COLLEGE OF DAIRY TECHNOLOGY

SYLLABI

FOR UNDER GRADUATE PROGRAMME
AS PER RECOMMENDATIONS OF
4TH DEAN’S COMMITTEE
LEADING TO THE AWARD OF

B. Tech (Dairy Technology) Degree

(EFFECTIVE FROM 2008-2009)

COLLEGE OF DAIRY TECHNOLOGY, C.G.K.V,
RAIPUR (C.G.)
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Total Credits: 21, Credit Hr.: 14, 7

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Total Credits: 22, Credit Hr.: 14, 9
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<td>Packaging of Dairy Products</td>
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Sub Total (Theory+Practicals)- Creditable: 134 89 45

**FOURTH YEAR, 1st SEMESTER**

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**FOURTH YEAR, 2nd SEMESTER**

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Sub Total- Creditable: 28 0 28

Total- Creditable: 162 89 73

Total –Towards S/US 22

Grand Total 184

* Out of 25 credit assigned for Hands on Training and Experiential Learning (Fourth Year/First Semester) and In-plant Training (Fourth Year/Second Semester) only 14 credits in each semester will be counted towards O.G.P.A calculation and rest 11 credits will be evaluated as Satisfactory (S)/Unsatisfactory (US)
### Hands on Training and Experiential Learning (DHT-411)
Distribution of Credits (Fourth Year/First Semester)

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<td>Documentation and Reports</td>
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<td>Oral Examination</td>
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<td><strong>Grand Total</strong></td>
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### In-plant Training (DIPT-421)
Distribution of Credits (Fourth Year/Second Semester)

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COURSE CURRICULUM
B. Tech (Dairy Technology)

(A) DAIRY TECHNOLOGY

1. Market Milk : DT-111: 4 (3+1)

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.

Practical : Familiarization with equipments for reception of milk in plant; Pretreatments: Chilling, clarification, filtration. Standardization and numericals relating to it. Cream

Suggested Reading


2. Fat-Rich Dairy Products : DT-121: 3 (2+1)

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) Bacteriology of cream including defects, 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. 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.

of animal body fats and vegetable oils. Examination of the quality of sodium chloride for butter making.

**Suggested Reading**


3. Traditional Dairy Products: DT-211: 3(2+1)


**Practical**: Preparation of khoa from cow, buffalo and concentrated milk. Analysis of khoa, chhanna and paneer for total solids, moisture, fat and acidity. Preparation of kheer. Preparation of chhana from cow and buffalo milk and mixed milk. Preparation of paneer from cow and buffalo milk and mixed milk. Preparation of misti dahi, chhaka and srikhand. Preparation of khoa and chhanna based sweets. Microbiological examinations of traditional dairy products: Khoa, paneer, spore counts, coliform counts yeast, molds counts etc. Field trip

**Suggested Reading**

4. Ice-Cream And Frozen Desserts DT- 212: 3(2+1)

History, development and status of ice cream industry, Definition, classification and composition of ice cream and other frozen desserts, Stabilizers and emulsifiers-their classification, properties and role in quality of icecream, 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, Physico-chemical properties of ice-cream and compositional standards, Microenvironment in ice cream, microbiological quality of ingredients, critical process factors & their impact on entry of pathogen in ice cream, their survival during storage, food poisoning out breaks, food safety & legal standards, Recent advances in ice-cream industry and plant management, Technology for preparation of dried ice-cream milk mix. And Nutritive value of ice-cream.


Suggested Reading


5. Condensed And Dried Milks : DT-221: 4(3+1)

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, Physico-chemical properties of condensed milk and role of stabilizers in the stability of condensed milk, Chemical defects in condensed milk, their causes and prevention., Microbiological qualities of condensed milks, preservative used in evaporated, condensed & dried milks, a) Type of microorganisms occurring in condensed milks b) Survival and growth of microorganisms
during manufacture and storage. c) Microbiological standards, d) Type of spoilage and their 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, Microbiological quality of various dried milks including infant foods and Management of condensed and dried milk industry.

