

**DEPARTMENT OF FOOD TECHNOLOGY
SCHOOL OF TECHNOLOGY**

SYLLABUS

FOR

M. SC FOOD TECHNOLOGY

(SEMESTER: I-IV)

Choice Based Credit System

(2015)



**ISLAMIC UNIVERSITY OF
SCIENCE AND TECHNOLOGY**

**ISLAMIC UNIVERSITY OF SCIENCE and TECHNOLOGY
AWANTIPORA, PULWAMA – 192122, J and K.**

P.O. Box: 1418, G.P. O. Srinagar – 190 001.

M. Sc (Food Technology)
Course Structure – at a Glance

1st Semester

Course Code	Course Title	Type of Course	L – P	Credit
MFT-101T/P	Basic and Food Microbiology	CF	3-2	4
MFT-111T/P	Food Chemistry	C	3-2	4
MFT-102T	Applied Statistics & Mathematics	CF	3-0	3
MFT-112T/P	Principles of Food Processing	C	3-2	4
MFT-113T/P	Food Engineering	C	3-2	4
MFT-114P	In-Plant Training (60 days)	C	0-10	5
Total Credits				24

2nd Semester

Course Code	Course Title	Type of Course	L – P	Credit
MFT-211T/P	Technology of Fruits & Vegetable Products	C	3-2	4
MFT-212T/P	Technology of Beverages	C	3-2	4
MFT-213T/P	Technology of Milk and Milk Products	C	3-2	4
MFT-214T/P	Technology of Animal Products	C	4-2	5
MFT-215T/P	Technology of Cereals and Legumes/Products	C	3-2	4
Total Credits				21

3rd Semester

Course Code	Course Title	Type of Course	L – P	Credit
MFT-301P	Analytical Techniques	CF	0-6	3
MFT-311T/P	Food Safety and Food Factory Audit	C	2-4	4
MFT-302T	Hygienic Design Principles I	CF	4-0	4
MFT-312T/P	Food Packaging Technology	C	3-2	4
MFT-303T	Hygienic Design Principles II	CF	4-0	4
MFT-313P	Research: Assignment of topic for Dissertation	C	0-10	5
Total Credits				24

4th Semester

MFT-411P	Research Project	C	0-10	5
Total Credits				5

1ST SEMESTER

MFT-101T/P Basic and Food Microbiology

Credits: 3-2 (4)

UNIT I

Fundamentals of Microbiology: Historical development, morphology, general cytology and reproduction of bacteria, yeasts, fungi, actinomycetes and algae. Physiology of microorganisms. Genetic recombination, transformation, transduction, bacterial conjugation, mutation and mutagenesis. General principles of serology and immunology. Viruses – structure and replication with particular reference to food borne viruses.

UNIT II

Growth and destruction of microorganisms Growth curves, generation time, intrinsic and extrinsic factors affecting growth. Physical and chemical factors influencing the destruction of microorganism including thermal death time, D, F and Z values.

Microorganism in natural products and their control.

Sources and prevention of contamination. General principles of food preservation. Microbiology of atmosphere, water, milk products; cereals and cereal products; meat and meat products, fish and fish products; poultry and eggs; spices and salt; canned foods.

UNIT III

Microbial techniques: Isolation and preservation of microbial cultures (Brief introduction). Methods of genetic improvement (Recombinant DNA, Natural Selection, Mutational Selection).

UNIT IV

Basic principles of food plant sanitation

Sanitation indices, personnel hygiene, Chemical and physical sanitizers, sanitation methods.. HACCP and predictive microbiology.

Food poisoning

1. Food borne infections
2. Food borne intoxications
3. Mycotoxins

Practicals

1. Microscopy
2. Micrometry
3. Cleaning and sterilization of glassware
4. Preparation of nutrient media and techniques of inoculation
5. Staining techniques – Monochrome staining, negative staining, gram staining, acid-fast staining, spore staining, capsule staining, flagella staining.
6. Isolation of pure cultures
7. Identification of bacteria
 - i) Cultural characteristics
 - ii) Morphological characteristics
 - iii) Biochemical characteristics
 - a) Acid and gas production from sugars
 - b) Starch hydrolysis
 - c) IMVic test
 - d) Lipolysis
 - e) Gelatin liquefaction
 - f) H₂S test
 - g) Urea hydrolysis
 - h) Nitrate reduction
 - i) Coagulase test
 - j) Catalase test
8. Growth characteristics of bacteria
 - a) Determination of microbial – direct and plate count?
 - b) Generation time
 - c) Factors influencing growth – pH, temperature, thermal death time, growth curves for bacteria and yeasts, osmotic pressure, preservatives.
9. Examination of moulds important in foods
10. Examination of yeasts and algae
11. Microbiological examination of natural products
 - a) Water
 - b) Milk and milk products
 - c) Cereals and cereal products
 - d) Fruits and vegetables
 - e) Meat and meat products
 - f) Fish and fish
 - g) Poultry and eggs
 - h) Sugars, spices and salt
 - i) Processed foods
13. Microbiological examination of tableware and containers.

