

Choice Based Credit Based System

Scheme & Syllabus of **Master of Technology- Process and Food** **Engineering** **(M. Tech of Process and Food** **Engineering)**

(Batch 2022)



By

**Board of Study (Food Science and
Engineering)(Main Campus)**

Department of Food Science and Technology
IK Gujral Punjab Technical University

Master of Technology in Food Technology (M. Tech of Process and Food Engineering)/

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)

Eligibility criteria for Admission: B.Tech. / B.E. (Food Engineering / Food Technology / Food Engineering & Technology / Food Process Engineering / Food Process Technology / Dairy Technology / Dairy Engineering / Food Biotechnology / Agri. Process Engineering / Agri. Engineering / Biotechnology)

or

B.Sc. (Hons) in Food Technology, B.Sc. (Hons.) Agriculture (with elective / hons in Food Technology / Food Process Engineering) or any equivalent degree with atleast 50% (45% in case of candidate belonging to reserved category) marks in aggregate.

Semester First

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTPFE-511-22	Food Engineering	PC	4	0	0	40	60	100	4
MTPFE -512-22	Process Engineering of cereals, pulses & oil seeds	PC	4	0	0	40	60	100	4
MTPFE -513-22	Energy Management	PC	4	0	0	40	60	100	4
MTPFE -514-22	Advances in Post-harvest Technology of Fruits and Vegetable	PC	4	0	0	40	60	100	4
MTPFE -515-22	Lab-I Food Process Engineering	PC	0	0	4	30	20	50	2
MTPFE -516-22	Lab-II Technology of cereals, pulses & oil seeds	PC	0	0	4	30	20	50	2
MTPFE -517-22	Lab-III Advances in Post- harvest Technology of Fruits and Vegetable	PC	0	0	4	30	20	50	2
	Total		16	0	12	250	300	550	22

SEMESTER FIRST

MTPFE-511-22: Food Engineering

Unit-1

Engineering Properties of foods, their significance and importance in equipment and process design. Material and energy balances, types and Properties of fluids Flow rate, friction losses and pressure drop relationships for Newtonian fluids through pipe. Steady state and unsteady state heat transfer. Numerical, graphical methods in the analysis of heat transfer. Solutions of unsteady state equations.

Unit-2

Kinetics of biological reactions-order of reaction, quality changes during storage of foods. Application of Arrhenius equations to biological reactions. Food quality modelling. Principles of Refrigeration. Natural refrigeration, Vapour compression refrigeration. Mollier Chart, Rating of Systems, Compressors, evaporators, Condensers, Expansion valve. Heat Pump, Absorption refrigeration.

Unit-3

Freezing of foods, prediction of freezing time. Thermal Processing foods. Pasteurization and sterilization, D value, F value, Z value. Process time calculation. Cook value and quality retention. Time temperature integrators (TTI). Microbial survival curve. Lethality, Ball method. Process calculation by graphical method.

UNIT-4

Mixing - Terminology (agitating, kneading, blending, and homogenizing), equipments - mixers for liquids of low or moderate viscosity (Paddle agitators, turbine agitators and propeller agitators), mixers for high viscosity pastes (Pan mixer, horizontal mixer and dough mixer), mixers for dry solids (tumbler mixer and vertical screw mixer), effect of mixing on foods. Power consumption and efficiencies.

Suggested Readings:

1. Geankoplis J Christie. (1999). Transport Process and Unit Operations. Allyn & Bacon.
2. Earle R. L. and Earle M.D.. Unit Operations in Food Processing
3. McCabe WL & Smith JC. (1999). Unit Operations of Chemical Engineering. McGraw Hill.
4. Sahay KM & Singh KK. (1994). Unit Operation of Agricultural Processing. Vikas Publ. House.
5. Singh RP and Heldman DR. (1993). Introduction to Food Engineering. Academic Press

MTPFE -512-22: Process Engineering of cereals, pulses & oil seeds

UNIT - 1

Utilization of cereals, pulses and oilseeds, Grain structure of cereals, Pulses and oilseeds and their milling fractions, Grain quality standards and physico-chemical methods for evaluation of quality of flours.

UNIT - 2

Sieving, Particle size analysis, Grinding and cutting, Energy used in grinding, Grinding equipment. By-products and effluents from different cereal processing industries and various techniques for their utilization and management.