**Practical:**

Manufacture of plain skim concentrated milk. Chemicals and microbiological examination of concentrated and dried milks for (a) Moisture, T.S., Fat, lactose, sucrose, bulk density, solubility index, and (b) SPC, coliforms, yeasts and molds, toxins etc. Manufacture of SCM. Manufacture of EM. Concentration of milk by membrane processing. Manufacturing of SMP by spray drying/roller drying. Manufacture of instant milk powder.

**Suggested Reading**


Harrey, W.M.C. and Hill H. Milk Products Biotech Books, Delhi.

**6. By-Products Technology : DT-222: 3 (2+1)**


Suggested Reading

Sienkiewiz, T and Rvidel, C.L, Whey and whey Utilization, Verlage, Mann-Bvir, Germany.
Kessler, H.G. Food engineering and Technology Verlay, Frising Germany.
7. Cheese Technology : DT-311 : 4 (3+1)


Suggested Reading

P.F. Fox. – Cheese-Physics, Chemistry and Microbiology Vol-I and II
8. Dairy Plant Management and Pollution Control: DT-312:2(1+1)

Production Management. Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement moiton and time study, Plant Operations. Efficiency factors losses, Financial and Managerial efficiency Provision for Industrial Legislation in India, Particularly in dairy industry, Personal 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. Cleaning and Sanitation – different type of cleaning and sanitizing agents, Effluent treatment: Type, degree and treatment of waste.


Suggested Reading

Gupta, H.C., Dairying in India Kanlyani Publishers, New Delhi.

9. Food Technology-I: DT-313: 3 (2+1)

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,


Suggested Reading

Pearson, D. Laboratory Techniques in food Analysis, Butter worths, (Longan) Landon.
Normen J., Technology of Food Preservation.
Mainlay, Technology of Biscuits.
Bernord. Chocolate, Coca and Confectioneries

Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects; factors affecting food acceptance. Terminology related to sensory evaluation. Design and requirements of 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.


**Suggested Reading**


11. Packaging of Dairy Products DT-322: 3(2+1)


Suggested Reading

Gordan .L. Robertson- Food Packaging, Principles and Practices
Ahvenainum, R- Novel Food Packaging Techniques-Marcel And Deker.
Griffin.R. Principle of Package Development

12. Food Technology-II –DT-323: 3(2+1)

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, Alcoholic beverages, 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, Processing of meat and meat products: curing, smoking, edeboning and comminuted, Slaughterhouse sanitation, meat hygiene and zoonotic diseases, Processing of poultry meat, Egg and egg products – Processing of albumen, yolk and whole egg, drying and freezing of egg, quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish., Manufacturing process of fish protein concentrate, fish sausages, dehydrated fish and fish pickles. Cleaning and sanitation, Waste management of food processing plants.


**Suggested Reading**

Pearson, D. Laboratory Techniques in food Analysis, Butter woths, (Longan) Landon.
Normen J., Technology of Food Preservation.
Mainlay, Technology of Biscuits.
Bernord. Chocolate, Coca and Confectioneries
Sam.A.R. Poultry and meat Processing
(B) DAIRY ENGINEERING

1. Engineering Drawing: DE-111: 1 (0+1)


Suggested Reading


2. Workshop Practice: DE-112: 2(1+1)

Introduction to workshop practice, safety, care and precautions in workshop. Wood working tools and their use, Carpentry and pattern making. Mould material and their applications. Heat treatment processes: hardening, tempering, annealing, normalizing etc.
Metal cutting. Soldering & Brazing, Electric arc welding, Gas welding. Smithy and forging operations, tools and equipment. The bench : Flat surface filing, Chipping, Scraping Marking out, Drilling and Screwing. Use of jigs and fixtures in production. Introduction to following machine tools : (a) Lathe (b) Milling machine (c) Shaper and planer (d) Drilling and boring machines (e) Grinder (f) CNC machines.

Suggested Reading


3. Dairy Engineering  DE-121 : 3(2+1)


Suggested Reading

Food Engg. & Dairy technology, H.G. Kessler, Verlag A Kessler, Germany, 1982
Dairy Plant Engineering & Management, Tufail Ahmad, Kitab Mahal, New Delhi, 1996

4. Thermodynamics: DE-122 : 3 (2+1)
Basic concepts: systems, processes, cycles, energy, The Zeroth Law of Thermodynamics.


