

SEMESTER WISE COURSE STRUCTURE
&
DETAILED SYLLABUS

M.TECH. CHEMICAL TECHNOLOGY- FOOD TECHNOLOGY

(Applicable from Session 2017-2018 for new entrants)



HARCOURT BUTLER TECHNICAL UNIVERSITY

KANPUR-208002 (UP) – INDIA

HARCOURT BUTLER TECHNICAL UNIVERSITY

SCHOOL OF CHEMICAL TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

VISION OF THE UNIVERSITY

“To achieve excellence in technical education, research and innovation”

MISSION OF THE UNIVERSITY

- 1. Imparting Knowledge to develop analytical ability in science and technology to serve the industry and society at large.*
- 2. Equip and enable students with conceptual, technical and managerial skills to transform the organization and society.*
- 3. Inculcating entrepreneurial philosophy and innovative thinking to promote research, consultancy and institutional social responsibility.*
- 4. Serving people, society and nation with utmost professionalism, values and ethics to make development sustainable and quality of life.*

VISION OF THE DEPARTMENT

“To develop technically sound food technocrats, to cater the needs of food processing industries, Research & Development organizations and society”

MISSION OF THE DEPARTMENT

The missions of the Department of Food Technology are:

- M1 : Imparting technical knowledge to develop human resources for food processing sectors.*
- M2 : Imparting knowledge & technical skills for better processing and value addition of Food & Agro-products through R&D.*
- M3 : Inculcating innovative thinking with the aim to support entrepreneurship and to develop state-of-art technologies for testing and consultancy to fulfill the needs of industry and society.*
- M4 : Cultivating strong ethical values for sustainable modern and safe food to society.*

H. B. Technical University, Kanpur-02 (U.P.)
M.Tech Chemical Technology-Food Technology
 Structure and Evaluation Scheme (w.e.f. 2017-18)

I Semester

S. No.	Course Code	Subject	Periods			Credit
			L	T	P	
1	TCH- 501	Advance Modeling and Simulation of Chemical Engineering Systems ^A	3	1	0	4
2	TFT -501	Advances in Food Technology-I ^{ABC}	3	1	2	5
3	TFT-503	Engineering Properties of Foods ^{ABC}	3	1	0	4
	TFT-505	Microbiology and Chemistry of Foods ^{BC}				
4	Programme Elective TFT-507 TFT-509 TFT-511 TMA-501	Post-harvest/Pre processing Quantified Operations ^A Food Industry Waste Management ^A Processing & Preservation of Foods ^{BC} *Engineering Mathematics ^{BC}	3	1	0	4
		Total	12	4	2	17

* Only for students of Non Mathematics background at Graduation level.

II Semester

S. No.	Course Code	Subject	Periods			Subject Total
			L	T	P	
1	TFT-502	Advances in Food Technology-II	3	1	2	5
2	TFT-504	Food Process Engineering	3	1	0	4
3	TFT-506	Food Safety & Quality Assurance	3	1	0	4
4	Programme Elective TFT-508 TFT-510 TFT-512	Nutraceutical & Functional Foods Applications of Biotechnological Tools in Food Analysis Advances in Food Packaging Technologies	3	1	0	4
		Total	12	4	2	17

III Semester

S. No.	Course Code	Subject	Periods			Credit
			L	T	P	
1	TFT-601	Frozen Food & Cold Chain Management	3	1	0	4
2	Programme Elective TFT-603 TFT-605 TFT-607	Novel Techniques in Food Processing & Preservation Computer Applications in Food Processing Rheological Properties and Microstructure of Foods	3	1	0	4
3	TFT-651	Seminar	0	0	4	2
4	TFT-697	Project Dissertation**	0	0	8	4
		Total	6	2	12	14

**dissertation to continue in fourth semester.

IV Semester

S. No.	Course Code	Subject	Periods			Subject Total
			L	T	P	
1	TFT-698	Research Project	0	0	24	12
		Total	0	0	24	12

Total Credit: 60

TFT 502: ADVANCES IN FOOD TECHNOLOGY- I

L	T	P	C
3	0	6	5

Syllabus

Module-I: Advances in food chemistry & biotechnology

Desirable and undesirable food constituents, Analytical approach to food chemistry, chemical/biochemical reactions and physical changes occurring during transportation storage & processing in foods and their implications on quality, permitted food additives and their rationale. Application of enzymes in food processing

Module-II: Milling of cereals & pulses and bakery products

Recent trends in milling operations for cereals and pulses, various types of improved machinery employed in rice and other grain milling, advances in baking technology, recent development in bakery ingredient and their functionality.

Module -III: Extrusion and extruded products

Principle of extrusion, advances in extrusion and co-extrusion processes, advances in extruded and other ready to eat food products e.g. Roasted toasted and fried products, instant ready to use formulations,

Module-IV: Processing of oilseeds

Advances in Processing of oilseeds for oil and protein products, advances in oil processing, recent modification in oil,

Module-V: Processing of fruits, vegetables and spices

Recent trends in fruits and vegetables preservation and processing techniques, high pressure processing. Advances in plantation products e.g. Tea, coffee and cocoa, Spices storage and their processing.