UNIT – 3

Pre-milling treatments and their effects on milling quality. Parboiling, conventional, modern and integrated rice milling operations. Wheat flour milling operation. Processes for milling of corn, oats, barley. Dhal milling operation. Expeller and solvent extraction processing of oilseeds. Refining of oil.

UNIT - 4

Grain storage structures - location and material selection for storage building, Types - traditional, modern; temporary and permanent storage structures; design considerations. Air tight, controlled atmosphere and modified atmospheric storage. Infestation control/sanitation-in-process and post process. Fumigation and aeration.

Suggested Readings:

1. Asiedu J.J. 1990. Processing Tropical Crops. ELBS/MacMillan. • Chakraverty A. 1995. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH
2. Morris Lieberman. 1983. Post-harvest Physiology and Crop Preservation. Plenum Press.
3. Pandey P.H. 1994. Principles of Agricultural Processing. Kalyani.
4. Pillaiyar P. 1988. Rice - Post Production Manual. Wiley Eastern.
5. Sahay K.M and Singh K.K. 1994. Unit Operations in Agricultural Processing. Vikas Publ. House.

MTPFE -513-22: Energy Management

UNIT-1 Energy forms and units, energy perspective, norms and scenario; energy auditing, data collection and analysis for energy conservation in food processing industries. Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; types, construction, working principle, uses and safety/environmental aspects of different renewable energy devices like gasifiers, biogas plants.

UNIT-2 Solar passive heating devices, photovoltaic cells and arrays, Phase Changing Materials; Brief introduction to wind energy, hydroelectric energy, ocean energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture.

UNIT-3 Energy forms and units, energy perspective, norms and scenario; energy audit and management in agro-processing units, data collection and analysis for energy conservation in food processing industries. non-conventional energy sources in agro-processing industries.

UNIT-4 Reuse and calculation of used steam, hot water, chimney gases and cascading of energy sources. Energy accounting methods, measurement of energy, design of computer-based energy management systems, economics of energy use.

SUGGESTED READINGS:

1. Garg HP & Prakash J.1997. Solar Energy - Fundamental and Application. Tata McGraw Hill
- Rai GD. 1998. Non-conventional Sources of Energy. Khanna Publ.
2. Twindal JW & Anthony D Wier 1986. Renewable Energy Sources. E & F.N. Spon Ltd.
3. Culp AW. 1991. Principles of Energy Conservation. Tata McGraw Hill.
4. Duffle JA & Beckman WA. 1991. Solar Engineering of Thermal Processes. John Wiley.
5. Mittal KM. 1985. Biomass Systems: Principles & Applications. New Age International.

MTPFE -514-22: Advances in Post-harvest Technology of Fruits and Vegetables

Unit-1

Importance of post harvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, Post harvest technology and its significance, pre-harvest factors affecting post-harvest quality of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables.

Unit-2

Harvesting and washing, pre-cooling, preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables. Cold storage, controlled atmosphere packaging of fruits and vegetables, Modified Atmospheric storage.

Unit-3

Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.

Unit-4

Intermediate moisture foods, ohmic heating principle, high pressure processing of fruits and vegetables, applications, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes.

Suggested readings:

1. Somogyi, L.P., Ramaswamy, H. S. and Hui, Y.H., eds. 1996. Processing Fruits: Science and Technology. Vol. 1. Biology, Principles and Applications. Technomic Publishing Co., Lancaster PA.
2. Salunkhe and Kadam. 1998. Handbook of vegetable science and technology: Production, composition, storage, and processing, Marcel Dekker, USA.
3. Barrett, D.M., L. Somogyi, and H. Ramaswamy. 2005. Processing Fruits, Second Edition: Science and Technology. CRC Press, Boca Raton, FL.
4. Hui, Y.H. 2006. Handbook of Fruits and Fruit Processing, Blackwell Publishing, Ames, IA, USA.
5. Salunkhe, D.K. and Kadam, S.S. 1995. Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker, New York.
6. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. 2001. Handbook of Post-harvest Technology: Marcel Dekker Press, USA

MTPFE -515-22 LAB II (Food Process Engineering)

Determination of the physical properties size, shape, sphericity of food products.

Determination of average particle size and distribution of powdered material.

Determination of moisture content and water activity of food product.

Determination of bulk density, true density and porosity of food grains.