Suggested literature:

1. A text book of microbiology by R.C. Dubey and D. K. Maheshwari, S. Chand & Co.
2. Microbiology by M. J. Pelezar, E. G. S. Chan and Noel R. Krieg, Tata McGraw Hill & Co. 5th edition
3. Microbiology, Fundamentals and applications by S. S. Purohit, Student ed.
4. Microbiology, A text book for university students by P. D. Sharma
5. Food Microbiology by W. C. Frazier and D. C. Westhoff, Tata McGraw Hill & Co.

UNIT I

Water Introduction to chemistry of foods: composition, factors affecting the composition of foods. Moisture in foods, methods of determination, water activity, sorption isotherms and water activity in relation to food stability.

UNIT II

Carbohydrates Monosaccharides: Occurrence, classification, hexoses, structure, reducing power of sugars. Oligosaccharides: Disaccharides, sucrose, dextrans, commercial sources, controlled hydrolysis of starch, isolation from natural products. Polysaccharides: Classification, cellulose, starches, starch enzymes, plant gums and hemicelluloses. Pectic substances: Occurrence, structure, properties and use in foods. Proteins Occurrence, amino acids, physical and chemical properties, peptides, proteins and their properties, structure of protein, denaturation and major sources of protein. Foaming and emulsion: Definition, surface activity, surface films, properties. Application of enzymes in food industry.

UNIT III

Oils and fats Introduction, occurrence and formation, composition, classification of glyceride structure, physical and chemical properties, rancidity, processing of oil bearing materials refining of oils and fats. Hydrogenation, shortenings and spreads. Shallow pan frying, deep fat frying, chemistry of frying and changes occurring during frying. Essential oils: occurrence, extraction of essential oils, use in foods.

Vitamins: Water and fat soluble, use of vitamins in foods.

Plant pigments

Chlorophyll and carotenoids – occurrence, structure, chemistry, function and changes during processing. Glycosides: Anthocyanins, anthoxanthins, flavonoids, bioflavonoids, bitter substances, tannins.

UNIT IV

Instrumentation Principles and instruments in colorimetry, spectrophotometry, fluorimetry, polarography and chromatography.

Practicals:

1. Typical exercises in quantitative analysis.
2. Determination of acidity and pH.
3. Determination of moisture by:
 - a) Drying method (using oven and vacuum oven)
 - b) Moisture meters
 - c) Distillation
4. Ash and mineral matter: Total ash, acid soluble and insoluble ash, alkalinity of ash, phosphorus, calcium, iron, lead, copper and tin estimation.
5. Determination of protein
 - a) Kjeldhal method
 - b) Formal titration or Folin-Ciocalteu's method. Qualitative tests for proteins. Paper chromatography of amino acids.
6. Carbohydrates – Qualitative tests, estimation of reducing sugars, total sugars and starch, polarimetry of sugars.
7. Oils and fats: Estimation of fat by soxhlet continuous extraction method, physical and chemical properties determination and rancidity tests. Demonstration of gas chromatography.
8. Estimation of crude Fibre.
9. Estimation of tannins.

Suggested literature:

1. Owen R. Fennema (1996). Food Chemistry, 3rd Edn. Marcel Dekker, Inc, New York
York.L.H. Meyer Food Chemistry, CBS Publishers, New Delhi.
2. Text book of Biochemistry by D. M. Vasudevan and SreeKumari, S. JayPee
Publishers.
3. Modern Experimental Biochemistry by Rodney Boyer, Pearson Ed
4. Handbook of Food and Nutrition by Blank, International Book Distributing Co.

