration. *Dairy plant design aspects:* General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design. Arrangement of different sections in dairy, sitting the process sections, utility/service sections, offices and workshop. Arrangement of equipment, milk piping, material handling in dairies, Common problems, office layouts-flexibility. Development and presentation of layout, model planning, use of planning table in developing plot plant and detailed layout. *Building construction materials:* Floors, general requirement of dairy floor finishes, floors for different section of dairy. Foundations, walls doors and windows. *Other design aspects:* Drains and drain layout for small and large dairies. Ventilation, fly control, mold prevention, illumination in dairy plants. *Computer aided Design:*Introduction to CAD software.

Practical

1. Building symbols and convention.
2. Symbols for equipments.
3. Symbols for P & I diagrams
4. Study of process schedule.
5. To draw layout of collection/chilling centre.
6. Visit to dairy processing plant for understanding of layout of different sections.
7. To draw layout of small dairy plant.
8. To draw layout of small dairy plant using CAD.
9. To draw layout of medium dairy plant.
10. To draw layout of large dairy plant.
11. To draw layout of cheese plant.
12. To draw layout of ice-cream plant.
13. To draw layout of butter manufacturing unit.
14. To draw layout of ghee plant.
15. To draw layout of composite dairy plant

IV. DAIRY MICROBIOLOGY

DM 111 Fundamentals of Microbiology 3(2+1)

Theory

*Overview of history and scope of microbiology:*Discovery of Microorganisms and Microscopy (types, working principles and applications); Theories of Biogenesis and abiogenesis; Contributions of Leeuwenhoek,Pasteur, Tyndal, Joseph Lister, Robert Koch, Edward Jenner and Alexander Fleming; Scope and application of microbiology in fields like Dairy, Food, Pharmaceutical, Industrial, Medical and agriculture.*Classification of Microbes:*Microbial classification systems, numerical taxonomy, General properties and principles of microbial classification, Whittaker's five kingdom and Carl Woese's three domain classification system; Systematics of bacteria and Bergey's manual of systematic bacteriology, Phylogenetic tree. *Procaryotic and Eucaryotic microorganisms:*Structure and functions of prokaryotic cells; Differences between prokaryotes and eukaryotes; Differences between cell wall of Gram positive and Gram negative bacteria; Structure of Archeal cell wall. *Microbial growth and nutrition***:** Bacterial growth curve; factors affecting growth of bacteria, direct and indirect methods of measurement of bacterial growth; Bacteriostatic and bactericidal agents; Common nutrient requirements and nutritional types of microorganisms. *Diversity of Microorganisms:*Viruses: Structure and Classification; Bacteriophages; Differences between viruses and bacteria; Fungi: Classification of Fungi; Reproduction in Fungi; Protozoa and algae.*Microbial Ecology and Environmental Microbiology:*Microflora of air, soil and water and Microbes of Extreme environment like Archea.*Basics of Microbial Genetics and Host-Microbe interactions:*DNA as the genetic material, Structure of DNA/ RNA, DNA replication, transcription and translation; Basic concepts of immunology; Role of immune system in governing host-microbe interactions, Microbial Commensalism, Colonization, Infection, Disease and Vaccines

Practical

1. General instruction for microbiological laboratory
2. Microscope- simple and compound
3. Microbiological equipments; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter.
4. Simple staining- methylene blue; crystal violet;
5. Negative staining.
6. Differential staining (Gram).
7. Differential staining (Spore, acid fast).
8. Motility of microorganisms - hanging drop technique.
9. Measurement of size of microorganisms by micrometry (ocular and stage).
10. Preparation of commonly used growth media liquid and solid
11. Preparation of simple and differential media
12. Isolation techniques for microorganisms – Streak, spreadand pour plate.
13. Enumeration of microorganisms in air and soil.
14. Enumeration of microorganisms in soil
15. Enumeration of microorganisms in water: total viable count, coliform (MPN).
16. Visit to Microbiology Laboratory of Dairy/Food Industry.

DM 121 Microbiology of Fluid Milk 3(2+1)

Theory

*Microbes associated with raw milk:*Significance of specific groups of microorganisms in milk i.e. psychrotrophic, mesophilic, thermoduric and thermophillic bacteria - their morphological and biochemical characteristics and classification. Microbial contaminants in raw milk, their sources during various stages of production - milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms; Microbiological changes in bulk refrigerated raw milk. *Sources of contamination and microbial spoilage of raw milk:* Microbial contaminants of raw milk supplies,their sources during various stages of production i.e. milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms and preventive measures.Types of microbial spoilage - souring, curdling, bitty cream, proteolysis, lipolysis, abnormal flavors and discolouration. Mastitis milk - types of mastitis, causative micro-flora of mastitis, compositional and microbiological changes during mastitis infection, their processing and public health. *Concept of clean milk production:*Hygienic milk production system; Cleaning and sanitation of udder, animal, utensils, equipments and dairy farm environment; Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world; Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoproxidase (LP) system. *Microbiological aspects of fluid milk:*Pasteurization, boiling, sterilization, ultra high temperature (UHT), non thermal (pulsed field) micro-filteration, bactofugation, standardization and homogenization.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.Bio-film formation during processing and their control measures. *Public health aspects of fluid milk:*Microbial zoonotic diseases transmitted through fluid milk; Milk borne diseases -food infection, intoxication and toxi- infection caused *E. coli, Salmonella typhi, Staphylococcus aureus, Bacillus cereus, Listeria monocytogenes, Shigella species, Campylobacter* etc. Microbiological grading and legal standards of raw and processed milk.