Reference Books and Suggested Readings:

Title

The Chemistry and Technology of Cereals as Food and Feed

Cereals Current Status and Vision

Spice Science and Technology

Quality Assurance in Spices and Spice Products
(Modern methods of analysis)

Author

Matz, S.A

TIFAC (DST) Report,

Hirasa, K & Takemasa, M

Pruthi, S

TFT-503: ENGINEERING PROPERTIES OF FOOD

L	T	P	C
3	1	0	4

Syllabus

Module-I: Physical properties of Foods

Mass-Volume-Area-Related Properties: size, shape, roundness, sphericity, geometric mean diameter, surface area, projected surface area, resemblance to geometric bodies, volume, bulk density, true density, specific gravity, porosity and their measurement. Particle Size Distribution, Acoustic properties of foods.

Module-II: Rheological Properties of Foods

Stress, strain, elastic limit, modulus of elasticity, poisson’s ratio, shear strength, compressive strength, tensile strength, yield point, yield strength, deformation, bio yield point, rupture point, stiffness, elasticity, plasticity, degree of plasticity, toughness, resilience, mechanical hysteresis, viscoelasticity, stress relaxation, relaxation time, creep, retardation time, Mechanical models, Newton’s Law of Viscosity; Newtonian Fluids; Non-Newtonian Fluids; ideal and non-ideal Plastic Fluids; ideal and non-ideal viscous Fluids; ideal and non-ideal solids, Viscometry, Texture profile analysis, Dough Testing Instruments

Module-III: Thermal, Hydrodynamics and aerodynamic Properties of Foods

Thermal conductivity, Heat capacity, specific heat, thermal diffusivity, methods of determination – steady state and transient heat flow. **Hydrodynamics and aerodynamics properties of foods:** Terminal velocity, drag coefficient, Reynold’s number, application of aerodynamic properties to food products.

Module-IV: Electromagnetic Properties of Foods

Colour, reflectance, diffraction, absorption, radiation, lightness, hue, chroma, saturation, value, gloss, tristimulus values of colour, CIE and Lab colour system, application of optical properties in food processing. **Dielectric properties:** dielectric constant, dielectric loss, power factor, dielectric heating, dielectric loss tangent, application of dielectric properties in food processing.

Module-V: Sorption & Surface Properties of Foods

Criteria of equilibrium, Raoult's and Henry's Law, colligative properties, water activity, effect of temperature on water activity, sorption isotherms, Hysteresis, Empirical equations such as GAB, BET, Peleg models etc. Surface tension, Laplace, Kelvin, Young & Dupre equation, colloidal systems of foods.

Reference Books and Suggested Readings:

Title	Author
Engineering Properties of Foods	M. A. Rao and others
Physical Properties of Foods	Sahin S. and Sumnu
Physical Properties of Plant and Animal Materials	N.N. Mohesnin
Physical Properties of Agricultural Materials and Food Products	R. Stroshine
Elements of Properties of Matter	D.S. Mathur

TFT 505: MICROBIOLOGY & CHEMISTRY OF FOODS

L	T	P	C
3	1	0	4

Syllabus

Module-I: Water Relations in Food

Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymatic, physical and microbial changes) and sorption isotherm, Glass transitions and molecular mobility in foods, their relevance to quality and shelf life of food systems, anticaking agents: Definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application.

Module-II: Carbohydrates and Proteins

Carbohydrates: Structure, classification and chemistry of carbohydrates, Starch, Hydrocolloids and gums: Occurrence, functions and properties, Modified starches.

Protein: Chemistry, structure and functions of amino acids and proteins, Role of enzyme in food processing, Functional properties of proteins: modified proteins, application in product formulation.

Module-III: Food Lipids

Chemistry of oils and fats, Antioxidants: Chemistry and mechanisms of action, Techniques of evaluation of antioxidant activity, Uses. Emulsifiers: Role of emulsifiers, different classes of emulsifiers and their chemical structure, Selection of emulsifier based on Hydrophilic and lipophilic balance (HLB) and its application, Role of different stabilizers and other substances in emulsion stability.

Module-IV: Food Spoilage

Cause of spoilage, Biochemical changes caused by microorganisms, Types of microorganism associated with food spoilage and their controls.

Module-V: Food Pathogens

Contamination of food, Sources of contamination, Food poisoning and microbial toxins, Use of antimicrobial chemicals: Organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbets/propionates naturally occurring antimicrobials-their mode of action.