Determination of colour for various food grains, fruits, vegetables, spices and processed foods by hunter colour lab.

Determination of density and specific gravity of various liquids food.

Study the rheological properties of food material by viscometer.

Study of frictional properties; angle of repose and coefficient of friction of food grain material.

To determine the mixing index of food material by ribbon blender and cone blender.

Solving problems on: single and multiple effect evaporator, distillation, extraction, membrane separation and mixing;

Experiments on rotary flash evaporator, humidifiers, reverse osmosis and ultra filtration;

Visit to related food industry.

MTPFE -516-22 Lab II (Technology of cereals, pulses & oil seeds)

Physical properties of cereals.

Conditioning of wheat. Gluten content of wheat flour.

Cooking quality of rice.

Determination of Gelatinization Temp.

Study on production technology of puffed and flaked rice Physical properties of Legumes and Oil seeds.

Principles of dehulling: Dal Milling Process.

Particle size analysis and energy requirement in comminution.

Milling of rice, wheat and pulses.

Estimation of milling yield and performance characteristics of equipment used.

Physical properties of cereals and pulses, raw and milled products quality evaluations;

Parboiling and drying; terminal velocities of grains and their fractions; study of paddy, wheat, pulses and oilseeds milling equipments;

Planning and layout of various milling plants,

Visit to related agro-processing industry.

MTPFE -517-22 Lab III (Advances in Post-harvest Technology of Fruits and Vegetables)

Kinetics of enzyme inactivation.

Drying of vegetables.

Blanching process. Heat.

Pectin determination in fruits and vegetable.

Calculation and mixing of sugar syrup.

Recipe calculation and preparation of fruit juices/squash.

Recipe calculation for and preparation of fruit Jam/jellies.

Thermal processing and preservation of fruits/vegetables (Canning/ bottling).

Preparation of pickles.

Preparation of tomato product (Puree/ketchup).

SEMESTER II

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTPFE-521-22	Food Rheology	PC	4	0	0	40	60	100	4
MTPFE -522-22	Drying and Storage Engineering	PC	4	0	0	40	60	100	4
MTPFE -523-22	Research Methodology	PC	4	0	0	40	60	100	4
MTPFE -524-22	Food Rheology Lab	PC	0	0	4	30	20	50	2
MTPFE -525-22	Drying and Storage Engineering Lab	PC	0	0	4	30	20	50	2
MTPFE -526-22	Program Elective-1 (Theory)	PE	4	0	0	40	60	100	4
MTPFE -528-22	Program Elective-1 (Lab)	PE	0	0	4	30	20	50	2
	Total		16	0	12	250	300	550	22

PROGRAMME ELECTIVE -I*

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTPFE-526-22	Advances in Food Packaging Technology	PE	4	0	0	40	60	100	4
MTPFE -527-22	Food quality and Analytical Techniques	PE	4	0	0	40	60	100	4
MTPFE -528-22	Lab (Advances in Food Packaging Technology)	PE	0	0	4	30	20	50	2
MTPFE -529-22	Lab Food quality and Analytical Techniques	PE	0	0	4	30	20	50	2

Note: *Select any one subject from Elective-I. The elective subject for theory & practical will be same.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-521-22

Course Title: Food Rheology

Hours per week: 4+0+0

Credits: 4

Unit -I

Food rheology concept, scope of food rheology, texture of foods – type of stress, types of strain, types of viscosity, modulus (young, shear, bulk), poisson's ratio, definition and importance of texture, texture related concepts.

Unit-II

Rheological properties of fluid food: viscosity, factors affecting viscosity, flow of material- Newton's law of viscosity, viscous fluids (Newtonian fluids, non-Newtonian fluids), plastic fluids (Bingham plastic, non-Bingham plastic fluids), fluid behavior in steady- shear flow: time dependent and time independent material function.

Unit-III

Viscometry: viscosity measurement- capillary flow viscometers, orifice type viscometers, falling ball viscometers, rotational viscometers- concentric cylinder (coaxial rotational) viscometers, cone and plate viscometers, parallel plate viscometers, single-spindle viscometers (brookfield viscometer).

Unit-IV

Texture of foods: basic concept, Principles of determining food texture, Texture measurement instruments compression, snapping bending, cutting shear, puncture, penetration, texture profile analysis, dough testing instruments- farinograph and mixograph, extensograph and alveograph, amylograph.