Practical

1. Morphological examination of common dairy microorganisms (size and shape, arrangement and sporulation).
2. Estimation of microbial load and grading of raw milk by standard plate count (SPC)
3. Estimation o microbial load and grading of raw milk by direct microscopic count (DMC)
4. Grading of raw milk by dye reduction tests (MBRT)
5. Grading of raw milk by dye reduction tests (RRT)
6. Grading of processed/ market milk by total viable count, coliform and methylene blue reduction time.
7. Enumeration of psychrotrophic and thermoduric bacteria in raw and market milk
8. Enumeration of thermophilic and spore forming bacteria in raw and market milk
9. Detection of sources of contamination: Air, water, and utensils

10. Detection of sources of contamination: Equipment and personnel, line testing.
11. Spoilage of milk caused by microorganisms: Souring, sweet curdling and gassiness
12. Spoilage of milk caused by microorganisms: Lipolysis, ropiness, proteolysis and discolouration.
13. Detection of mastitis milks: pH, chloride content, Hotis test and CAMP test.
14. Detection of mastitis milks: SLST and somatic cell count
15. Detection and estimation of coliforms: presumptive, rapid coliform
16. IMViC Tests.

DM 211 Microbiology of Dairy Products 2(1+1)

Theory

Microbiology of Cream and Butter **-** Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream and butter; Microbiological aspects including defects in pasteurized (ripened/unripened cream), sterilized and UHT cream; Factors influencing the microbial growth during batch/continuous butter making process; Microbial Defects in butter - Bacterial/mold discoloration, enzymatic deterioration and their control measures; Regulatory microbiological standards. *Microbiology of Condensed, Evaporated andDried products:* Type of microorganisms associated with condensed, evaporated and dried products, their growth/ survival during manufacture and storage; Microbial defects - Bacterial thickening / Mold button formation in SCM; Gassiness/bloating, Bacterial coagulation (Sour and sweet), Bitterness, Fishy flavor in evaporated milk; pre-heating/DSI temperature and their impact on microflora of dried products; Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards

Microbiology of Ice Cream and Frozen desserts: 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. *Microbiology of Indigenous Milk Products:* 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.; 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; Microbial defects, control measures and legal standards; Active packaging concepts and role in bio-preservation.

Practical

1. Microbiological examination of raw cream for Standard plate count (SPC), lipolytic and coliform counts, direct microscopic count (DMC) and dye reduction tests
2. Microbiological examination of pasteurized cream for Standard plate count (SPC) and coliform counts
3. Microbiological examination of sterilized and UHT cream for Standard plate count (SPC) and sterility test.
4. Microbiological examination of unsalted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test.

5. Microbiological examination of salted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test
6. Microbiological examination of concentrated milk for SPC, coliforms and yeast and mold
7. Microbiological examination of concentrated milk for spores, thermoduric and thermophilic counts.
8. Microbiological examination of dried milks for SPC, coliforms, *Staph. Aureus and B. cereus,*
9. Microbiological examination of dried milks for *E. coli, Salmonella*, Sulphite reducing clostridia and Staphylococcal enterotoxins.
10. Microbiological examination of ice-cream and other frozen desserts for SPC, coliforms and Staphylococcal counts;
11. Microbiological examination of ice-cream and other frozen desserts - Detection of *Salmonella* spp./*E. coli*.
12. Microbiological examination of khoa for SPC, coliforms and yeast and mold counts.
13. Microbiological examination of paneer for SPC, coliformsand , yeast and molds counts.
14. Microbiological examination of shrikhand for SPC, Spores, coliforms, yeast and molds and Staphylococcal counts.
15. Microbiological examination of paneer andshrikhand for Spores, and Staphylococcal counts.
16. Microbiological examination of packaging materials for SPC, Spores and Yeast and mold counts.

DM 221 Starter Cultures and Fermented Milk Products 3(2+1)

Theory

*Types, metabolism and propagation of starter cultures:*History, classification and importance of starter Cultures in dairy industry; Single, multiple, defined and mixed strain starters; Probiotics and Special cultures like exopolysaccharide production; Propagation of starter cultures-concentrates - direct bulk and direct vat starter cultures, factors affecting propagation; Metabolism of starter cultures (carbohydrate, protein, citrate) and production of metabolites and antibacterial substances; methods of starter distillates their merits/demerits.

*Activity, Purity, Preservation of Starters and Starter Failure:*Quality and activity tests for dairy starters and their preservation- methods (liquid, spray drying, vacuum drying, freeze-drying, frozen concentrate, concentrated dried cultures), merits and demerits; factors affecting the survival of cultures during preservation; Defects in starters and their control; Starter failures- effect of antibiotic residues, sanitizers and bacteriophages. Phages-life cycle, sources, prevention, chemical and mechanically protected systems. *Role of Starters in fermented milks:*Role of starters in the preparation of various fermented milks; Types of fermented milks - dahi, yoghurt, acidophilus milk; different types of dahi and yoghurt; preparation; defects and their control. Kefir and koumiss : origin and characteristics; microbiology of kefir grains; Other fermented milks such as Bulgarian milk, cultured buttermilk, Leben, Villi and Yakult; Microbiology of fermented milk products; their nutritional and therapeutic significance. *Chesse Starters:*Classification, desirable properties, Artisanal and adjunct cheese cultures, primary and secondary flora of cheese; biochemical

changes during ripening, bacterial and mold ripened cheeses: soft, semi-soft, semi-hard, hard, Brick and Brie cheese, Camembert and Roquefort cheese; Rennet: rennet substitutes, microbial rennet and recombinant chymosin

