

### **Plan of Written Examination**

All the aspirants are informed as under with respect to the written test to be conducted for the recruitment of **Dairy Development Inspector Grade II (Advt. No.08 of 2023)** :-

1. The Exam will be conducted in MCQ (Multiple Choice Questions) format. OMR sheets will be used for answering the questions.
2. The Exam would be of 2 hours 30 minutes duration.
3. The Exam will consist of two parts (Part A and Part B) as follows:-

(a) **Part A:-** Qualifying test of Punjabi Language equivalent to Matriculation standard as per Notification No. G.S.R.72 / Const. / Art.309/Amd.(22)/2022, dated:28.10.2022.

Part	Topic	No. of Questions	Marks (Each Question carries 1 mark)	Type of Questions
<b>A</b>	Punjabi (Qualifying Nature) (Annexure-1)	50	50	MCQs (Multiple Choice Questions)

**Note:- (i) There will be no negative marking in Part-A.**

**(ii) Part 'B' will be evaluated only if a candidate scores minimum 50% marks (i.e 25 marks) in Part 'A'.**

(b) **Part-B:-** Part-B will consist of two sub-sections i.e Section (I) and Section (II) as following:-

Part	Section	Topic	No. of Questions	Marks (Each Question carries 1 mark)	Type of Questions
<b>B</b>	(I)	Questions from General Knowledge, English, Logical Reasoning and Mental ability, Punjabi (Annexure-2)	30	30	MCQs (Multiple Choice Questions)
	(II)	Questions from the Subject (Annexure-3)	70	70	
	<b>Total</b>		<b>100</b>	<b>100</b>	

**Note:-(i) There will be negative marking in Part-B. Each question carries 1 mark. For every wrong answer, 1/4<sup>th</sup> mark would be deducted. The question(s) not attempted will receive no credit or discredit.**

**(ii) The merit list of candidates, who will qualify Part-'A', will be prepared on the basis of marks secured by candidate in Part-B.**

4. Tentative syllabus for the written examination for the recruitment of **Dairy Development Inspector Grade II (Advt. No.08 of 2023)** is annexed at Annexure-1,2 and 3.

Annexure-1 (Punjabi Syllabus)  
Part-A (Punjabi Qualifying Exam)

1. ਜੀਵਨੀ ਅਤੇ ਰਚਨਾਵਾਂ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ:-  
ਸ੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ, ਸ੍ਰੀ ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਜੀ, ਸ੍ਰੀ ਗੁਰੂ ਰਾਮਦਾਸ ਜੀ,  
ਸ੍ਰੀ ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ, ਸ੍ਰੀ ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਜੀ, ਸ੍ਰੀ ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ ਜੀ।
2. ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ, ਸਮਾਨਾਰਥਕ ਸ਼ਬਦ।
3. ਮੁਹਾਵਰੇ।
4. ਅਖਾਣ।
5. ਸਬਦ ਦੇ ਭੇਦ।
6. ਅਗੇਤਰ/ਪਿਛੇਤਰ।
7. ਵਚਨ ਬਦਲੇ ਤੇ ਲਿੰਗ ਬਦਲੇ।
8. ਵਿਸਰਾਮ ਚਿੰਨ੍ਹ।
9. ਸ਼ਬਦਾਂ / ਵਾਕਾਂ ਨੂੰ ਸੁੱਧ ਕਰਕੇ ਲਿਖੋ।
10. ਅੰਗਰੇਜ਼ੀ ਸ਼ਬਦਾਂ ਦਾ ਪੰਜਾਬੀ ਵਿੱਚ ਸੁੱਧ ਰੂਪ।
11. ਅੰਕਾਂ, ਮਹੀਨੇ, ਦਿਨਾਂ ਦਾ ਸੁੱਧ ਪੰਜਾਬੀ ਰੂਪ।
12. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।
13. ਪੰਜਾਬ ਦੇ ਇਤਿਹਾਸ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।
14. ਪੰਜਾਬ ਦੇ ਸਭਿਆਚਾਰ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