Suggested Reading

Dairy Plant Engg. & Management, Tufail Ahmad, Kitab Mahal, New Delhi.

5. Refrigeration & Air Conditioning: DE-211: 3(2+1)

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- and p-h diagrams, Mathematical analysis of vapour compression refrigeration system. Refrigerants: Primary and secondary refrigerants, common refrigerants (Ammonia, Freon), Brine, their properties and comparison. Multiple evaporator and compressor systems: Applications, One compressor systems: dual compression, comparison of system, Control of multiple evaporator system, Working and mathematical analysis of above systems. Refrigeration equipments: Compressor, Condenser, evaporator, Cooling tower, spray pond, Basic elements of design, Construction, operation and maintenance, balancing of different components of the system. Refrigeration Controls: Low side and high side float valves, capillary tube, thermostatic expansion valve, automatic expansion valve, solenoid valve, High pressure and low pressure cutouts, thermostat, overload protector, common defects and remedies. Refrigeration Piping:

**Practical**: Study of tools used in installation of a refrigeration plant including charging and detection of leaks. To study different parts and learn operation of bulk milk cooler. Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant. Study of different parts and learn the operation of a vapour absorption refrigeration plant. Dismantling and assemble an open compressor and a sealed unit. Study different parts and refrigeration controls of the following (a) Refrigerator (b) Water cooler (c) Deep Freezer (d) Compare their cooling coils and other systems. To find out the rating (cooling rate) at different suction temperatures (temperature differences) and air handling capacity of the air cooling unit. Plotting the practical refrigeration cycle on a pressure enthalpy diagram and to compare it with a theoretical refrigeration cycle. Study different parts and operation of a (a) Air washer, (b) Room cooler, (a) Air conditioner, (d) Chemical dehumidifiers, (e) Cooling. Plotting of psychrometric process: Sensible heating & cooling. Dehumidification & cooling and heating & humidification. Study of different humidity indicating, recording and controlling devices. Problems on cold storage. Visit to cold storage.

**Suggested Reading**


6. **Principles of Dairy Machine Design**: DE-212:3(2+1)


Springs, Couplings, Bearing

Suggested Reading


7. Fluid Mechanics: DE-213 : 3(2+1)


Practical: Study of different tools and fittings. Plotting flow rate versus pressure drop with U-tube manometer. Verification of Bernoulli’ s theorem. Determination of discharge coefficient for venturi, Orifice, V-Notch. Verification of emptying time formula for a tank. Determination of critical Reynold’ s number by Reynold’ apparatus. Study of reciprocating,
Centrifugal and gear pump. Calibration of Rota meter. Study of different types of valves. Problems on following topics: Pressure, capillarity and surface tension. Floating bodies, Liquid flow, venturimeter, orifice, weir, flow through pipes, pumps.

Suggested Reading


8. Heat & Mass Transfer: DE-221: 3(2+1)


Suggested Reading

9. Electrical Engineering: DE-222: 2(1+1)


Suggested Reading


10. Instrumentation and Process Control:: DE-311: 3(2+1)

Absolute and secondary instruments, Types of secondary instruments, Essentials of indicating instruments, Constructional details of indicating instruments. Principle of induction type instruments- shaded pole method and two pole methods, compensation for

**Practical:** Preparation and calibration of thermocouple; study the construction and working of Bourden pressure gauge. Study the mechanism of pH meter and its electrodes. Study a pressure transducer. Study a Proximity sensor. Study of the different parts and working of Rotameter. Study the different parts and working of pressure switch. Study the different parts of an indicating instrument. Study the different parts and their working of single phase induction type watt-hour meter. Visit to a microprocessor controlled dairy plant.

**Suggested Reading**

Mechanical Measurement, Beckarith & Buck.