Practical

1. Testing purity of starter cultures by gram's staining, catalase test; creatine test.
2. Testing **s**tarter activity by dye reduction tests, Horrall-Elliker, White Head& 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 (temperature, pH, Salt and Sugar) on dairy starters.
8. Testing milk for presence of inhibitory substances using *B. stearothermophilus* and *S. thermophilus* as indicator organisms.
9. Effect of presence of antibiotic residues in milk on starter activity.
10. Evaluation of associative growth of Starter cultures in milk.
11. Detection of Bacteriophages in cheese whey by plaque assay method.
12. Preparation and microbial examination of dahi
13. Preparation and microbial examination of yoghurt
14. Preparation and microbial examination of cultured butter milk, acidophilus milk and kefir
15. Analysis of cheese for total spore and anaerobic spore count.
16. Microbiological analysis of cheddar cheese at different stages of manufacture of (storage and ripening).

DM 311 Quality and Safety Monitoring in Dairy Industry 3(2+1)

Theory

Consumer Awareness about Microbiological Quality and Safety of Dairy Foods: Changing scenario; Concepts of quality control, quality assurance and food safety; Global quality and food safety standards, Integrated food law, its main features and functions. *Introduction to FoodSafety Management System:* Concepts of Quality Management System (QMS)–ISO: 9000:2000; Principles of QMS; Standard requirements for QMS; HACCP concept and principle with special reference to biological hazards in dairy foods, TQM tools and techniques. *Microbiological RiskAnalysis Concepts:*Risk assessment, risk management and risk communication; risk profiling of dairy products; Microbiological criteria and two and three class sampling plan / guidelines; Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant. *Rapid Enumeration Techniques:* Enumeration principles and procedure for rapid detection of predominant hygiene indicator organisms and pathogens like *E. coli* (*E. coli* 0157:H7), *Salmonella, Shigella, Staphylococcus aureus, Bacillus cereus* and *Listeria monocytogenes*. *Role of Biosensors for monitoring hygiene and safety of dairy foods:* Detection of antibiotic residues in milk –Delvo SP, MDR test, penzyme test, charm assay, lateral flow assay (ROSA test) etc. Detection of aflatoxins, pesticides other inhibitors etc. and their public health importance in dairy foods. *Plant and*

*equipment hygiene:*Concepts of hygiene and sanitation, microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply, quality of air, personnel hygiene, treatment and disposal of waste water and effluents.

Practical

1. Rapid detection of total plate count, yeast and mold counts, Coliform, count using D-count
2. Rapid detection of total plate count, yeast and mold counts, Coliform, count using 3M Petrifilm kits.
3. Rapid detection of *E. coli*, Enterococci, Enterobacteriacae count using D- count
4. Rapid detection of *E. coli*, Enterococci, Enterobacteriacae count using 3M Petrifilm kits.
5. Rapid detection of *Staphylococcal enterotoxins*based on antigen antibody principleusing VIDAS system
6. Rapid detection of *E. coli* O157:H7based on antigen antibody principleusing VIDAS system
7. Rapid detection of *Listeria monocytogenes* based on antigen antibody principleusing VIDAS system
8. Rapid detection of *Salmonella*based on antigen antibody principle using VIDAS system.
9. Rapid detection of antibiotic residues in milk using Delvo SP, MDR test, Charm assay, Lateral flow assay (ROSA test).
10. Rapid detection of aflatoxin M1/ pesticides residues in milk usingCharm Assay, Lateral Flow Assay (ROSA test) / Enzyme Inhibition Assay using Luminometer.
11. Evaluation of common sanitizing agents used in dairy plants by suspension test.
12. Evaluation of common sanitizing agents used in dairy plants by capacity test.
13. Microbiological tests for assessing equipment and personnel hygiene by swab methods
14. Microbiological tests for assessing equipment and personnel hygiene by rinse methods
15. Determination of BOD in dairy waste water
16. Quality evaluation by HACCP in the preparation of dairy products

DM 321 Food and Industrial Microbiology 3(2+1)

Theory

*Scope of food microbiology:*Basic aspects, history and scope of food microbiology. Intrinsic and extrinsic factors that affect microbial growth in different foods.

*Microbial Spoilage of foods:*Microbial spoilage of fruits, fruit juices, vegetables, cereals, meat, poultry, sea foods, carbonated soft drinks, canned foods; Sources of contamination; Control of spoilage. *Food preservation:*Principles of food preservation : physical methods viz. low temperature and high temperature preservation (D, Z and F Values); Drying Methods; Chemical preservatives, Natural antimicrobial compounds and bio- preservation; Mode of action of various preservation methods on microbes. *Fermentation processes:*Fermentation processes : Historical development, the range, components and types (i.e. submerged, surface and solid state fermentation); criteria for selection of industrially

important microorganisms; preservation and improvement of industrially important micro-organisms using metabolic engineering/genetic engineering; media for industrial process; upstream and downstream processing. *Types of fermenters:* Fermenters: types (batch, fed batch and continuous), functions, design and control; sterilization; growth rate analysis, estimation of biomass; difference in chemostat and turbidostat. *Microbial production of industrial products:*Immobilization of enzymes/cells; Microorganisms and processes involved in the production of single cell protein and industrial alcohol, beer and wine; organic acids (citric and lactic), enzymes (protease, lipase and rennet), vitamin (B_{12}), antibiotics and bacteriocins; and fermented whey beverages.