Recommended readings:

1. Rao, M. A., Rizvi, S. S. H. and Datta A. K. 2005. Engineering Properties of Foods: CRC Press.
2. Heldman, D. R. (2007). Food Process Engineering: AVI Publications.
3. Faridi, H. and Faubion, J. M. (1997). Dough Rheology and Baked Products: CBS Publications, New Delhi.
4. Rao, M. A. (2007). Rheology of Fluid and Semisolid Foods: Principles and Applications (2 ed.): Springer, USA.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-522-22

Course Title: Drying and Storage Engineering

Hours per week: 4+0+0

Credits:4

Unit-I

Introduction: Introduction to drying of agricultural products, utilities of drying, Thermal properties, Moisture content representation, Moisture content determination methods, EMC and methods of their determination, EMC curve and models, principle of drying, periods of drying, thin layer, deep bed and their analysis, critical moisture content, drying models.

Unit-II

Grain Dryers: Storage Unit, Aeration system, Air distribution system, Heated air Dryers- Flat bed type Batch drier, Re-circulatory batch driers, Louisiana state University drier, Baffle drier and Rotary drier, Testing of grain driers.

Unit-III

Food Grain Storage: Grain storage principle, Changes occurring in food grains during storage, Types and causes of spoilage in storage, Direct indirect damages, storage of perishable products, functional requirements of storage, control of temperature and relative humidity inside storage, Modern storage structures.

Unit-IV

Grain storage pest and control: destruction of insect infestation, grain storage pest, important insect species, Fumigation: principle of fumigation, Properties and application of fumigants, Rodent control: Rodenticides for rats and mice.

Recommended Books

1. Giridhari Lal : Preservation of Fruits & Vegetables, ICAR Publication, India.
2. Ranganna : Analysis of Fruits and Vegetables, Tata MacGraw Hill, India.
3. Luh&Woodroof : Commercial Vegetable Processing, AVI Publishing, USA.
4. KM Sahay and KK Singh: Unit operations of agricultural processing, India.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-523-22

Course Title: Research Methodology

Hours per week: 4+0+0

Credits:4

Unit-I

Introduction: Nature and objective of research, criteria of good research, scientific approach to research, limitations of applying scientific methods, Ethical issues in research, IPR.

Unit-II

Research: Types, Research process and steps in it, Hypothesis, Research proposals and aspects; Research Design: Need, Problem Definition, variables, research design concepts, Literature survey and review, Research design process, Errors in research; Research Modeling: Types of Models, Model building and stages, Data consideration and testing. Report Writing: Pre writing considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.

Unit-III

Data and data types, Data collection Methods: Observations, Survey, Interview and Questionnaire. Data Presentation and Analysis: diagrams and graphs, measures of central tendency, dispersion, skewness and kurtosis. Inferential Statistics – estimation, type-I and type-II error, testing of hypothesis, test of significance, t-test, Z-test, F-test, Chi-Square test, ANOVA.

Unit-IV

Statistical Quality Control: Quality control charts- p-chart, c-chart, X bar charts, R charts, σ charts, process under control and specification limits, process out of control, control limits. Benefits & Limitations of Statistical Quality Control. Acceptance Sampling.

Recommended Readings

1. Cramer Michael M (2016) Food plant sanitation: Design, maintenance, and Good Manufacturing Practices.
2. S Ranganna (2001) Handbook of analysis and Quality control for fruit and vegetable products.
3. C R Kothari (2004) Research methodology- methods and techniques.
4. William J. Stevenson (2011), Operations Management.
5. Andrew Greasley (2007), Operations Management.
6. Scott T. Young (2009), Essentials of Operations Management Paul R. Dittmer, J.
7. Desmond Keefe (2008), Principles of Food, Beverage, and Labour Cost Controls.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-524-22

Course Title: Food Rheology Lab

Hours per week: 0+0+4

Credits:2

List of Practicals

1. Effect of fat type on cookie dough rheology
2. Determination of viscosity of oil by viscometer
3. Study of textural attributes of food products
4. Texture analysis of fruit using texture analyzer
5. Viscosity measurements of fruit juices using viscometer
6. Viscosity measurements of liquid food products using viscometer
7. To study the effect of temperature on viscosity of liquid foods
8. Development of stress and strain curve for Newtonian fluids
9. Development of stress and strain curve for Non Newtonian fluids
10. Determination of thermal conductivity of selected food products
11. Texture analysis of baked products (bread/ biscuit)
12. Preparation of food emulsions and their stability study
13. Preparation of food gels and their characteristics
14. To correlate subjective sensory evaluation with textural analyzer