11. **Dairy Process Engineering: DE-312 : 3 (2+1)**

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. Mechanization and equipment used in manufacture of indigenous dairy products, Butter and Ghee making machine, Ice-cream and Cheese making equipments. Packaging machines for milk & milk products. Membrane Processing: Ultra filtration, Reverse Osmosis and electro
Fourth Deans Committee

- Dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.

**Practical:** Study of construction and operation of: Vacuum pan: Double effect evaporator: Spray dryer: Vacuum and atmospheric drum dryers. Study and operation of Butter, Ghee, Icecream and cheese making equipments, Study the Reverse Osmosis and Ultra filtration system: Design problems on Double effect evaporator and Vacuum pan. Visit to a milk product plant.

**Suggested Reading**

Mechanical Measurement, Beckarith & Buck.


**Practical:** Building symbols and convention layouts for small, medium and large size dairies. Isometric presentation of piping. Design and layout of: Milk collection/chilling centre; Fluid milk plant (small, medium and large): Single product dairy (i) Cheese, (ii) icecream, (iii) butter and (iv) ghee. Composite dairy plant.

**Suggested Reading**

Dairy Plant layout, Lalat Chander.
13. **Food Engineering: DE-322: 3(2+1)**


**Suggested Reading**


(C) **DAIRY CHEMISTRY**

1. **Chemistry of Milk : DC-111: 3(2+1)**

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.


**Suggested Readings**

**2. Physical Chemistry of Milk : DC-112: 3 (2+1)**


**Suggested Readings**
Food Chemisty, Dr. Lng H.D. Beltz, Dr. Lng W. Groseh (1987) springerverlag, New York.
Chemistry and testing of Dairy Chemists by A.V. Atherton and J.A. Newlander.

**3. Biochemistry DC –121 : 2(1+1)**


method. Estimation of HMF content in food.

Suggested Readings


4. Human Nutrition: DC-221: 1(1+0)


Suggested Readings

Fundamental of Nutrition, L. Loyd Mc Dounald, Crempton (1979); W.H. Freeman & Co, LMC.
Food Nutrition and Diet Therapy; Krause and Mahan (1990); W.B. Sounders Co., New York.

5. Chemical Quality Assurance :DC-311: 3(2+1)

Importance of chemical quality control in dairy industry ; setting up quality control laboratories and testing facilities: mobile testing laboratories. Sampling procedures ; labeling of samples for analysis : choice of analytical tests for milk and milk products for chemical analysis; instrumental methods of analysis. Calibration of dairy glassware including butyrometer, pipettes, burettes, hydrometers, lactometers and freezing point thermometer. Preparation and standardization of reagents required in the analysis of milk and milk products. Application of PFA, AGMARK, BIS and codex related to dairy products for the

**Practical** : Calibration of dairy glassware such as pipette, burette, volumetric flasks, hydrometer, butyrometers. Preparation and standardization of dairy reagents such as acids, alkalies, sodium thiosulfate, silver nitrate, Fehlings. EDTA solutions etc. Detection of adulterants, preservatives, and neutralizers in milk and milk products. Chemical analysis of permissible additives used in milk and milk products. Chemical analysis of detergents and sanitizers. Preparation and testing of Gerber sulfuric acid used in fat determination. Testing the amyl alcohol used for fat determination. Analysis of market samples of milk and milk products.

**Suggested Readings**

The fluid milk Industry by Handerson
Milk Hygiene : WHO Monograph series 48
Chemical Analysis of food & food Products by MB Jacob
Chemistry and testing of Dairy products by AVA Ahterton and JN New land
ISI Specification.
Quality Control in the food Industry by SM Handerson.

**6. Food Chemistry : DC-321: 3(2+1)**


Suggested Readings

Technology of Food Preservation by N.W. Dosrosier and J.M. Dorrosier.