Practical

1. Microbiological examination of fresh and canned fruits
2. Microbiological examination of fresh and canned vegetables
3. Microbiological examination of fresh and canned juices
4. Microbiological examination of flour and bread
5. Microbiological examination of eggs
6. Microbiological examination of meats
7. Isolation of psychrophilic, salt and sugar tolerant microorganisms from foods.
8. Isolation of industrially important microorganisms from environment.
9. Determination of Z, D and F values.
10. Production and assaying of microbial enzymes (protease/ lipase).
11. Production of lactic acid from whey
12. Production of nisin and assaying the antimicrobial activity of the culture
13. Design and control of a table-top and 10 liter lab fermenter (Demonstration)
14. Production of ethyl alcohol from molasses and whey by yeasts
15. Production of fermented whey beverages
16. Educational tour to food processing/ fermentation industries

V. DAIRY TECHNOLOGY

DT 211 Market Milk **4(3+1)**

Theory

Market milk industry in India and abroad: Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries. Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitors, lactoperoxidase system. Reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception, chilling, clarification and storage: General practices. b) Homogenisation: Definition, pretreatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST) c) Effect of homogenization on physical properties of milk. d) Bactofugation: Theory and microbiology. Thermal processing of milk: a) Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value. b) Factors affecting thermal destruction of microorganisms. c) Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing. d)

Product control in market milk plant. e) Defects in market milk. f) Manufacture of special milks: toned, doubled toned, reconstituted, recombined, flavoured, homogenized, vitaminised and sweet acidophilus milk. g) Manufacture of sterilized milk. h) Distribution systems for market milk. UHT processing of milk**:** a) Relevance of UHT processing in the tropical climate b) UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants. c) Aseptic packaging, types and systems of packaging, sterilizing packages, filling systems. d) Technical control in the UHT plant. e) Shelf life of UHT milk and tests for UHT milk. Nutritive value of milk. Effect of heat processing on nutritive value. Cleaning and sanitization of dairy equipment.

Practical

1. Familiarization with equipments for reception of milk in plant.
2. Pretreatments: Chilling, clarification, filtration of milk.
3. Standardization and numericals relating to it.
4. Cream separation: parts of separator and the process.
5. Operation of LTLT, HTST pasteurizer, laboratory steriliser.
6. Preparation of toned and double toned milks.
7. Preparation of standardised milk.
8. Preparation o f flavoured milks.
9. Preparation of sterilised milk.
10. Cleaning of storage tanks, cream separators, HTST plants
11. Manual cleaning and CIP.
12. Detection of adulterants and preservatives in milk.
13. Assessment of homogenisation efficiency in milk.
14. Strength of common detergents used in market milk plant.
15. Strength of common sanitizers used in market milk plant.
16. Visit to the Market Milk Plant

DT 212 Fat-Rich Dairy Products 3 (2+1)

Theory

Status of fat-rich dairy products in India and abroad. *Cream:* a) Definition & Legal standards, efficiency of cream separation and factors affecting it; control of fat concentration in cream. b) Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream. c) Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream), UHT processing of cream. d) factors affecting quality of cream; ripening of cream e) Packaging, storage and distribution, defects (non-microbial) in cream and their prevention. *Butter:* a) Introduction to the butter making process; theory of churning, Legal standards. b) Technology of Butter manufacture, Batch and continuous methods. Over-run in butter; control of fat loses in butter-milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter. Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butter churn and

continuous butter making machine. Special butters and related products: a) Manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter/fractionated and polyunsaturated milk fat products, vegetable oil-blended products and low-fat spreads. b) Manufacture, packaging, storage and characteristics of margarine of different types. *Ghee and butter oil:* a) Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee; utilization of substandard milk. b) Ghee: Composition and changes during manufacture fat constants. C) Butteroil: Manufacture of butteroil, packaging and storage.

Practical

1. Study of Cream Separators
2. Calculation of skimming efficiency and yield of cream.
3. Standardization of cream for consumer products.
4. Neutralization of cream.
5. Pasteurization and cooling of cream.
6. Preparation of sterilized cream.
7. Study of construction and cooperation of the power operated butter churn and butter packaging machine.
8. Preparation of cooking butter by the hand operated churn.
9. Preparation of desi butter.
10. Manufacture of table butter using the power-driven churn.
11. Moisture Control in Butter
12. Preparation of ghee from cream and butter
13. Preparation of Butter oil.
14. Preparation of Low Fat Butter Spread
15. Study and operation of continuous ghee plant.
16. Visit to the Fat Rich Dairy Product Plant

DT 213 Traditional Indian Dairy Products 3(2+1)

Theory

Status and significance of traditional Indian milk products in India. *Khoa:* Classification of types, standards methods of manufacture and preservation, factors affecting yield of khoa. Mechanization in manufacture of khoa. *Khoa based sweets:* Burfi, Peda, Milkcake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices. *Rabri and Basundi:* Product identification, process description, factors affecting yield, physico-chemical changes during manufacture. *Channa:* Product description, standards method of manufacture, packaging and preservation. *Chhana-based sweets:* Rasogolla, Sandesh, Rasomalai. Mechanization of manufacturing process, advances in preservation and packaging. *Paneer:* Product description, standards, method of manufacture, packaging and preservation**.** Mechanization of Paneer manufacturing/packaging process. *Chakka/Maska and Shrikhand:* Product description, standards, method of manufacture, small scale and industrial process of production, packaging and preservation aspects. Misti *Dahi:* Product description method of manufacture and packaging process. *Kheer and Payasam:* Product description methods of manufacture, innovations in manufacturing and packaging processes. Bio preservative

principles in enhancing the self-life of indigenous milk products including active packaging.