I.K. Gujral Punjab Technical University

Course Code: MTPFE-525-22

Course Title: Drying and Storage Engineering LAB

Hours per week: 0+0+4

Credits:2

List of Practicals

1. Study of mechanics of bulk solids affecting cleaning, drying and storage of grains;
2. Measurement of moisture content, relative humidity and air velocity during drying and aeration;
3. Drying characteristic and determination of drying constant;
4. Determination of EMC and ERH; Study of various types of dryers;
5. To study the effect of relative humidity and temperature on grains stored in gunny bags;
6. Design and layout of commercial bag and bulk storage facilities;
7. Study of different domestic storage structures;
8. Visits to commercial handling and storage facilities for grains.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-526-22

Course Title: Advances in Food Packaging Technology

Hours per week: 4+0+0

Credits:4

Unit-I

Introduction: Introduction to Food Packaging, History, Definitions, importance and scope of packaging of foods; Systems and Regulations, package components. Types of packaging: Forms of packaging – box, bottle, tetra, pouch, shrink, vacuum, gas, CAP, MAP, aseptic etc.

Unit-II

Advances in Active packaging techniques and Intelligent packaging techniques, Current use of novel packaging techniques in different food products, consumers acceptance of novel food packaging, Edible films, Antioxidant and anti microbial packaging.

Unit-III

Scavengers for food packaging- oxygen, ethylene, Carbon dioxide, odor and flavour absorber and other scavengers, concept and its food applications. Ethanol emitters and preservative releaser, and their food packaging uses. Antimicrobial food packaging: concept and mechanism, Factors affecting the effectiveness of antimicrobial packaging.

Unit-IV

Testing & Packaging Machinery: Bottling, can former, form fill and seal machines, bags – their manufacturing and closing, vacuum packs unit, shrink pack unit, tetra pack unit. WVTR, GTR, bursting strength, tensile strength, tearing strength, drop test, puncture test, impact test etc.

Recommended readings:

1. Jung H. Han. Innovations in Food Packaging. Elsevier Science Ltd.
2. Gordon L. Robertson. Food Packaging: Principles and Practice. CRC press
3. Dong Sun Lee, Kit L. Yam , Luciano Piergiovanni. Food Packaging Science and Technology. CRC press
4. Raija Ahvenainen. Novel Food Packaging Techniques. Woodhead Publishing
5. M. L. Rooney. Active Food Packaging. Blackie Academic & Professional
6. Aaron L. Brody, E. P. Strupinsky, Lauri R. Kline. Active Packaging for Food Applications. Taylor & Francis
7. Charles L. Wilson. Intelligent and Active Packaging for Fruits and Vegetables. Taylor & Francis.
8. Aaron L. Brody, PhD, Hong Zhuang, PhD, Jung H. Han. Modified Atmosphere Packaging for Fresh-Cut Fruits and Vegetables. John Wiley & Sons.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-527-22

Course Title: Food quality and Analytical Techniques

Hours per week: 4+0+0

Credits:4

Unit-I

Introduction to Food Quality & Analysis: Introduction to food and its components, Sampling, Sample preservation, Extraction, Proximate analysis. Quality Control, Evaluation of food quality; concept of total quality control (TQM).

Unit-II

Spectroscopic Techniques: Introduction & theory of spectroscopic techniques, UV-Visible NIR spectroscopy, X-ray, CT, NMR, Fluorescence machine spectroscopy – Principle, Instrumentation, application of each technique, destructive and non-destructive quality Evaluation.

Unit-III

Chromatographic Techniques: Introduction, HPLC, GC, Paper chromatography, TLC/HPTLC, Ion chromatography, Flash chromatography – Principle, Instrumentation, applications of each technique.

Unit-IV

Food standards: FSSAI, Use of hazard analysis critical control Point (HACCP) and its implication in food industries. Agmark, FPO, PFA, BIS, consumer protection act, Vanaspati control order, MMPO, export quality control and inspection act.