Reference Books and Suggested Readings:

Title	Author
Food Chemistry	H.K Chopra and P.S. Panesar
Food Chemistry	S. Damodaran, K.L. Parkin and O.R. Fennema

Food Chemistry	H.D. Belitz, W. Grosch and P. Schieberle
Physical Chemistry of Foods	P. Walstra
Food Microbiology	M.R. Adams
Food Microbiology	Frazier, M.C William and C.W. Dennis
Food Microbiology	R.K. Vijaya

L	T	P	C
3	1	0	4

TFT-503: POST HARVEST/PRE PROCESSING

QUANTIFIED OPERATIONS

Syllabus

Module-I: Post Harvest / Pre Processing of Fruits & Vegetables

Fruit and vegetable production, classification, structure and composition, Importance and scope of pre harvest and postharvest management of fruits and vegetables in Indian economy, Pre-harvest factors affecting postharvest quality, post-harvest losses, Maturity indices and standards for selected fruits and vegetables, instrumental methods of maturity determination, standards and specifications for fresh fruits and vegetable, Assessment of fruit quality, Advances in non-destructive quality measurement of fruits and vegetables.

Module-II: Post Harvest Changes in Fruits & Vegetables and their Primary Processing Operations

Post-harvest physiological and biochemical changes in fruits and vegetables, ripening of climacteric and non-climacteric fruits, changes during ripening, role of ethylene in fruit ripening, ripening chambers, Field heat of fruits and vegetables and primary processing operations post-harvest treatments, Advances in pre-cooling, equipment commodity pretreatments-chemicals, types of coating, pre-packaging, irradiation, blanching, peeling and other pre-processing operations, transportation and storage operations, Mechanism and advances in CA and MA, hypobaric storage, cold storage design, Zero energy cool chamber.

Module-III: Harvesting Tools and Post-Harvest Handling Operations

Advanced harvesting tools and their design aspects, advances in Post-harvest handling operations, Cleaning, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air

cleaners, washers), cleaning efficiency, care and maintenance, Sorting and grading: Sorting, grading, methods of grading, Size grading, color grading, specific gravity grading, screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance, Separation: Magnetic separator, de stoners, electrostatic separators, pneumatic separators.

Module-IV: Post Harvest Diseases & Disorders and their Remedies

Post-harvest disorders chilling injury and diseases, Biological, Physical and Chemical control of post-harvest diseases, Advances in drying and packaging of fruits and vegetables, Cushioning materials used in packaging of fresh fruits, Minimal processing.

Module-V: Post Harvest Handling of Grains

Crop drying principles and methods, Grain storage: principle and structures, Design of storage bins, Storage quality attributes of stored produce, Causes of wastes and pretreatments for minimizing losses during storage.

Reference Books and Suggested Readings:

Title	Author
Postharvest Biology and Handling of Fruits and Vegetable	N.F. Haard and D.K. Salunkhe
Post-harvest Technology of Horticultural Crops	A.A. Kader
Handbook of Fruit Science and Technology, Production	D.K. Salunkhe and S.S. Kadam
Post-Harvest Technology of Fruits and Vegetables	A.K. Thompson
Advances in Postharvest Fruit and Vegetable Technology	B.H. Wills-Ron and J.B. Golding
Post-Harvest Biology and Technology of Horticultural Crops: Principles and Practices for Quality Maintenance, Apple Academic Press Inc., 2015	M. W. Siddiqui
Meat and Meat Products: Technology, Chemistry and Microbiology: Chapman & Hill, London, 1995.	H. V. Alan and P. S. Jane
Poultry Meat and Egg Production, CBS Publications, New Delhi, 1997	R. O. Carmen and J. M. George
Fish and Fish Products: Agrobios, Bikaner, 1999.	A. L. Winton and K. Barberwinton

The Structure and Composition of Animal Product, A. L. Winton and K. B. Winton
Agro Botanical, Bikaner, 1993

TFT-509: FOOD INDUSTRY WASTE MANAGEMENT

Syllabus

L	T	P	C
3	1	0	4

Module-I: Standards and Acts

Food industry wastes, Food waste treatment, ISO 14001 standards, Standards for emission or discharge of environmental pollutants from food processing Industries as per Environment (Protection) Act, 1986. Elements of importance in the efficient management of food processing wastes

Module-II: By Products and their Utilization

Characterization and utilization of by-products from cereal, pulses, oilseeds, fruits and vegetables, plantation products, fermented foods, milk, fish, meat, egg and poultry processing industries.

Module-III: Characterization of Food Industry Effluents

Physical and chemical parameters, Oxygen demands and their inter relationship, Residues (solids), Fats, Oils and grease, Forms of Nitrogen, Sulphur and Phosphorus, Anions and cations, Surfactants, Colour, Odour, Taste, Toxicity, Unit concept of treatment of food industry effluent, Screening, Sedimentation floatation as pre and primary reactants.

Module-IV: Biological Oxidation

Objectives, Organisms, Reactions, Oxygen requirements, Aeration devices Systems: Lagoons, Activated sludge process, Oxidation ditches, Rotating biological contactors and their Variations and advanced modifications.