UNIT I

Preliminary ideas (Mean, Mode, Median & standard deviation)
Frequency distributions
Measures of location and dispersion
Binomial distribution
Poisson distribution
Normal distribution

UNIT II

Tests of significance, T test, F Test, Z test and chi-square test
Analysis of variance, designs- CRD, LSD and RBD
Statistical quality control
Sampling.

UNIT III

Mathematics Quadratic equations: Theorems and solutions Binomial theorem: Statement, expansion (positive integral index only) Differentiation: Concept, differentiation, successive differentiation, maxima minima.

UNIT IV

Integration: Concept, indefinite and definite integrals, areas and volumes.
Differential equations: First order and linear only.
Introduction to MS Word, MS excel and MS power point

Suggested literature:

1. Applied Mathematics Vol. I by S. S. Sabharwal, Rajnish Kant, Sunita Jain, L. S. Kang, Amarseer, Pankaj Kumar. Eagle Prakashan, Jalandhar, edition 2002.
2. Engineering Mathematics by Mary Attenborough, Mc Graw Hill Book Company, edition 1994
3. Engineering Mathematics vol.I 3rd edition by S. S. Sastry , edition 2004, Prentice Hall.
4. Engineering Mathematics by K. A. Stroud, Dexter J. Booth 5th edition 2001, Palgrave Hampshire, New York.
5. Technical Mathematics by VishwaNath , Satya Prakashan, New Delhi.

UNIT I

Heat processing

Food processing-current scenario, preservation and shelf life.

HEAT PROCESSING: Theory, sources of heat and methods of application to foods, effect of heat on micro-organisms and enzymes, effect of heat on nutritional and sensory characteristics of foods.

BLANCHING: Theory, equipments: steam blanchers, hot-water blanchers and newer blanching methods, effects on foods, effect on microorganisms

PASTEURISATION: Theory, equipments: pasteurisation of packed foods, pasteurization of unpackaged liquids, effect on foods.

STERILIZATION: In-container sterilization: theory, retorting, equipments, ultra-high-temperature (UHT)/aseptic processes: theory, processing, equipments, effect on foods: canning, UHT processing.

UNIT II

Refrigeration and freezing

CHILLING AND MODIFIED ATMOSPHERES: Theory: refrigeration, modified atmospheres, equipments: mechanical refrigerators, cryogenic chilling, cold storage, temperature monitoring, modified and controlled atmospheres storages, applications: fresh foods, processed foods, effect on sensory and nutritional qualities of foods, effect on micro-organisms.

FREEZING: Theory: Ice crystal formation, solute concentration, calculation of freezing time, thawing, equipment: mechanical freezers, cryogenic freezers, new developments in freezing, frozen storage, thawing, effect on foods: freezing, frozen storage, thawing, effect on micro-organisms.

FREEZE DRYING AND FREEZE CONCENTRATION

Freeze drying: Theory, Equipment, Effect on foods and micro-organisms, Freeze concentration: Theory, Equipment, Effect on foods and micro-organisms.

UNIT III

Dehydration and smoking

DEHYDRATION: Theory: drying using heated air, drying using heated surfaces, intermediate moisture foods, equipment: hot-air driers, heated-surface (or contact) driers, control driers, rehydration, effect on foods and micro-organisms: sensory properties, nutritional value, effect on micro-organisms.

SMOKING: Theory: constituents in smoke, liquid smoke, processing: equipments, effect on foods, and effect on micro-organisms.

UNIT IV

Frying baking and roasting

FRYING: Theory: Heat and mass transfer, frying time and temperature, equipment: atmospheric fryers, vacuum and pressure fryers, control of fryer operation, oil filtration and heat recovery, types of oils used for frying: effect of frying on oils, effect of frying on foods and micro-organisms: oil absorption, change to texture, colour and flavour, nutritional changes, effect on micro-organisms.

BAKING AND ROASTING: Theory, equipment: batch and semi-continuous ovens, continuous ovens, control of ovens, effect on foods and micro-organisms: changes to sensory qualities and nutritional value and effect on micro-organisms.

Practicals

1. To study the thermal processing of vegetables /fruits by canning
2. To study the cut out examination of canned food products
3. Tin coating measurement and tests for sulphide stain and crystal size of tin plates;
4. Determination of thermal inactivation time of enzymes;
5. Thermal processing of foods;
6. Dehydration curve plotting and packaging
7. Refrigeration Freezing of foods: comparison between fast rate ,slow rate of freezing
8. Concentration of foods by using double effect evaporators
9. To determine the quality of fried products
10. Comparison between baked, fried and roasted food products;
11. Visit to a food processing plant.