Recommended Readings

1. Food Analysis: Theory and Practice, 1994. Y. Pomeranz and C.E. Meloan. 3rd edn., Conn. (USA): AVI Publ. Co.
2. Stewart, K.K. and Whitaker, J.R. (1984). Modern Methods of Food Analysis. Conn: AVI Publ. Co.
3. James, CS. (1995). Analytical Chemistry of Foods. Blackie Academic and Professional, UK
4. Methods of analysis of food components and additives by Semih Otle, Published in 2005 by CRC Press
5. Singal RS, Handbook of indices of food quality and authenticity; Woodhead Publ. Cambridge, UK.

I.K. Gujral Punjab Technical University

Course Code: MTPFE-528-22

Hours per week: 0+0+4

Course Title: Advances in Food Packaging Technology LAB

Credits:2

List of Practicals

1. Identification of different types of packaging and packaging materials
2. Determination of WVTR in different packaging materials
3. Determination of GTR in different packaging materials.
4. Development of ethylene scavengers for fresh fruits and vegetables
5. Study of time temperature indicators
6. Determination of oxidative changes in packaged foods
7. Determination of wax weight
8. Determination of tearing strength of paper
9. Measurement of thickness of packaging materials
10. To perform grease-resistance test in plastic pouches
11. Determination of bursting strength of packaging material
12. Determination of drop test of food package

I.K. Gujral Punjab Technical University

Course Code: MTPFE-529-22

Hours per week: 0+0+4

Course Title: Food quality and Analytical Techniques LAB

Credits:2

1. Determination of acid soluble, water soluble, insoluble acid, ash fractions.
2. Determination of carotenoids.
3. Determination of ascorbic acid by titrimetric and photometric methods.
4. Determination of lycopene content of tomato & its products.
5. Determination of iron, phosphorous & sulphur in foods.
6. Determination of pigment in food sample.
7. Determination of lead, arsenic, and tin content in food.
8. Analysis of canned and processed products available in the market
9. Cut out analysis of canned product.
10. Estimation of Vit A, D in desi ghee
11. Determination of viscosity liquid food
12. Determination of FFA and Acid value of given sample
13. Analysis of ice cream for fat, acidity, total solids, foreign fat
14. Evaluate the given food sample using different sensory test methods.
15. Study of pH meter, conductivity meter, spectrophotometer.
16. Study of HPLC, GLC, and TLC for analysis of different food constituents.

IK Gujral Punjab Technical University
M.Tech. Process and Food Engineering Batch 2022 onwards

SEMESTER III

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTPFE-611-22	Milk and Milk Products Technology	PC	4	0	0	40	60	100	4
MTPFE -612-22	Lab-V (Milk and Milk Products)	PC	0	0	4	30	20	50	2
MTPFE -613-22	Seminar	PC	0	0	2	30	20	50	1
MTPFE -614-22	Open elective	OE	4	0	0	40	60	100	4
MTPFE -615-22	Program Elective-II	PE	4	0	0	40	60	100	4
MTPFE -618-22	Dissertation-I	RP	0	0	10	60	40	100	10
	Total		12	0	16	240	260	500	25

Open elective: The student is required to register for one “Open Elective” paper (in Semester III) of his/her choice from any department other than the parent department

PROGRAMME ELECTIVE -II*

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTPFE-615-22	Meat Process Engineering	PE	4	0	0	40	60	100	4
MTPFE -616-22	Biochemical and Process Engineering	PE	4	0	0	40	60	100	4

MTPFE -617-22	Agricultural Waste and By-Products Utilization	PE	4	0	0	40	60	100	4
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Note: *Select any one subject from Elective-II.

IK Gujral Punjab Technical University
M.Tech. Process and Food Engineering Batch 2022 onwards

SEMESTER IV

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTPFE-621-22	Dissertation-II	RP	0	0	32	60	40	100	16
	RP		0	0	32	60	40	100	16

SEMESTER

THIRD

I.K. Gujral Punjab Technical University

Course Code: MTPFE-611-22

Course Title: Milk and Milk Products Technology

Hours per week: 4+0+0

Credit: 4

Unit -I

Status and scope of dairy industry in India: production, utilization and per capita consumption of milk. Fluid Milk: Definition of milk, composition, physical and chemical properties of milk, constituents and nutritive value of milk, factors affecting composition of milk, types of milk, FSSAI standards and legislations for market milk. Fluid Milk Processing: Receiving, Filtration and clarification, straining, standardization Homogenization and its effects, Pasteurization: (LTLT, HTST, UHT methods), sterilization, packaging of fluid milk. Reconstituted & recombined milk, toned and double toned milk.