Module-V: Advanced Waste Water Management

Advanced waste water management systems: Physical separations- Micro-strainers, Filters, Ultra filtration and reverse osmosis, Physico-chemical separations: activated carbon adsorption, Ion-exchange electro-dialysis and magnetic separation, Chemical oxidations and treatment: Coagulation and flocculation, Disinfection, handling and disposal of sludge.

Reference Books and Suggested Readings:

Title

Author

Waste Management for the Food Industries, Academic I.S. Arvanitoyannis

Press, 2008

Environmental Biotechnology: Industrial Pollution Management, (III ed.), Himalaya Publishing House, New Delhi, 2010 S.N. Jogdhand

Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006 L.K. Wang, Y.T. Hung and C. Yapijakis

Environmental Bioremediation Technologies, Springer Verlag Publishers, 2007 N. Singh, Shree and T.D. Rudra

Food, Climate and Carbon Dioxide: The Global Environment and World Food Production, CRC Press, 1995 S.H. Wittwer

Pesticide Residues in Food and Drinking Water -Human Exposure and Risks, John Wiley & Sons Publishers D. Hamilton and S. Crossley

TFT-511: PROCESSING & PRESERVATION OF FOODS

Syllabus

L	T	P	C
3	1	0	4

Module-I: Introduction

Scope and importance of food processing- Properties of food- Physical, thermal, mechanical, sensory. Characteristics of tissues and non-tissues foods, Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods, intermediate moisture foods, wastage of foods.

Module-II: Low Temperature Processing

Chilling temperatures: Consideration relating to storage of foods at chilling temperatures, Applications and procedures, Controlled and Modified atmosphere storage of foods, Post storage handling of foods. Freezing temperatures: Freezing process, Slow and fast freezing of foods and its consequence, other occurrences associated with freezing of foods. Technological aspects of pre freezing, Actual freezing, Frozen storage and thawing of foods.

Module-III: High Temperature Processing

Basic concepts in thermal destruction of microorganisms D, Z, F values, Heat resistance and thermophilic microorganisms. Cooking, Blanching, Pasteurization and Sterilization of foods. Assessing adequacy of thermal processing of foods, General process of canning of foods, Spoilage in canned foods.

Module – IV: Drying and Dehydration

Sun drying of various foods, water activity and its effect on the keeping quality, sorption, isotherms and their use. Characteristics of food substances related to their dehydration

behavior, drying phenomenon, factors affecting rate of drying, methods of drying of various food products, type of driers and their suitability for different foods; intermediate moisture foods.

Module – V: Preservation through Non-Thermal Techniques

Preservation of foods by Irradiation. Preservation of foods by use of sugar, salt, chemicals and antibiotics and by smoking. Natural preservation, Concentration: Application in food industry processes and equipment for manufacture of various concentrated foods and their keeping quality. Fermentation: Applications in preservation of food; pickling; curing etc, hurdle technology.

Reference Books And Suggested Readings:

Title	Author
Food Processing and Preservation	B. Sivasankar
Food Processing Technology : Principles and Practice	P.J Fellows
Food Processing Technology : Principles and Practice	M.Shafeiur Rahman
Food Processing and Preservation	Khetarpaul N

TFT-502: ADVANCES IN FOOD TECHNOLOGY-II

Syllabus

L	T	P	C
3	1	2	5

Module-I: Advance Technology of Milk

Industry in India: present status and scope, Advances in processing of milk & milk products, FSSAI standards and legislations for market milk, Liquid milk processing, Technology of Ohmic Heating for Pasteurization of Milk, Advances in Microwave-Assisted Processing of Milk, Recent trends in milk procurement strategies and operation, Plate-form test and segregation of sweet and sour milk, Modern processing of fluid milk and distribution network.

Module-II: Technology of Dairy Products

Technology of fat rich dairy products: Cream: Definition and legal standards, consumer cream products, standardization & production of cream, processing of cream (neutralization & pasteurization), Butter: Definition, butter-making process, overrun, yield, theories of churning, quality of butter, fat losses in cream & butter, defects in cream & butter, Ice-cream: Definition, classification and composition of ice-cream, technological aspects of ice cream preparation, packaging, hardening, storage and shipping of ice cream.

Module-II: Advance Technology of Dairy Products

Technology of fat rich dairy products such as Cream, Butter and Ice-cream: Definition, classification, composition and technological aspects of preparation. Advancement in the Ghee Making Process, Technological Interventions in Kulfi Production, Classification of Dried Milk Products.

Module-III: Dairy Industry By-Products and Sanitation

By-products: Introduction, definition, composition, Importance and food applications, whey protein concentrates & isolates, Dairy plant sanitation: hygiene in dairy industry, different types of cleansing/sanitizing agents and their applications, cleaning systems in dairy industry.

Module-IV: Advances in Technology of Meat and Marine Products

Recent trends in processing of meat and meat Products in India, Chemical composition and microscopic structure of meat, Pre-mortem and post mortem changes influencing the quality of meat, Modern slaughter house management and by-product utilization.