Practical

1. Preparation of Khoa from cow, buffalo and concentrated milk.
2. Analysis of Khoa for total solids, moisture, fat and acidity
3. Preparation of Basundi
4. Preparation of Burfi and Peda
5. Preparation of Kalakand and Milkcake
6. Preparation of Gulabjamun.
7. Preparation of Paneer from cow, buffalo and mixed milk.
8. Analysis of Paneer for total solids, moisture, fat and acididty
9. Preparation of Chhana from cow and buffalo milk and mixed milk.
10. Analysis of Chhana for total solids, moisture, fat and acididty
11. Preparation of Sandesh and Rasogolla.
12. Preparation of kheer and Rabri.
13. Preparation of Lassi and Butter Milk
14. Preparation of, Misti Dahi,
15. Preparation of Chhaka and Shrikhand.
16. Visit to the Market Milk Dairy Plant

DT 214 Condensed and Dried Milks 4(3+1)

Theory

Condensed Milks: History, status and scope in India and abroad, Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk, manufacturing techniques; a) Manufacture of evaporated milk including pilot sterilization test, b) Manufacture of sweetened condensed milk, c) Recombined sweetened condensed milk. Grading and quality of raw milk for condensed and evaporated milk, Physico-chemical changes taking place during manufacture of condensed milk, Heat stability of milk and condensed milk and role of stabilizers in the stability of condensed milk, Chemical defects in condensed milk, their causes and prevention. Recent advances with reference to freeze concentration and membrane concentration. *Dried Milks:* History and status in India and abroad, Grading and quality of raw milk for dried milks, Manufacture of skim milk powder (SMP), whole milk powders and heat classified powders, Physico-chemical changes taking place during manufacture of dried milks, Physical properties of dried milks, Defects in dried milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk, Manufacture of infant foods, malted milk foods and other formulated dried products, Cheese spread powder, ice cream powder, cream powder, butter powder, whey powder, Management of condensed and dried milk industry.

Practical

1. Testing the suitability of milk for concentration
2. Standardization of milk for preparation of Concentrated Milks.
3. Manufacture of plain skim concentrated milk.
4. Manufacture of Sweetened Condensed Milk.

5. Analysis of Sweetened Condensed Milk
6. Manufacture of Evaporated Milk.
7. Pilot Sterilization test for Evaporated milk
8. Analysis of Evaporated Milk
9. Concentration of milk by membrane processing.
10. Manufacturing of Skim Milk Powder by spray drying
11. Manufacturing of Skim Milk Powder by roller drying
12. Analysis of Dried Milk
13. Manufacture of instant milk powder.
14. Manufacture of Infant Food
15. Manufacture of Dairy Whiteners
16. Visit to the Condensed and Dried Milk Plant

DT 221 Cheese Technology 4 (2+2)

Theory

Origin and history of development of cheese manufacture, status and scope in India and abroad. Definition, standards and classification of cheese. Milk quality in relation to cheese making. Pre-treatment of milk; Physical and chemical. Additives and preservatives for cheese making. Rennet preparation and properties, rennet substitutes. Action of rennet on milk in relation to cheese making. Manufacture of different varieties of cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage. Enzyme modified cheese (EMC), flavourings, Application of membrane processing in cheese manufacture. Factors affecting yield of cheese. Packaging, storage and distribution of cheese. Accelerated ripening of cheese. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing.

Practical

1. Familiarization with equipments and accessories
2. Familiarization with Cheese varieties
3. Standardization numerical.
4. Standardization of casein/fat ratio
5. Testing the milk for cheese making
6. Study of factors affecting rennet action.

7-9 Manufacture of Cheddar cheese.

10-12. Manufacture of Gouda cheese.

13-15 Manufacture of Mozzarella cheese by Traditional Method

16-17. Manufacture of Mozzarella cheese by Direct Acidification Method

18-20. Manufacture of Swiss cheese.

21-23. Manufacture of un-creamed Cottage cheese.

24-26. Manufacture of creamed Cottage cheese.

27-28. Manufacture of Feta cheese.

29. Manufacture of processed cheese
30. Manufacture of processed cheese spread
31. Manufacture of processed cheese food
32. Visit to the Cheese Industry

DT 222 Ice-Cream and Frozen Desserts 3(2+1)

Theory

History, development and status of ice cream industry, History, development and status of ice cream industry, Definition, classification and composition and standards of ice cream and other frozen desserts, Stabilizers and emulsifiers-their classification, properties and role in quality of ice cream, Technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant, Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of over run, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention, Recent advances in ice-cream industry (flavourings, colourings, fat replacers, bulking agents) and plant management, Nutritive value of ice-cream.