Unit -II

Technology of dairy products: Cream: definition and legal standards, standardization & production of cream, processing of cream. 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.

Unit –III

Technology of condensed and dried milk: Definition and legal standards for evaporated and condensed milks, methods of manufacture and physico-chemical properties of evaporated and condensed milk, Quality of raw milk for dried milks, definition and legal standards for dried milks, method of manufacture of dried milks (WMP & SMP), milk drying system (film, roller, drum, spray, foam spray drying), defects in dried milk; Technology of cheese: definition and different varieties of cheese manufacturing (cheddar & mozzarella), changes during ripening of cheese, yield of cheese, defects in cheese.

Unit –IV

Technology of indigenous dairy products: Introduction to traditional dairy products, khoa, channa, paneer, dahi, shrikhand, ghee, khoa and channa based sweets; Dairy industry by-

products and sanitation: By-products: 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 and sanitation of dairy plant and equipments.

Suggested Readings:

1. Smit G. (2003) Dairy processing - improving quality, Woodhead Publishing.
2. Hohnson M. & Alford (1987) Fundamentals of dairy chemistry. 2nd edition, CBS Publishers..
3. Early R. (2010) Technology of dairy product, Springer Publishers.
4. Vaclavik V. A. & Christian E. W. (2003) Essentials of food science. 2nd edition, Springer International.
5. Rajagopal, Roy, S.K. (2014) Milk & milk products technology, BS Publishers.
6. . Winton, A. L. and Winton, K. B. (2000). Milk and Milk Products: Agrobios, India.
7. Fox, P. F. and McSweeney, P. L. H. (1998). Dairy Chemistry and Biochemistry: Kluwer Academic, New York

I.K. Gujral Punjab Technical University

Course Code: MTPFE-612-22

Course Title: Lab-V (Milk and Milk Products)

Hours per week: 0+0+4

Credit: 2

To conduct platform test of milk. Determination of SNF (Solids Not Fat), specific gravity, total solids of milk. Testing efficacy of pasteurized milk. Determination of moisture & fat content of milk powder, Study of familiarization with various parts and working of cream separator.

Preparation of Khoa, Preparation of channa and paneer, Preparation of ice cream. Detection of adulterants in milk like water, urea, neutralizers, preservatives, sucrose, starch. Visits to different dairy plants. To perform sampling of milk, Determination of titrable acidity of milk, Determination of fat by garber method.

Professional Elective –II

Course Code: MTPFE-615-22

Course Title: Meat Process Engineering

Hours per week: 4+0+0

Credit: 4

Unit –I

Introduction- Sources of meat and meat products in India, its importance in national economy. Per capita consumption of meat, poultry and fish. Present status of meat, poultry and fish industries in India. Chemical composition and microscopic structure of meat.

Unit –II

Methods of slaughtering & meat processing- Pre-slaughter care, Antemortem inspection of meat animals. Methods of stunning, slaughtering and dressing of meat animals and poultry birds Post mortem examinations of meat-Rigor mortis. Factor affecting post mortem changes, properties and shelf life of meat. Methods of meat tenderization. Meat curing types and factors affecting quality of cured meats. Preparation of smoked meats, pickled meats, sausages and hamburgers. Methods of meat preservation- refrigeration, refrigeration, thermal processing and dehydration.

Unit –III

Poultry products- Structure, composition, nutritive value and functional properties of eggs. Grading of eggs. Factors affecting egg quality and measures of egg quality. Preservation of eggs by different methods- freezing, dehydration and coating.

Unit –IV

Fish products- Types of fish, composition, structure, post mortem changes in fish. Handling of fresh water fish. Nutritional quality of fish. Canning of fish.

Recommended Readings:

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
3. Alan H. Varnam, Jane P. Sutherland. Meat and Meat Products: Technology, Chemistry and

Microbiology. Chapman & Hall. 1995.