Commercially important marine products from India, Product export and its sustenance, Processing operations, Basic biochemistry, Preservation of postharvest fish freshness, Transportation in refrigerated vehicles, Deodorization of transport systems, Design of refrigerated and insulated trucks, Grading and preservation of shell fish, pickling and preparation of fish protein concentrate, fish oil and other byproducts.

Module-V: Recent Advances in Poultry and Egg Products

Quality characteristics of poultry products, Lay-out and design of poultry processing plants, Plant sanitation, Poultry meat processing operations and equipment for de-feathering, bleeding, scalding etc., Poultry meat products, Refrigerated storage of poultry meat, by-products. Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage, eating quality of eggs, Inspection and grading, preservation and safe handling.

Reference Books and Suggested Readings:

Title	Author
Milk and Milk Products, Agrobios, India, 2000.	A.L. Winton and K.B. Winton
Novel Dairy Processing Technologies: Techniques, Management and Energy Conservation, Apple Academic Press, Distributed by CRC Press, a Taylor & Francis Group, USA, 2018	Megh R. Goyal, Anit Kumar and Anil K. Gupta

Dairy Chemistry and Biochemistry, Kluwer Academic, P.F. Fox and P.L.H. McSweeney
New York, 1998.

Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey and Related Products, CBS Publications, New Delhi, 1992.

Milk Testing: The Laboratory Control of Milk, Agro Botanical, Bikaner, 1994.

Lawrie's Meat Science (6 Ed.), Woodhead Publications, Cambridge, R.A. Lawrie

Meat and Meat Products: Technology, Chemistry and Microbiology, Champan & Hill, London, 1995.

Poultry Meat and Egg Production, CBS Publications, New Delhi, 1997.

Fish and Fish Products, Agrobios, Bikaner, 1997.

The Structure and Composition of Animal Product, Agro Botanical, Bikaner, 1993.

Milk Production and Processing, Daya, Delhi, 2004.

TFT-504: FOOD PROCESS ENGINEERING

Syllabus

L	T	P	C
3	1	0	4

Module-I: Material and energy balance

Basic principles of material balance, Overall material balances, Concentration and Composition, Component Material Balances, Blending of Food Ingredients, Multistage Processes, Recycle and Bypass. The Steady-Flow Energy Equation, Heat Capacity, Latent Heat of Vaporization, Latent heat of fusion, Heat Balances, Overall energy balance

Module-II: Flow of fluids

Types of fluids, flow of fluids, rheology of fluids, mass, momentum and energy balances, Bernoulli Equation, fluid flow through pipes, flow of falling films, boundary layer, Reynolds number and flow regimes, friction losses in pipes and pipe fittings, flow of non-newtonian fluids.

Module-III: Thermal Processing of Foods

Mechanisms of Heat Transfer, Concept of Resistance to Heat Transfer, Overall Heat Transfer Coefficient, Heat Transfer in Heat Exchangers, Logarithmic Mean Temperature Difference, Concept of F value, z value, Q10 value, Thermal Process Calculations for Canned Foods, kinetics of chemical and biochemical reaction in foods

Module-IV: Refrigeration and Evaporation

Mechanical Refrigeration System, Heat pump, Refrigeration Cycle, Compressor, Condenser expansion device and Evaporator, Refrigeration Load, **Evaporators**: Single effect, multiple effect and other Evaporators

Module-V: Dehydration and Physical separation process

Principles of drying and dehydration, rates of drying: constant and falling rate periods during convective drying, freeze drying and spray drying; calculations of freeze drying and spray drying times. **Separation**: Centrifugation, separation, homogenizers, Micro filtration, ultra-filtration, reverse osmosis and electro dialysis. **Extraction**: Types of extractors, Leaching and Super critical fluid extraction.

Reference Books and Suggested Readings:

Title	Author
Fundamentals of Engineering Heat and mass transfer	R.C. Sachdeva
Fundamentals of Food Process Engineering	R.T. Toledo
Food Engineering Operations	Brennan, J.G. and J.R. Cowell
Food Process Engineering	Heldman, D.R. and R.P.Singh
Fundamentals of Food Process Engg.	Charm S.E
Elements of Food Engg	Harper J.C

TFT-506: FOOD SAFETY & QUALITY ASSURANCE

L	T	P	C
3	1	0	4

Syllabus

Module-I: Food safety

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and microorganisms- microbial problems in food safety-food toxicants and food poisoning –prevention. Cross contamination, Limits for pesticide and metal contamination of food. Adulteration, Food additives- types- usage, permissible limits, concept of safe food.

Module-II: Quality control and assurance

Objectives, Importance and Functions of Quality Control and Quality assurance, Quality control specifications, training of food technologists for quality control, implementation of standards and specifications, principles of quality control – raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques-mechanization, future of quality.

Module-III: Food Quality Evaluation

Classification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials-Fruits, vegetables, cereals, legumes, dairy products, meat, poultry, egg and processed food. Sensory Evaluation of Food Quality. Regulating methods for food analysis, case studies.