(D) DAIRY MICROBIOLOGY

1. Fundamentals of Microbiology :DM -111:  3(2+1)

Microbiology: history and scope; contributions of Leeuwenhock, Pasteur and Koch. Principle of microbiology: Light Microscopy (Bright field, dark field, phase contrast, fluorescence); preparation and staining of specimens; electron microscopy. Microbial taxonomy: principles; numerical taxonomy; major characteristics used in taxonomy; classification according to Bergey’s manual of systematic bacteriology. Structure and functions of prokaryotic cells; difference between prokaryotes and eukaryotes. Microbial growth and nutrition: the growth curve; factors affecting growth of microorganisms, estimation of bacterial growth; bacteriostatic and bactericidal agents; the common nutrient requirements and nutritional types of microorganisms. Bacterial genetics; DNA as the genetic material; structure of DNA; bacterial mutations (spontaneous and induced); genetic recombination- (transformation, transduction, conjugation). Micro flora of air, soil and water: methods for controlling microorganisms in air; water as carrier of pathogens.
Practical: General instruction for microbiological laboratory. Microscope- simple and compound; Microbiological equipments; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter. Simple staining- methylene blue; crystal violet; negative staining. Differential staining (Gram, spore, acid fast). Mortality of microorganisms; hanging drop technique. Measurement of microorganisms by micrometry. Preparation of commonly used growth media liquid and solid: simple and differential media. Isolation technique for microorganisms- Streak & pour plate Enumeration of microorganisms in air and soil. Enumeration of microorganisms in water: total viable count, coliform (MPN).

Suggested Readings

Fundamental principles of Bacteriology; By A.J.Salle; Tata McGraw Hill Publishing Co. Ltd. New Delhi
General Microbiology Vol.I & II; By C.B.Powar; H.F.Daginawala; Himalaya Publishing House, Bombay
Microbiology; By M.J.Pelezar ; E.C.S.Chan; N.R.Krieg; McGraw Hill Book Co., New York
Microbiology 6th Ed. S.S.Purohit; Agrobios(India) Jodhpur.
Introduction to Microbiology; By A.S. Rao; Prentice-Hall of India, New Delhi.
A Text book of Microbiology; By R.C.Dubey & D.K.Maheshwari; S.Chand & Company Ltd. New Delhi.
Microbiology : An Introduction; By G.J.Tortora, Berdell R.Funke and Christine L Case; Addisor Wesley Longman, Inc. San Francisco

2. Introductory Dairy Microbiology: DM:121: 3(2+1)

Hygienic milk production system; microbial quality of milk produced under organized v/s unorganized milk sector in India and comparison with developed countries; microbial and non microbial contaminants, their sources and entry points in milk during various stages of production; Good Hygiene Practices (GHP) during milk production operations
Microorganisms associated with raw milk; morphological and biochemical characteristics of important groups and their classification; significance of different groups of bacteria i.e. psychrotrophs, mesophiles, thermodurics, and thermophiles in milk. Microbiological changes in bulk refrigerated raw milk; Impact of various stages like milking, chilling, storage and transportation on microbial quality of milk with special reference to psychrotrophic organisms; Direct and indirect rapid technique for assessment of microbial quality of milk.
Role of microorganisms in spoilage of milk; souring, curdling, bitty cream, proteolysis, lipolysis; abnormal flavors and discoloration. Mastitis milk: Processing and public health significance, organisms causing mastitis, somatic cells secreted in milk; detection of somatic cell count (SCC) and organisms causing mastitis in milk. Milk as a vehicle of pathogens; Food infection, intoxication and toxic infection caused by milk borne pathogens like E. coli, Salmonella typhi, Staph aureus, Bacillus cereus etc. Antimicrobial substances in milk: immunoglobulin, lactoferin, lysozymes, LP systems etc.

Practical: Morphological examination of common dairy organism (size and shape, arrangement and sporulation). Enumeration of psychrotrophic, thermophilic, thermoduric and spore forming bacteria in milk. Detection of sources of contamination: air, water, utensils,
equipment and personnel line testing. Spoilage of milk caused by microorganisms souring, sweet curdling, gassiness, lipolysis, ropiness, proteolysis and discoloration. Detection of mastitis milks, pH, SLST, somatic cell count, chloride content. Hotis test, CAMP test. Detection and estimation of coliforms; presumptive test, rapid coliform count, IMVIC test. Detection of important pathogens using selective media; *E. coli*, *Staphylococcus aureus*, *Salmonella* and *Bacillus cereus*. Estimation of microbial load in milk by SPC and Dye reduction tests-(MBRT, RRT). Detection of antibiotic residues using quantitative test

**Suggested Readings**

- A Comprehensive Dairy Microbiology By J.S.Yaday, S.Grover & V.K.Batish; Metropolitan, New Delhi.
- Applied Microbiology; By P.C.Trivedi; Agrobios(India) Jodhpur.