**Annexure-2**

**Part B(I)--General Knowledge, Logical Reasoning and Mental Ability.**

<b>Sr. No.</b>	<b>Indicative Contents of Syllabus</b>	<b>Weightage (Approx.)</b>
1	<p><b>General Knowledge and Current affairs of National and International importance including:</b></p> <p>(i) Political issues,                      (ii) Environment issues,                      (iii) Current Affairs,                      (iv) Science and Technology,                      (v) Economic issues,                      (vi) History of Punjab-14<sup>th</sup> century onwards                      (vii) History of India with special reference to Indian freedom struggle movement.                      (viii) Sports,                      (ix) Cinema and Literature.</p>	10
2	<p><b>Logical Reasoning &amp; Mental Ability:</b></p> <p>Verbal reasoning: Coding, Decoding, Analogy, Classification, Series, Direction sense test, relations, mathematical operations, time test, odd man out problems.</p> <p>Non Verbal reasoning: Series, Analogy and Classification.</p> <p>Basic numerical skills, Percentage, Number system, LCM and HCF, Ratio and Proportion, Number series, Average, Problems based on Ages, Profit &amp; Loss, Partnership and Mixture, Simple and Compound Interest, Work and Time, Time and Distance. Mensuration and Data Interpretation.</p>	10
3	<p><b>English:-</b></p> <p>Basic Grammar, Subject and Verb, Adjectives and Adverbs, Synonyms, Antonyms, One Word Substitution, Fill in the Blanks, Correction in Sentences, Idioms and their meanings, Spell Checks, Adjectives, Articles, Prepositions, Direct and Indirect Speech, Active and Passive Voice, Correction in Sentences, etc.</p>	5
4.	<p><b>ਪੰਜਾਬੀ:-</b></p> <p>ਸੁੱਧ-ਅਸੁੱਧ, ਸ਼ਬਦਜੋੜ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ, ਸਮਾਨਾਰਥਕ/ਵਿਰੋਧੀਸ਼ਬਦ, ਨਾਂਵ, ਪੜਨਾਂਵ ਅਤੇ ਕਿਰਿਆ ਦੀਆਂ ਕਿਸਮਾਂ ਤੇ ਸਹੀ ਵਰਤੋਂ, ਲਿੰਗ ਅਤੇ ਵਚਨ, ਪੰਜਾਬੀ ਅਖਾਣ ਤੇ ਮੁਹਾਵਰੇ, ਅੰਗਰੇਜੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਅਤੇ ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੀ ਥਾਂ ਇੱਕ ਸ਼ਬਦ ਆਦਿ।</p>	5
	<b>Maximum Marks</b>	30

### **Annexure-3**

#### **Part B (II)-Subject Syllabus (Dairy Development Inspector Grade II)**

##### **Milk Production Management & Dairy Development**

Introduction to Animal Husbandry. Distinguishing characteristics of Indian 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. 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 to 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. Socio-economic and geographical features of Indian dairying. Traditional Systems of cattle keeping, estimates of milk production, utilization and sale: cattle & buffalo population and its distribution: trends in population growth. annual milk production and per capita availability, productivity profile of indigenous dairy stock. Trial by-product of livestock industry. Five year plans and dairy development: resource inadequacy, post partition pressure: catalytic action of international air, major aided dairy projects; public sector milk supply schemes; co-operative dairy organizations. Anand pattern and perspectives; milk products manufacture in private sector, import substitutions in dairy products. Strategy of cattle improvement: pioneering role military dairy farm: key village scheme and its limitations, intensive cattle development programmes concept, approach and achievements. Public sector dairy schemes, Economic burden performance analysis National Dairy Development Board-aim and objectives policy orientation in dairy development. Operation Flood-I,II,III programmes & Outlay, implementation, success, achievements. Integrated infrastructure of milk production, improvements of dairy co-operative organization, Dairy development Corporations, Co-operative Dairy Federations. Self-reliance in dairy development, income & employment potential. Conversion of milk into products. Utilization pattern indigenous & western products. Dairy problems and policies.