Module-IV: International and National Food Laws and Standards

Food safety standard act of india- 2006, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The. Food and Drug Administration Act (FDA), International Organization for Standards (ISO), Requirement and procedure for ISO certification and its implication, Generally recognized as safe (GRAS), European Council (EU), Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good Manufacturing Practices (GMP), Good Agricultural Practices (GAP), and Good Hygienic Practices (GHP), GMP, Hazard Analysis Critical Control Point (HACCP).

Module-V: Quality Control Measures in Industries and Market

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Reference Books and Suggested Readings:

Title	Author
Food Quality Assurance: Principles and Practices	Inteaz Alli
Rheology and Texture in Food Quality	J.M.DeMan
Food Analysis : Theory and practice	Y.Pomeranz
Principles of Sensory Analysis of Food	M.A. Amerine

TFT-508 NUTRACEUTIAL AND FUNCTIONAL FOODS

L	T	P	C
3	1	0	4

Syllabus

Module-I: Technological Aspects of Nutraceuticals and functional Foods

Defining nutraceuticals and functional foods, nature, type and scope. Nutraceuticals and functional foods applications and their health benefits, classification based on chemical and biochemical nature with suitable and relevant descriptions.

Module-II: Nutraceuticals for specific diseases

Food recommended and restricted in metabolic disorders and disturbances, gastrointestinal disorders; fever and infection; liver, gall, bladder and pancreatic disturbances; blood, circulatory and cardiac diseases; urinary and musculoskeletal diseases, allergies, infant and baby foods, adolescent/ teen age foods, foods for pregnant ladies and nursing mothers, geriatric foods

Module-III: Functional role of bio-active compounds

Antioxidants, phytochemicals, isoflavones, lycopenes, their role in Nutraceuticals and functional foods, dietary fibers and complex carbohydrates as functional food ingredients. Health benefits/ mode of action of PUFA/ gamma linolenic acids, Proteins as a functional food ingredients, probiotic foods and their functional role, minerals and other minor food constituents as reported in literature.

Module-IV: Role of Specific Food Products as a Functional Food

Herbs as functional foods, health promoting activity of common herbs. Cereal products as functional foods- Oats, Wheat bran, rice bran etc. Functional vegetable products, oil seeds and sea foods. Coffee, tea and other beverages as functional foods/ drinks and their protective effects

Module-V: Legal Aspects of Nutraceuticals & Functional foods

Effects of processing and storage, interaction of various environmental factors on the potentials of such foods. Marketing and regulatory issues of Nutraceuticals and functional foods and. Recent developments and advances in the area of Nutraceuticals and functional foods.

Reference Books And Suggested Readings:

Title	Author
Handbook of Nutraceutical and Functional Foods	Wildman REC
Angi-angiogenic Functional and Medicinal Foods	Losso JN
Handbook of Nutraceuticals	Pathak YV
Innovations in Healthy and Functional Foods	Ghosh D et al
Nutrition and Dietetics	S. A. Joshi

TFT-510: CRYOGENIC SYSTEMS IN FOOD PROCESSING

L	T	P	C
3	1	0	4

Syllabus

Module I: Introduction to cryogenics

Applications involving Cryogenic Engineering, Properties of Cryogenic Fluids: Oxygen, Nitrogen, Air, Argon, Neon, Fluorine, Hydrogen, Helium. Properties of Solids: Mechanical Properties, Thermal Properties, Electrical Properties, Superconductivity.

Module II: Refrigeration and Liquefaction

Refrigeration and liquefaction principles, Joule-Thomson expansion, isentropic expansion, Cascade processes, Ortho-Parahydrogen conversion, cold-Gas refrigerators, miniature refrigerators, Ultra-Low-Temperature refrigerators, Thermodynamic analyses of system.

Module III: Storage and Transfer Systems

Basic storage vessels and design issues of small and large storage dewars. Structural design of Inner vessel and outer vessels, Design of suspension system, Insulation systems, Surface evaporation, thermal overfill, thermo-acoustic oscillation, eddy current heating, Cooling of storage vessels, cool down time estimation. Transfer systems, Industrial storage and transfer of cryogens, Cool down of Storage and Transfer System.

Module IV: Cryogenic Instrumentation.

Properties characterizing cryogenic Instrumentation, strain, displacement and position, Pressure, Flow, Liquid Level, Density ,Temperature.

Module V: Safety Issues with Cryogenic Fluids

Cryogenic safety, General safety issues, cold damage, Asphyxiation, sudden thermal contraction and pressure build-up in cryogen systems, brittle failure, LNG safety, Properties – Flammability, auto ignition temperature, rapid phase transition, LNG storage tanks, Risk of LNG fires, Oxygen safety – General concept of ignition and combustion, ignition mechanisms of different types, Effect of operating parameters, Selection of materials for oxygen use, Design of systems with oxygen rich environment, International and national codes and standards of safe handling of cryogenic fluids.