### 3. Starter Cultures and Fermented Milk Products DM –211 : 3(2+1)

Introduction of starter cultures & their importance in dairy industry, classification of Lactic Acid Bacteria; Metabolism of Lactic Acid Bacteria and diacetyl production, production of antibacterial substances by lactic starter cultures. Mixed and define strain starter culture; propagation of starter cultures; factors affecting their propagation; starter concentrates- direct bulk and direct vat starter cultures; starter distillates. Quality and activity of starter cultures; defects in starters and their control; starter failures; antibiotic residues, sanitizers and bacteriophages. Preservation of starter cultures: freezing and freeze-drying; factors affecting the survival of cultures during preservation. Role of starter cultures in the preparation of various fermented milks; classification of fermented milks Microbiology of dahi and yoghurt; different types of dahi and yoghurt; preparation; defects and their control. Microbiology of milk products; their nutritional and therapeutic significance. Kefir and Kumiss: origin and characteristics: microbiology of Kefir grains. Microbiology of other fermented milks such as Bugarian milk, cultured buttermilk, Leben and Yakult; their significance. Concept of probiotic starters and their application in probiotic dairy food.

Microbiological analysis of processed cheese - Total spore count & Anaerobic spore count. Microbiological analysis at different stages of manufacture of (storage and ripening) hard varieties of cheese - such as Cheddar cheese.

**Suggested Readings**

Dairy Starter Cultures By T.M.Cogan & J.P.Accolas Wiley –VCH, New York
Cheese and Fermented Milks; By F.V.Kosikowsky; Applied Science Publisher, London.
International Dairy Federation- Monograph on Fermented Milk (IDF) No.277/1988

**4. Dairy Biotechnology : DM -221 : 3(2+1)**


**Practical :** Isolation of plasmid and genomic DNA from bacteria (*E. coli*, lactic acid bacteria Agarose gel electroporesis of DNA fragments). Restriction analysis of DNA. Curing of plasmids. Preparation of competent cell. Conjugal transfer in *E. coli* cells. Transformation of *E. coli* by calcium chloride treatment/ electro oration. Preparation of protoplasts and protoplast fusion. PCR technique demonstration. Visit to a biotechnology lab.

**Suggested Readings**

Molecular Microbiology Laboratory course By Ream W.
5. Quality and Safety Monitoring in Dairy Industry: DM-311: 3(2+1)

Current awareness on quality and safety of dairy foods; consumer awareness and their demands for safe foods; role of Codex Alimentarius Commission (CAC) in harmonization of international standards; quality (ISO 9001:2000) and food safety (HACCP) system and their application during milk production and processing. National and international food regulatory standards; BIS, PFA, ICMSF, IDF etc., their role in the formulation of standards for controlling the quality and safety of dairy foods. Rapid assessment of dairy food for microbial and non-microbial contaminants; Enumeration Principles in detection of predominant spoilage organisms and pathogens like indicator organisms, \( E.\text{coli} \), salmonella, shigella, staph aureus, Bacillus cereus and non-microbial contaminants like antibiotic residues, aflatoxin, pesticides other inhibitors etc from dairy foods and their control measures. 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; setting up of a microbiological/pathogen lab in a dairy plant and its safety concern.