##### **Dairy Extension Education**

History, need definition, philosophy, principles, approaches and objectives of extension education Present status of extension and rural Development programmes. Teaching/learning process Extension Teaching Methods, classification and selection of teaching methods. Nature and importance of communication Key elements of communication Models of communication, process, feedback and problems in communication. Importance of audio visual aids in extension education. Classification, planning and selection of A.V. Aids identification of rural leaders, their characteristics, roles and functions in rural development. training of rural leaders. Definition of groups natural types, principles of working with groups and their mobilization Need, principles and steps of programme planning Evaluation of extension programmes Diffusion of innovations and categories of farmers Conceptual orientation about different terms, like PRA, RRA, IVLP/TAR, ATMA, ATIC. PTD etc.

### **Marketing Management and International Trade**

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: 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).

### **Physical Chemistry of Milk**

Constituents and gross composition of milk of different species and breeds of milch animals, Colloidal State Distinction between true and colloidal

solution. lyophilic & lyophobic Milk solution, properties of colloidal system  
Properties of colloidal systems Gels-their formation and properties. as a  
colloidal system and its stability. Elementary idea about emulsion. Density:  
Density and specific gravity, pycnometer 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 1 Non-Newtonian liquids. Stokes Law, influence of  
temperature and condensed and concentration of solute on viscosity.  
Viscosity of milk, evaporated mi Property of milk, evaporated milk and milk.  
Refractive index. Colligative Properties of Dilute Solution: Vapour pressure.  
Raoult's Law. Depression of freezing point, Elevation of boiling point.  
Freezing point and point of milk. Osmosis and Osmotic pressure. Inter-  
relation of colligative colligative properties. Aqueous solution of  
Electrolytes: Electrolytes; non-electrolytes, ionic mobility, electrical  
conductance, Ostwald Dilution Law, Kohlrausch 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 its application, buffer capacity and buffer index,  
milk as 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 electro  
magnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet  
Spectroscopy. Mention of mass, NMR spectroscopy.

## **Chemistry of Milk**

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: a Lactalbumin  
and B- Lactoglobulin. Properties of a Lactalbumin and lactoglobulin.  
Immunoglobulin 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.

### **Chemical Quality Assurance**

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 quality control of milk and milk products Preservatives, neutralizers and adulterants in milk and milk products and their detection Accreditation of analytical laboratories Hazard analysis and critical control points (HACCP). Prediction of shelf life behavior of milk and milk products. Milk contact surfaces, metallic contamination, environmental contaminants such as pesticides, antibiotics, heavy metals in dairy products: methods of estimation. Soft and hard water, temporary and permanent hardness, softening of hard water.

### **Fluid Mechanics**

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, capillants Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical gages. Piezometer. Floating bodies: Archimedes principle, stability of floating bodies. Qalib of floating bodies. Metacentric height. Fluid flow: Classification, steady uniform and non uniform flow, Laminar and turbulent, continuity equation. Bernoulli'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. Types of chambers, selection and sizing.

## **Heat & Mass Transfer**

Basic heat transfer process, thermal conductivity, convective film coefficient, Stefan Boltzman's constant and equivalent radiation coefficient. Overall heat transfer coefficient. 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 Cartesian co-ordinates, 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. One dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with uniform heat generation, Development of equations of temperature distribution with different boundary conditions. Steady-state heat conduction 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 in dairy and food industry. Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolar diffusion. Mass transfer coefficient and problems on mass transfer.

## **Thermodynamics**

Basic concepts systems, 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. The second Law of Thermodynamics Thermodynamic temperature scale. Carnot cycle, entropy, reversibility, availability. Air Cycles: Otto, Diesel, dual efficiencies. Plotting the cycles on various thermodynamic planes viz., p-V. T-S. p-h diagram: etc. IC. Engines: Two stroke and four stroke engines, construction. injection and ignition of fuel. Performance of IC engines. Fuels: Chemical properties, air fuel ratio and its determination, Burners. of fuels. Renewable energy combustion. Calorific value and its firing of sources. Properties of steam: Wet, dry saturated, superheated steam, Use of steam tables and Mollier charts. Steam



generators: Fire tube boilers. Water tube boilers Boiler mountings and Boiler accessories. Draught: Natural, forced, fan, jet, Measurement of Height of chimney. Condensers. Layout of pipe-line and expansion joints. Boiler trial: Codes. Indian Boiler Regulation acts. Air Compressors: Reciprocating. Single and two stage air compressors.