Reference Books and Suggested Readings:

Title	Author
Cryogenic Process Engineering	Klaus D. Timmerhaus
Cryogenic Systems	by Randall F. Barron

TFT-512: ADVANCES IN FOOD PACKAGING TECHNOLOGIES

L	T	P	C
3	1	0	4

Syllabus

Module-I: Introduction of food packaging

Primary and secondary functions of a package. Product characteristics and protection required through packaging. Packaging materials: Physico-mechanical, optical, thermal and barrier properties

Module-II: Analysis of packaging materials

Development of protective packaging, shelf life studies using packaging materials, methods of shelf life estimation, packaging materials properties and identification, paper and paper boards

production, storage and recycling of packaging materials, standards & regulation and equipment analysis of various existing packaging system

Module-III: Packaging economics

Evaluation of packaging economics, packaging operations cost consideration and disposability. Hazards in distribution & design of packages for various foods.

Module-IV: Package labeling and designing

Label, types of label, importance of nutritional labeling package design consideration, cushioning materials and their properties Testing and Identification of packaging materials

Module-V: Novel techniques in packaging

Technologies for novel packaging materials for active packaging, biodegradable packaging, edible packaging and nano packaging materials.Tailoring of packaging materials.Thermal processing, aseptic packaging lines and retortable pouches.Microwave-ovenable packaging materials, Modified atmosphere packaging and RFID indicator, Consumers and novel packaging. Oxygen, ethylene Carbon dioxide and other scavengers: Scavenging technology, and its applications.

Reference Books and Suggested Readings

Title	Author(s)
Handbook of Food Packaging Technology	Frank Albert Paine, Heather Y. Paine
A Handbook of Food Packaging	Painy FA.
Principles of Food Packaging	Sacharow S & Griffin RC
Food Packaging	Kadoya T
Food Packaging Materials	Mahadeviah M &Gowramma RV.
Developments in Food Packaging	Palling SJ.

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TFT-601: FROZEN FOODS AND COLD CHAIN MANAGEMENT

Syllabus

Module-I: Fundamentals and innovation in freezing

Fundamentals of freezing: Glass transition in frozen foods, microbiology of frozen foods, thermo-physical properties of frozen foods, Freezing load and freezing time calculations, Innovation in freezing process.

Module-II: Cold chain management system

Facilities for the cold chain: freezing methods and equipment, cold store design and maintenance, transportation of frozen foods, retail display equipment and management, household refrigerators and freezers, monitoring and control of the cold chain. Stages and points of control in cold storages and structures. Cryogenic system in food application: introduction to cryogenic system, low temperature properties of engineering materials, cryogenic fluid storage and transfer systems.

Module-III: Quality and safety of frozen foods

Quality and Safety of Frozen Foods: Quality and Safety of frozen meat and meat product, Quality and safety of frozen poultry and poultry products, Safety and quality of fish, Shellfish and related products, Quality and safety of frozen vegetables, fruits, dairy products, ready meads , bakery products, Eggs and eggs products.

Module-IV: Monitoring and measuring techniques

Monitoring and measuring techniques for quality and safety: Chemical measurements, sensory analysis of frozen foods, Food borne illnesses and detection of pathogenic microorganisms, shelf life prediction of frozen foods. Time indicators (TTI), Time, Temperature, Correlation, The kinetic approach, Effective temperature Transportation regulations

Module-V: Packaging of frozen foods

Packaging of frozen foods: Introduction to frozen food packaging, plastic packaging of frozen foods, paper and card packaging of frozen foods, Packaging of frozen foods with other materials, Packaging machinery. Role of packaging in cold chain, MAS, MAP, CAS, CAP etc.

Reference Books and Suggested Readings:

Title

Food Processing Technolgy – Principles and applications

The Freezing Preservation of Foods

Cold and Chilled Storage Technology

Frozen Food Technology

Author(s)

Fellows, P.J

Tressler D.K.& EversC.F

Clive DellinoD.J

Ed.Mallet C.P

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**TFT-603: NOVEL TECHNIQUES IN FOOD PROCESSING
& PRESERVATION**

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Syllabus

Module-I: Advances in membrane technology

Membrane Technology, membrane processing technology of liquid foods, different membrane modules, types of membrane 1G to 3G. Factors affecting flux and related equations, application of membrane in food processing & preservation.

Module-II: SCE process and HPP

Theoretical concept of super critical extraction process, equipment used and its application in food processing & preservation. Theoretical concept of high pressure technology equipment used and its application in food processing & preservation.

Module-III: Application of microwave and RF technology

Theoretical concept of Microwave and radio frequency technology equipment used and its application in food processing & preservation.

Module-IV: Ohmic, IR heating and cold plasma processing

Concept and technology of ohmic heating, IR heating, inductive heating and X-rays in food processing and preservation, Pulse Electric field, Pulse Light Technology, concept and technology of cold plasma, application limitation.