4. Lawrie, R. A. (1975). Meat Science. 2nd Edn. Pergamon Press. Oxford UK.
5. Anonymous (1995). Meat processing and Meat Products Handbook, EIRI Board of Consultants and Engineers, Indian Institute of Consultants, New Delhi. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
6. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp

I.K. Gujral Punjab Technical University

Course Code: MTPFE -616-22

Course Title: Biochemical and Process Engineering

Hours per week: 4+0+0

Credit: 4

Unit-I

Biochemical process development an interdisciplinary challenge, engineering calculations: recapitulation of basic concepts (Errors in Data Calculations, Presentation of experimental data, data analysis, General procedures for plotting data, Process flow diagrams)

Unit-II

Microbial kinetics of growth, substrate utilization and product formation in batch, chemostat and fed batch culture, Maintenance energy and yield concepts, Principles of model building for biochemical processes, unstructured models, structured models.

Unit-III

Design of various bioreactors: CSTR, fed batch systems, air-lift bioreactors, fluidized bed bioreactors. Bioreactor design of agitator/agitator motor, power consumption in aerated bioreactor, design of sparger, mixing time estimation, oxygen mass transfer capability in bioreactor, Removal of Heat in bioreactor, Main parameters to be monitored and controlled in fermentation processes, Advanced control strategies: PID controllers, fuzzy logic based controllers and artificial neural network based controllers.

Unit-IV

Modifying batch and continuous reactions: Chemostat with recycle, multistage chemostat systems and perfusion systems. Convective mass transfer: liquid-solid mass transfer, liquid-liquid mass transfer, gas-liquid mass transfer, oxygen uptake in cell cultures, oxygen transfer in fermenters, oxygen transfer in large vessels. Scale-Up of Bioreactor: Scaling up procedure from laboratory to plant scale, scale down.

Recommended Readings:

1. Stanbury, P.F., Hall S. J. and Whitaker A. 2003. Principles of Fermentation Technology. 2nd ed. Science & Technology Books.
2. Doran P. 2012. Bioprocess Engineering Principles, 2nd ed. Academic Press
3. Nielsen, J. and Villadsen, J. 2007. Bioreaction Engineering Principles. 2nd ed. Springer science and business media.

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Course Code: MTPFE -617-22

Course Title: Agricultural Waste and By-Products Utilization

Hours per week: 4+0+0

Credit: 4

Unit-I

Agro-industries-Definition, classification, factors responsible for establishment. By-products utilization-Rice husk-Introduction, characteristics, uses, production of pure silica and silicon, uses of amorphous silica, grades of silicon, structure of rice husk silica. Burning of rice husk for production of white ash, production of high purity silicon (calcium reduction process).

Unit-II

Rice husk –Alcoholic fermentation –Introduction, processes for manufacture of alcohol, production of ethyl alcohol by SSF process. Furfural –Chemistry, products properties of furfural,synthesis, production of furfural and xylose from corn cobs, furfural through RRL process. Rice bran –Oil extraction, food and chemical products processing. Coconut coir and shell utilization –Introduction. Commercial products –Edible copra, milling copra, oil milling, quality of copra and oil.

Unit-III

Properice of agricultural waste: Properties of agricultural waste –characteristics of solid and liquid wastes, parameter importance, determination of DO, COD, total organic carbon, BOD. BOD analysis of industrial waste waters, determination of BOD with seed material, problems on BOD. Waste collection, storage and handling –Collection, components of waste collection systems, storage of manures and slurries, factors affecting choice of storage facility.

Unit-IV

Agricultural waste management: Biological treatment –Introduction. Anaerobic decomposition, lagoons, advantages and disadvantages, designing problems lagoon sludge. Aerobic treatment – Introduction, reactions, processes advantages and disadvantages types of aeration systems - Natural aeration mechanicalaeration –Film reactors –Tricking filters, rotating biological contactors, problems on tricking filters. Floc reactors –Mechanically aerated lagoons, diffused air systems, Waste for reuse. Briquetting –Introduction, principle, briquetting machines. Processing

–Direct compaction, carbonization and extrusion.

Recommended Readings:

1. Food Agricultural Waste Manual, Vandersholm D H, New Zealand.
2. Agricultural Waste Management Field Hand Book, USDA: New York, USA.
3. Manure Production and Characteristics. Standards, ASAE: Am. Soc. of Agricultural Engineers, New York.
4. Bhatia, S.C.. 2001. Environmental Pollution and Control in Chemical Process Industries. Khanna Publishers, New Delhi.