## **Refrigeration & Air Conditioning**

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: Purpose. materials. joint and fittings, water and brine pipe size selection. Absorption Refrigeration Systems: Simple vapour absorption refrigeration systems, Practical absorption system. Refrigerant absorbent combinations Absorption cycle analysis. Psychrometry: definition. properties of air-vapour mixtures, Psychrometric charts. Processes involving air vapor mixtures. Dehumidification. humidifiers. Humidity measurements, humidity control. Wet bulb, dry bulb temperature dew point temperature Cooling load calculations: Types of loads, design conditions for air cooling, air conditioning loads. Cold storage: Types of cold storage. Types of loads in cold storage. Construction of cold storage. Insulating materials and vapour barriers.

## **Dairy Engineering**

Sanitization: Materials and sanitary features of the dairy equipment Sanitary pipes and fittings, standard glass piping, plastic tubing, flanges and gaskets, installation, care and maintenance of pipes & fittings Description, working and maintenance of can washers, hettle 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 disfudging centrifuge. Bacto-fuge, care and maintenance of Homogenization Classification, single stage and two stage homogenizer pumps, power separators and clarifiers requirement. care and maintenance of homogenizers, aseptic homogenizers Pasteurization: Batch, flash and continuous (HIST) pasteurizers, Flow diversion valve. Pasteurizer control. Care and maintenance of pasteurizers. Different type of sterilizers, in bottle sterilizers. autoclaves, continuous sterilization plant, UIT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers. Filling Operation: Principles and working of different types of bottle filters and capping machine, pouch filling machine (Pre-pack and aseptic filling bulk handling 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.

### **Dairy Process Engineering**

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

### **Dairy Plant Design and Layout**

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. Dairy building planning. Process schedule. basis of dairy layout, importance of planning, principles of datry

layout Space requirements for dairy plants, estimation of service requirements including peak load consideration. General points of considerations for designing dairy plant, floor plan types of layouts. service accommodation, single or multilevel design. Arrangement of different sections in dairy, siting 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 plan and detailed layout. Choice of building construction materials. floors, general requirement of dairy floor finishes, floors for different section of dairy. Foundations, walls doors and windows, Drains and drain layout for small and large dairies. Ventilation, fly control, mold prevention, illumination in dairy plants.

### **Introductory Dairy Microbiology**

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, thermotolerant, 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, bitter 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, lactoferrin, lysozymes, LP systems etc.

### **Starter Cultures and Fermented Milk Products**

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 defined 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.

## **Market Milk**

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. c) Microbial quality of milk produced on farm. Effect of pooling and storing on microbial quality of refrigerated milk. Role of psychrotrophs, Role of tropical climate on spoilage of milk d) Chemical tests for grading raw milk, e) Microbio-logical tests for grading raw milk 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, anthenius equation. D value Z value.  $F_0$  value,  $Q_{10}$  value b) Factors affecting thermal destruction of micro-organisms, c) Definition and description of processes Pasteurization thermisation, sterilization, IT Processing, d) Microbiology of pasteurised milk thermdzes, sterilized & UHT milk e) Product control in market milk plant, f). Defects in market milk g) Manufacture of special milks toned, doubled toned reconstituted , recombined flavoured, homogenized vitaminised and sweet acidophilus milk, h) Manufacutre of sterilized milk , i) distribution systems for market milk. Quality and safety aspectes in dairy food chain, good manufacturing practices (GMP) in dairy processing 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) Asep e packaging, types and systems of packaging sterilizing packages, filling systems. d) Technical control in the UHT plant. Training of personnel Plant hygiene, e) Shelf life of UHT milk and tests for UHT milk. Nutritive value of milk. Effect of heat processing on nutritive value. Efficiency of plant operation product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency. Maintaining plant hygiene & HACCP.