Module-V: Ultrasonicator and Hurdle Technology

Theoretical concept of ultrasound/sonication technology, equipment used and its application in food processing & preservation. Hurdle technology its concept and application in food preservation.

Reference Books and Suggested Readings:

Title	Author
Emerging Technologies for Food Processing.	Da-Wen Sun
Novel Food Processing Technologies	M. P. Cano, M. S. Tapia, and G. V.
Innovation in Food Engineering: New Techniques and Products,	Maria Laura Passos, Claudio P. Ribeiro
Nonthermal Processing Technologies for Food	Howard Q. Zhang. et al.,

2000

Non-thermal Food Engineering Operations

Enrique Ortega-Rivas

Food Processing Technologies: Impact on Product Attributes

Amit K. Jaiswal

TFT-605: COMPUTER APPLICATION IN FOOD PROCESSING

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Syllabus

Module-I: Modeling and Simulation

Fundamentals of modeling and simulation; definition of basic terms like system, entity attribute, activity, state of system, system environment; categories of system, stochastic activities; Different steps involved in modeling and simulation, Types of models, advantages of modeling and simulation, disadvantages of modeling; Monte Carlo Method of random simulation, Application areas of simulation.

Module-II: Algorithms for Numerical methods

Numerical methods for solving transcendental model equations; iterative convergence method, derivation and algorithms of bisectional method or intermediate value theorem; false position or Regula Falsi method; Newton Raphson method, Iterative or method of successive approximation; Solution of ordinary differential equation model: Picard, Taylor's series method. Euler's method, Modified Euler's method, First order, third and fourth order Rungi Kutta method.

Module-III: Partial differential equations models

Differential laplace, parabolic and hyperbolic equation, Finite difference method, graphical method, Bender-Schmidt method Sci-lab/ MATLAB based solutions to partial differential equations

Module-IV: Optimization systems

Introduction, optimization theory, optimization methods: Graphical and numerical methods of optimization, unconstrained optimization, constrained optimization, Programming optimization, experimental optimization, Response surface methodology (RSM). Artificial neural network and Fuzzy logic: Concepts and applications of Fuzzy logic and ANN in foos processing.

Module-V: Modeling and Simulation of food engineering operations

Thermal processing, convection dehydration, osmotic dehydration, spray drying, Freeze drying, Freezing Process; deep fat frying; extrusion process; filtration processes; membrane separation; distillation and extraction processes. Image analysis.

Reference Books and Suggested Readings:

Title

Computerized Control Systems in the Food Industry
Response surface methodology
Computer aided techniques in Food Technology
Response surfaces design and analysis
Design of Experiments

Author

Gauri S. Mittal
R. H. Myers
Israel Saguy
AI. Khuri
Douglas C. Montgomery

**TFT-601: RHEOLOGICAL PROPERTIES AND MICROSTRUCTURE
OF FOODS**

L	T	P	C
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Syllabus

Module-I: Examining Food Microstructures

History of Food Microstructure Studies, Light Microscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Other Instrumentation and Techniques.

Module-II: Fundamentals of Structuring: Polymer, Colloid, and Materials Science

Food Polymers, Polymer Solutions, Phase Transitions, Colloids and Surface Chemistry, Mechanical and Rheological Properties, Rheology of Foods, Mechanical Properties of Food Solids, Food Structure in the Mouth and Beyond.

Module-III: Image Analysis

Image Acquisition, Image Processing, Measurement Analysis , Food Structuring: Traditional Food Structuring and Texture Improvement, Approaches to Food Structuring, Extrusion and Spinning, Structuring Fat Products, Structure and Stability, Gels, Gelation Mechanisms, Mixed Gels, The Microstructure of Gels, Structure-Property Relations in Gels.

Module-IV: Microstructural Components and Food Assemblies

Water and Ice, Proteins, Lipids, Carbohydrates, Cells and Cell Membranes, Structural Aspects of Animal Tissue, Structural Aspects of Plant Tissue. Food Microstructure and Quality: Measurement of Texture, Structural Aspects of Food Texture, Quality and Structure.

Module-V: Microstructure and Mass Transfer

Solid-Liquid Extraction: Fundamental Aspects of Extraction, The Extraction process, Extraction of Food Materials, Modifying Microstructure, Modeling the Extraction Process Simultaneous Heat and Mass Transfer: . Dehydration: Basic Concepts, The Drying Process, Osmotic Dehydration, Influence of Drying on Structural Properties, Frying of Foods The Micro-structural Approach: Structure-Property Relationships, The Micro-structural Approach

Reference Books and Suggested Readings:

Title

Principles of Food Processing

Microstructural Principles of Food Processing Engineering

Food Texture

New Frontiers in Food Microstructure

An Introduction to Rheology

Multidimensional Microscopy

Author(s)

Richard W. Hartel

José Miguel Aguilera

Moskowitz

Donald B. Bechtel

H.A. Barnes

Philip C. Cheng