Practical

1. Calculation of standardization of ice-cream mixes.
2. Manufacture of plain ice-cream.
3. Manufacture of fruit flavoured ice-cream
4. Manufacture of chololcate ice cream.
5. Manufacture of fruit ice cream.
6. Manufacture of nut ice cream.
7. Preparation of sherbet.
8. Preparation of ices.
9. Preparation of soft served ice-cream.
10. Preparation of filled ice-cream.
11. Manufacture of kulfi.
12. Study of batch type freezers.
13. Study of continuous type freezers.
14. Manufacture of ice-cream by continuous process.
15. Determination of overrun in ice cream.
16. Visit to the Ice cream Industry.

DT 311 Packaging of Dairy Products 3(2+1)

Theory

Introduction, Importance of Packaging, History of Package Development, Packaging materials, a) Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fibre board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms, Legal requirements of packaging materials and product informatio. Packaging of milk and

dairy products such as pasteurized milk, UHT-sterilized milk, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeades, concentrated and dried milks including baby foods. Packaging of functional dairy/food products. Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling of Food packages, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipments (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP, Microbiological aspects of packaging materials. Disposal of waste package materials, Packaging Systems. Hazards from packaging materials in food

Practical

1. Identification of packaging materials
2. Flame Hot wire test
3. Testing of papers/paperboards for Percentage moisture
4. Testing of papers/paperboards for Grease resistance
5. Testing of papers/paperboards for Water absorptiveness
6. Testing of papers/paperboards for Grammage
7. Testing of papers/paperboards for Tearing resistance
8. Testing of papers/paperboards for Bursting strength.
9. Testing of papers/paperboards for Puncture resistance
10. Testing of glass bottle for resistance to thermal shock.
11. Identification of various plastic packing materials
12. Testing of plastics and laminates for Thickness and Water vapour transmission rate (WVTR)
13. Testing of plastics and laminates for Grease resistance.
14. Packaging of different dairy products by using prepak
15. Packaging of different dairy products by vacuum packaging machines.
16. Visit to the Dairy Plant

DT 312 By Product Technology 3(2+1)

Theory

Status, availability and utilization of dairy by-products in India and Abroad. Associated economic and pollution problems, Physico-chemical characteristics of whey, butter milk and ghee residue, *By-products from skim milk: Casein:* types of commercial casein, their specifications, manufacturing processes with basic principles involved. b) Industrial and food uses of caseins c) Manufacture of sodium and calcium caseinates their physico-chemical and functional properties and food applications d) Manufacture of casein hydrolysates and its industrial application e) *Cooprecipitates:* types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications. *Whey processing:*a) Fermented products from whey, b) Beverages from whey c) Deproteinized and demineralized whey d) Condensed whey e) Dried whey, types and their specification, manufacturing techniques. F) Utilization of whey products. Application of membrane processing for whey processing. *Whey proteinconcentrates:* a) Methods of isolation with

basic principles involved, physico-chemical properties of whey proteins concentrates 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. Butter milk processing: a) Condensed butter milk b) Dried butter milk c) Utilization of butter milk products. *Ghee residue*: Composition, processing and utilization. Nutritional characteristics of by products.

Practical

1. Manufacture of acid casein from cow and buffalo milk.
2. Manufacture of edible casein from cow and buffalo milk.
3. Manufacture of rennet casein.
4. Manufacture of sodium caseinate.
5. Manufacture of calcium caseinate.
6. Manufacture of co-precipitate.
7. Isolation of whey proteins by cold precipitation technique.
8. Manufacture of whey protein concentrate by ultra filtration process.
9. Manufacture of whey drinks.
10. Manufacture of dried whey.
11. Manufacture of lactose.
12. Incorporation of whey protein concentrates in processed cheese foods.
13. Manufacture of coffee whitener.
14. Preparation of coconut candy from ghee residue
15. Preparation of chocolate from ghee residue
16. Visit to the Dairy Plant

DT 321 Sensory Evaluation of Dairy Products 3(2+1)

Theory

Introduction, definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects. Terminology related to sensory evaluation. Design and requirements of a sensory evaluation laboratory. Basic principles: senses and sensory perception. Physiology of sensory organs. Classification of tastes and odours, threshold value. Factors affecting senses, visual, auditory, tactile and other responses. Fundamental rules for scoring and grading of milk and milk products. Procedure and types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring, hedonic scale and descriptive tests. Panel selection, screening and training of judges. Requirements of sensory evaluation, sampling procedures. Factors influencing sensory measurements. Milk: score card and its use. Judging and grading of milk, defects associated with milk. Cream: desirable attributes and defects in cream, Score card for cream, sensory evaluation of different types of cream. Butter: Specific requirements of high grade butter, undesirable attributes of butter, butter score-card, sensory evaluation of butter. Ghee: grades of ghee, special requirements of quality ghee, defects in ghee, sensory evaluation of ghee. Fermented milks: desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, chakka, srikhand, lassi and other fermented drinks. Frozen dairy products: desirable and undesirable characteristics of frozen dairy products. Sensory evaluation of ice cream, kulfi and milk sherbets. Cheese:

sensory ~~Quality~~ attributes of some common cheese varieties and their defects, score card for cheese. Sensory evaluation and grading for cheddar, cottage and other varieties of cheeses. Dried dairy products: desirable and undesirable characteristic of dried milks. Sensory evaluation and grading of dry milk products. Concentrated milks: desirable attributes and defects. Sensory evaluation and grading of evaporated and condensed milk. Heat desiccated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets. Acid coagulated Indian milk products: desirable arid undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets. Consumer acceptance studies: Objectives, methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and consumers studies, limitations. Interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests.