## **Traditional Dairy Products**

Status and significance of traditional milk products in India Khoa: Classification of types standards methods of manufacture and preservation factors affecting yield of khoa Physico-chemical changes during manufacture and storage of khoa. Mechanization in manufacture of khoa. Confectioneries made from Khoa-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. Chhanna-based sweets, Rasogolla. Sandesh. Ras-malai. Mechanization of manufacturing process. Paneer: Product description standards method of manufacture packaging and preservation. Physico-chemical changes during manufacture and storage. Mechanization of paneer manufacturing/packaging process. Shrikhand: Chakkproduct description, standards method of manufacture, small scale and industrial. packaging and preservation aspects. Shrikhand-same as chakka. Physico-chemical changes and quality assurance during manufacture and storage. Sandesh: Product description method of manufacture and packaging process. Mistidahi: Product description method of manufacture and packaging process Kheer and Payasam: Product description methods of manufacture. innovations in manufacturing and packaging processes. Microbiology of indigenous milk products, predominance of spoilage & pathogenic organisms in Khoa. Chhanna, Paneer. Shrikhand, their spoilages, control measures & legal specifications Biopreservative principles in enhancing the self-life of indigenous milk products including active packaging.

## **Ice-Cream And Frozen Desserts**

History, development and status of ice cream industry, 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 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. 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.

### **Fat-Rich Dairy Products**

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 losses in butter-milk; packaging and storage; transportation, defects in butter, theology of butter: uses of butter. Microenvironment in cream and butter. impact of critical process factors on entry of spoilage and pathogenic organisms in cream & butter, their spoilages & control measures. Legal microbiologies specifications of cream & butter Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator. factory butterchurn 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.

### **Cheese Technology**

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. Treatment of milk: Physical and chemical. Cheese additives and preservatives. Role of starter culture in relation to cheese quality. 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 Microbiological changes. during preparation ripening in cheese. Role of milk constituents and changes during manufacture and

ripening in cheese. Factors affecting yield of cheese. Packing, storage and distribution of cheese. Accelerated ripening of cheese. Microbiological defects in cheese: their cause and prevention. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing. Microbiological critical control of cheese cold store.

## **Condensed and Dried Milk**

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 tea b) Manufacture of sweetened condensed milk es 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 by 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. Defect 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.

## **By Product Technology**

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: a) Casein: types of commercial casein. their specifications, manufacturing processes with basic principles involved. b) Industrial and food uses of caseins e) 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) Co-precipitates: 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. Whey protein concentrates: a) Methods of isolation with basic principles involved, physico-chemical properties of whey protein 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.

## **Packaging of Dairy Products**

Introduction, Importance of Packaging. History of Package Development. Packaging materials, a) 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 information, 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 sweetmeats, concentrated and dried milks including baby foods. 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.

## **Judging of Dairy Products**

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. Procedure. 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: Classes of raw and processed milks, defects associated with them: milk score card and its use. Judging and grading of milk. Fermented milks. Desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt. chakka, srikhand, lassi and other fermented drinks. Cream Desirable attributes and defects in cream. Score card for cream. Judging and grading



of different types of cream Butter. Specific requirements of high grade butter, undesirable attributes of butter, butter Score-card, requirements of sensory evaluation of butter. Ghee: Grades of ghee, special requirements of quality ghee. defects in ghee ghee, sensory evaluation of ghee. Frozen dairy products: Desirable and undesirable characteristics of frozen dairy products. Sensory evaluation of ice cream, kulfi and milk sherbets. Cheese: 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 dry milk Judging and grading of dry milk products. Concentrated milks: Desirable attributes and defects. Judging and grading of evaporated and condensed milk. Heat desiccated milk products: Desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets. Acid coagulated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets. Consumer of milks acceptance studies: Objectives. Methods, types or questionnaires, development questionnaires, comparison of laboratory testing and Consumers studies. limitations. Interrelationship between sensory properties of dairy products and various instrumental and Indian physico-chemical tests. Preparation of milk and milk products with defects, techniques for simulation.