**Suggested Readings**

- Standard Methods for the Examination of Dairy Products. By W.J.Hausler. APHA, Washington DC

6. Food and Industrial Microbiology: DM-321: 3(2+1)

Food Microbiology: Basic aspects and scope of food microbiology. Intrinsic and extrinsic factors that affect microbial growth in foods. Microbial spoilage of fruits, fruit juices, vegetables, cereals, meat, poultry, sea foods, carbonated soft drinks, canned foods; control of spoilage. Food preservation: physical methods; chemical preservatives and natural antimicrobial compounds, biology based preservation system. Industrial Microbiology: Fermentation processes: the range, components and types (submerged, surface and solid state fermentation); criteria for selection of industrially important microorganisms; media for industrial and inoculums development; down stream processing of fermentated products.
Fermenters: types, functions, design and control; chemostat and turbidostat. Microorganism and processes involved in the production of industrial alcohol, organic acids (citric lactic), enzymes (protease, lipase and rennet), vitamin (B-12), antibiotic (nisin) and microbiology of effluent treatment in food industry.

**Practical:** Microbiological examination of: fresh and canned fruits/vegetables/juices; flour and bread, eggs and meat. Design and control of a tabletop and 10 liter lab fermenter (Demonstration). Isolation of psychrophile, salt and sugar tolerant microorganisms from foods. Isolation of industrially important microorganisms from environment. Production and assaying of microbial enzymes (protease/ lipase). Production of lactic acid from whey. Production of nisin and assaying the antimicrobial activity of the culture. Production of ethyl alcohol from molasses and whey by yeasts. Production of fermented whey beverages. Educational tour to food processing/fermentation industries.

**Suggested Readings**

Industrial Microbiology; By Gerald Reed; CBS Publisher & Distributors, Delhi
Industrial Microbiology; By L.E.Casida; New Age International (P) Ltd.Pub. New Delhi.
Modern Food Microbiology 3rd Ed. By James M.Jay. CBS Publisher & Distributors, Delhi.
Food Microbiology; Tata McGraw Hill By W.C.Frazier and Dennis C.Westhoff Publishing Co., Delhi.
Microbiology of food Fermentation. 2nd Ed. Carl S.Pederson AVI Publishing Co. Inc., Westport.
Basic Food Microbiology George J. Banwart. CBS Publishers & Distributors, Delhi.

(E) OTHERS

1. **Economic Analysis : DEC-111: 2(2+0)**

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. Economic features and characteristics of dairy sector in India. Dairy development strategy with special emphasis in post- independence era and Operation Flood Programme.

**Suggested Readings**


2. Environmental Studies : DES-111: 3(2+1)

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.


**Suggested Readings**


Environment Decision Making Vol. II Yusuf J. Ahmad, Pratha Dasgupta,Karl Govan Maler

Environment Concerns and Strategies ,T.N. Khosla
3. Dairy Production and Management : DAH - 121: 3(2+1)


Suggested Readings

A Text Book of Animal Husbandry,G.C. Banergee
Live Stock Production and Management, N.S.R. Shastry & C.K. Thamos
4. Dairy Extension Education: DEXT-121: 2(1+1)


Practical: Acquiring skill in use of audio-visual & other aids: Overheads Projector, Slide Projector. Use of VCR and PA system, Camera handling. Preparation and use of visual aids and printed material; Poster and chart, Flash card and flannel Graph. Circular letter, leaflet, pamphlet, folder. Group Discussion Technique, Developing Communication and Overall Skills, Brain-storming Technique for developing the Decision making Process, Interview technique(s), Identification of problems of village farmers through interview method, Writing a radio script.

Suggested Readings
The Process of communication by David K. Berlo.

5. Industrial Statistics: DSC-121: 3(2+1)


Suggested Readings

Fundamental of Applied Statistics - S C Gupta and V K Kapoor, Sultan Chand and Sons Publication
Elementary Mathematical Statistics Gupta, S.C. & Kapoor, V.K. Sultan Chand and Sons Publication

6. Communication Skills and Entrepreneurship Development: DEXT-211: 2 (1+1)

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. 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 horticulture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business.

Practical: Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations.

Suggested Readings

Entrepreneurship Development - S.S. Khanna


Developing New Entrepreneurs EDII, NISIET Library: 338.93/EDI/87/25104.


7. **Computer Programming : DSC-211:3 (1+2)**

Problem solving with computers, flowchart and algorithm development, Data types variables, constants, arithmetic and logical expressions, input/output statements, conditional statements, control structures, arrays, functions, structures, unions.