Practical

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 using different types of sensory tests.
5. Sensory evaluation of milk
6. Sensory evaluation of milk cream.
7. Sensory evaluation of butter and ghee.
8. Sensory evaluation of 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.

DT 322 Food Technology-I 3(2+1)

Theory

Status of food processing industries in India and abroad, magnitude and inter- dependence of dairy and food industry, prospects for future growth in India. Harvesting, transportation and storage of fruits and vegetables. *Post harvest processing of fruits and vegetables:* Peeling, sizing, blanching, Canning of fruits and vegetables, Drying and freezing of fruits and vegetables. *Juice processing*: General steps in juice processing, role of enzymes in fruit. Juice extraction, equipments and methods of fruit juice extraction, preservation of fruit juices, fruit juice clarification, concentration of fruit juices, fruit juice powders. Fruit juice processing; Orange and tangerine, Lemon and lime juice, Apple juice, Grape juice, Nectars, pulpy juices, tropical blends, Vegetable juices. *Manufacture of Jam, Jelly and Marmalade*: Role played by pectin, sugar and acid in jellied fruit products. Fruits and vegetable preserves,

Glazed, Crystallized fruits. Tomato based products: Juice, puree, paste, sauce, ketchup. Pickles: Principle of pickling, technology of pickles.*Beverages:* Classification, scope, carbonated non-alcoholic beverages and their manufacture. Fruit beverages and drinks, additives for fruit based beverages. *Coffee:* Production practices, structure of coffee/cherry, Coffee processing including roasting, grinding, brewing extraction, dehydration, aromatization, instant coffee. *Tea:* Tea leaf processing, green, red, yellow, instant tea. *Technology of confectionery foods:* Candies, Chewing gums and bubble gums, Toffees, Caramels, Standards of confectionery products. *Chocolate products:* Cocoa bean processing, chocolate liquor, Standards of confectionery products. *Functional foods:* Introduction, Phytochemicals, Milk ingredients as nutraceuticals, fiber-rich food products etc.

Practical

1. Manufacture of toffees.
2. Manufacture of caramels.
3. Testing the efficacy of blanching process
4. Drying of fruits and vegetables
5. Preparation of fruit based drinks and beverages
6. Ready-to-serve drink, Nectar, 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

DT 411 Student READY In-Plant Training 20 (0+20)

Practical:

In-plant training in commercial dairy and or dairy food processing plants to acquire state of art of technology through exposure to actual field conditions. This will be conducive in enhancing linkages between academic institutions and industry and for more job opportunities to outgoing students. The in-plant training and evaluation will be as per the manual to be used

.

DT 421 Dairy Plant Management 2(1+1)

Theory

Production Management: Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement motion and time study. *Efficiency of plant operation:* product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency. *Plant Operations:* Energy conservation and Auditing, Product and process control, Control charts, Process Sigma,

Efficiency factors losses, Financial and Managerial efficiency. Provision for Industrial Legislation in India, particularly in dairy industry, Factory Act & Regulations. *Human Resource Management:* Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job enrichment, MBO, working conditions. *Safety hazards:* hazards prevention, security for plant machinery and the employees, Plant Maintenance. *Prevention & Break-down maintenance:* Spare parts inventory, tools & lubricants, etc. *Food hygiene:* personnel hygiene, plant hygiene, water quality, etc.

Practical

1. Flow process charts of Heat Desiccated milk products
2. Flow process charts of Fat Rich Dairy products
3. Flow process charts of fermented products
4. Flow process charts of Heat and acid coagulated products
5. Flow process charts of milk puddings
6. Identification of steps of material losses on dairy plants.
7. Identification of hazardous processes and equipments, safety and precautions.
8. Identification and uses of common lubricants.
9. Analysis of cleaning agents
10. Analysis of sanitizers
11. Reports and Records maintenance of dairy plant
12. Operational Precautions
13. CIP Cleaning of Homogenizer
14. CIP cleaning of HTST pasteurizer
15. CIP cleaning of Ice Cream Plant
16. Visit to the Dairy Plant

DT 422 Waste Disposal and Pollution Abatement 2(1+1)

Theory

Wastes discharged from dairy plants: An overview. Wastewater discharged from a) Milk reception dock b) Liquid milk processing section, c) Butter and ghee manufacturing, d) Ice-cream and condensed milk manufacturing, e) Milk powder manufacturing, f) Cheese and paneer manufacturing. Packaging wastes. *Environmental issues in effluent discharge:* a) Effects on waterways, b) Effects on land c) Effects on the atmosphere d) Solid waste. *Waste treatment process in a dairy processing plant*: Wastewater treatment options for A Dairy Processing Plant. Calculation of wastes discharged and the economics thereof.