**Practical**: Understand different Components of Computer System. Write a C program to calculate volume of a prism having trapezoidal base. Write a program, which can input a positive integer (<=10000000) and print it in reverse order. For example 98756789. Write a program to calculate sum of squares of all odd integers between 17 to 335. Exclude integers divisible by 7. Ohm’ s law is I=V/R. Write a program to calculate I from given n sets of V and R. Write a program to generate the Cartesian coordinates of points (x, y) for the values of ranging from 0, 5, 10, 15 ------- 90. title and label the output. Write a program to calculate the resultant focal length f, when f1 and f2 are placed in contact. Used formula is f= (f1+f2)/(f1xf2). Compute for following pairs of local lengths. f1= 10, -8, -6, -1 1, 8, +10; f2= 0.5, -0.4, ………….. +0.4, +0.5 Write a program to sort an array of N elements in ascending order.

Write a program to evaluate following series to calculate cos x

\[ \cos x = \frac{1x2}{2} + \frac{x4}{4} + \frac{x6}{6} + \ldots \]  

Compare the calculated value with the one by using library function. Write a program which reads in indefinite number of Name, Marks1, Marks2, Marks3 from keyboard and store them in a file along with total marks, Percentage marks and Grade in a file.
Suggested Readings

Mastering C, Venugopal, 2004,
Data Structure & Program Design, Robert L. Kruse, 2000
Programming in C – Yaswant Kanitkar


**Suggested Readings**

Financial management, I.M. Pandey, Vikash Publishing House Ltd. New Delhi, 1995
Financial management, Jain and Khan, Tata McGraw Hill, New Delhi,
Financial management, Prasanna Chandra,
Book Keeping and Accounting , R.R. Gupta
Double Entry System of Book Keeping, R. Batliboi
Management Accounting, Hingorani, Ramanathan Grewal, Sultan Chand & Sons, Delhi, 1996
Double Entry Book-Keeping, S. Grewal (Vol. 1,2,3,), Sultan Chand & Sons, Delhi, 1994
Introduction to Accounting, T.S. Grewal, Sultan Chand & Sons, Delhi

9. **IT in Dairy Industry : DSC-221: 2(1+1)**


**Practical:** Applications of MS Excel to solve the problems of dairy technology: Statistical quality control, Sensory evaluation of food. Chemical kinetics in dairy processing. Use of word processing software for creating reports and presentation. Familiarization with the application of computer in dairy industries: Milk plant, Dairy units, Fruit & Vegetable processing unit. Familiarization with software related to dairy industry. Visit to Industry and knowledge of computer application in the same.

**Suggested Readings**

Information technology today, S. Jaiswal, 2003
Operating System, Mandinick & Donovan, 1999
Fundamental of I.T, V. Rajaram, 2002
Operation Research, Gupta and Kumar, 1999
Office 2000 Made Easy, Alan Neibauer, 2000
Data Base Management System, Raguramakrishnan 1999
Artificial Intelligence – Elain Rich and Kevin Knight
Rule Based Expert system – M. Sashikumar and S. Ramani


Concept of marketing; Functions of marketing; concepts of marketing management; scope

Suggested Readings

Marketing Management, Philip Kotler,Prentice Hall of India, New Delhi, 1994
Marketing Management, Dr. P.K. Shrivastava, Himalaya Publication House, New Delhi, 1993
Marketing Management, Dr. S.C. Jain, Sahitya Bhavan, Agra, 1995
Advertising management, David A. & Rajiv Batra, Prentice Hall of India, New Delhi, 1995
Marketing in the International Environment, Cundiff & Higher, PHI, New Delhi, 1993

11. Operation Research; DEC-321: 2(2+0)


Suggested Readings

Operation Research Kanti Swarup, Gupta, P.K. & Man Mohan, Sultan Chand and Sons Publication
Introduction to Operation Research, Kanti Swarup, Gupta, P.K. & Man Mohan, Sultan Chand and Sons Publication
Problem in Operation Research, Gupta, P.K. & Man Mohan, Sultan Chand and Sons Publication
Linear Programming and Theory of Game, Gupta, P.K. & Man Mohan, Sultan Chand and Sons Publication