Practical

1. Waste Utilization processes.
2. Different types of wastes generated in dairy industry
3. Different types of pollutions in diary industry
4. Various treatments in waste disposal.
5. Waste Generated in Liquid milk processing section
6. Waste Generated in Butter and ghee manufacturing

7. Waste Generated in Ice-cream manufacturing
8. Waste Generated in condensed milk manufacturing
9. Waste Generated in Milk powder manufacturing
10. Waste Generated in CIP section
11. Waste Generated in Cheese and paneer manufacturing
12. Packaging wastes
13. Calculation of wastes discharged and the economics thereof.
14. Analysis of effluent BOD and COD
15. Waste minimization methods
16. Visit to the dairy Effluent treatment plant

DT 423 Food Technology-II 3(2+1)

Theory

Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds, Milling of paddy, quality factors of rice grains, processing of rice bran oil, Instant rice, quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour, Milling technology of maize, wet milling of corn, Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods, Dehulling and processing technology of important pulses, Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut, Vegetable protein concentrates/isolates, Utilization of oil cake in food formulation. *Bakery and Snack technology:* Technology of bread, biscuits, crackers and cakes, Technology of manufacturing process of Pasta foods-Macaroni, Noodles and Spaghetti, Technology of breakfast cereals: corn flakes, puffed, extruded snacks, Potato chips. *Meat, fish and egg technology:* Development of meat, poultry, egg and fish industry in India, Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques, Postmortem inspection, rigor mortis and conversion of muscle to meat Slaughterhouse sanitation, meat hygiene and zoonotic diseases, Processing of poultry meat, Egg and egg products – quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish., Manufacturing process of dehydrated fish and fish pickles. Cleaning and sanitation, Waste management of food processing plants.

Practical

1. Manufacture of barley malt.
2. Determination of cooking quality of rice.
3. Manufacture of bread and bun.
4. Manufacture of biscuits.
5. Preparation of noodles.
6. Preparation of cake.
7. Manufacture of potato chips.
8. Preparation of malt based food products.
9. Manufacture of malted milk foods.
10. Manufacture of soy beverage

11. Manufacture of tofu
12. Preparation of salami.
13. Preparation of chicken soup.
14. Manufacture of chicken pickle.
15. Cleaning and sanitation food processing plant
16. Waste management of food processing plant

DT 424 - Student READY Experiential Learning Module

Students should prepare a business plan/entrepreneurship for production of dairy products in the area of specialized processing from procurement of raw material to processing including packaging and storage, conduct manufacturing, organize resources and utilities, sell the product, maintain accounts and documents, wind up production and submit the report of performance. All the students will be provided with course coordinator who will guide the students in "Experiential Learning Module". The Student READY Experiential Learning Module and evaluation will be as per the manual to be used

SUPPORTING COURSES

SC 111 PHYSICAL EDUCATION Credits 1 (0+1)

1. Introduction to physical education – Definition of physical education, aims, objectives and scope of physical education.
2. Postures: Exercises for good posture (2).
3. Physical Fitness: Exercises to develop physical fitness, components, speed, strength, endurance, power, flexibility agility, coordination and balance.
4. Recreation: Definition, agencies promoting recreation.
5. Rules and regulations of major games: Football, Hockey, Cricket, Volleyball,
6. Basketball, Ball Badminton, Throw ball and Tennikoit, Coaching and skills development of major games (3).
7. Rules and regulations of Indoor games: Shuttle Badminton, Chess and Table Tennis, Coaching and skills development of Indoor games (3).
8. Rules and regulations of Athletic events: Short and long distance running, Broad Jump, High jump, Triple jump, Javelin throw, Discuss throw, Shot-put, Hammer throw, and Relay events. Coaching and skills development of Athletic events (2).
9. Asanas – Importance of Asanas and Surya namaskar (2).
10. Training methods – Calisthenics, weight training, circuit training, Interval training, far trek training, pressure training and resistance training.

Note: Warming up and conditioning exercises are compulsory before the commencement of each class.

SC 311 N.S.S Credits 1 (0+1)

1. Orientation of students towards National problems.
2. Study of the philosophy of N.S.S.
3. Fundamental rights, directive principles of the constitution, socio-economic structure of Indian society, population and five year plans.
4. Functional Literacy: non-formal education of rural youth, eradication of social evil.
5. Awareness programmes, consumer awareness, highlights of the Consumer Act.
6. Environment enrichment and conservation.
7. Clean and Green Programme.
8. Health, family welfare and nutrition.
9. Organizing Medical Camp.
10. Organizing Tree Planting (*Vanamahostavam*).
11. Organizing Blood Donation Camp.
12. Organizing Pulse Polio Camp.
13. Organizing AIDS Awareness Rally
14. Celebrating NSS Day.
15. Observing National Days.
16. Observing United Nations Notified Days.

Student READY Rural Dairy Work Experience Program : 10 (0+10)

Student READY Rural Dairy Work Experience Program will be implemented in two parts as per ICAR V Deans Committee recommendations with 10 (0+10) non-evaluated credits equally distributed during I and II Years. The student will undergo various dairy production and processing activities during the summer breaks.

Student READY Rural Dairy Work Experience Program-I 5 (0+5)
(Summer Break after II semester)

The Student READY Rural Dairy Work Experience Program-I is aimed at provide exposure to the students to the areas on Milk Production & Procurement to be taken up in State Dairy Federations/ Dairy Development Departments/ Private Dairies/ Animal Husbandry Department/ Cattle farm/ Progressive dairy farmers *through visits/tours//survey/training programmes.*

Student READY Rural Dairy Work Experience Program-II 5 (0+5)
(Summer Break after IV semester)

The Student READY Rural Dairy Work Experience Program-II is aimed at exposure of students on Preliminary Dairy Operations to be taken up in Experimental Dairy/ Referral lab/ Dairy Plants / Exposure to Product manufacturing operations in Dairy & Food Industry

through field visits/tours//survey/training programmes