Suggested Readings

1. Arsdel WB, Copley MJ & Morgan AI. 1973. *Food Dehydration*. 2nd Ed. Vols. I, II. AVI Publ.
2. Desrosier NW & James N.1977. *Technology of Food Preservation*. 4th Ed. AVI. Publ.
3. Fellows PJ. 2005. *Food Processing Technology: Principle and Practice*. 2nd Ed. CRC.
4. Jelen P. 1985. *Introduction to Food Processing*. Prentice Hall. Potter NN & Hotchkiss 1997. *Food Science*. 5th Ed. CBS.
5. Potty VH & Mulky MJ. 1993. *Food Processing*. Oxford & IBH.
6. Ramaswamy H & Marcotte M. 2006. *Food Processing: Principles and Applications*. Taylor & Francis.

UNIT I: Introduction

Dimensions, engineering units, system, state of a system, Density, Concentration, moisture content, temperature, pressure, enthalpy, equation of state and perfect gas law, phase diagram of water, conservation of mass, material balance, thermodynamics, law of thermodynamics, energy, energy balance, energy balance for an open and closed system, total energy balance, area.

UNIT II: Fluid Flow and Food Processing

Liquid transport system, properties of liquid, handling system for Newtonian liquids: the continuity equation, Reynolds number, velocity profile, , pumps selection and performance evaluation of pumps, brief of flow measurement, measurement of viscosity: capillary tube viscometer, rotational viscometer, influence of temperature on viscosity, flow characteristics of non-Newtonian fluids, transport of solid fluids.

UNIT III: Heat Transfer in Food processing

Systems for heating and cooling, food products, thermal properties of food, mode of heat transfer, steady state heat transfer: conductive heat transfer in a rectangular slab, conductive heat transfer through a tabular pipe, heat conduction in multilayered system, estimation of overall heat transfer coefficient, design of a tabular heat exchanger, radiative heat transfer between two objects and unsteady state heat transfer: importance of external and internal resistance to heat transfer, negligible internal resistance to heat transfer, procedure to use temperature-time charts , electrical conductivity of food, ohmic heating, micro-wave heating.

UNIT IV: Preservation processes

Microbial survivor curves, influence of external agents, thermal death time F, spoilage probability, general method for process calculation: applications to pasteurization, commercial sterilization and aspectic processing and packaging, mathematical methods.

Practicals:

- 1) Calculation of material balance and energy balance
- 2) Measurement of flow and viscosity
- 3) Determination of sterilization time
- 4) In-bottle pasteurization and sterilization
- 5) Thermal in-activation of enzymes and microbes

Suggested Literature:

- 1) *Heldman DR & Singh RP. IV Edition. Introduction to Food Engineering.*
- 2) *D.G.Rao, Fundamentals of food engineering*
- 3) *Text books of XI and XII*

MFT-114P In-Plant Training (60 days) Jan-Feb

Credits 0-10 (5)

Students will undergo training in different food industries for a minimum period of 45-60 days during Jan-Feb or winter after the examination of 1st semester.

2nd SEMESTER

MFT-211T/P Technology of Fruit and Vegetable Products

Credits 3-2 (4)

UNIT I

Indian and global scenario on production and processing of fruits and vegetable; Quality requirements of raw materials for processing; sourcing and receiving at processing plants; primary processing: grading, sorting, cleaning, washing, peeling, slicing and blanching; minimal processing.

UNIT II

Processing for pulp, puree and concentrates, using aseptic packaging, canning, RTS fruit beverages, IQF and frozen fruits and vegetables

UNIT III

Technology for processed products like pickles, chutneys, sauces from fruits and vegetables of regional importance.

UNIT IV

Processing of fruits for candies, bars, toffees, jams and jellies, squashes and syrups using locally available fruits Dehydration of fruits and vegetables using various drying technologies like sun drying, solar drying (natural and forced convection), osmotic, tunnel drying, fluidized bed drying, freeze drying, convectional and adiabatic drying; intermediate moisture fruits and vegetables.

Practical

1. Evaluation of pectin grade;
2. canning of fruits
3. Canning of vegetable
4. preparation and quality evaluation of fruit jam and fruit jelly,
5. fruit preserve and candy;
6. fruit RTS, squash,
7. Processing of tomato products;
8. preparation of *anardana*;
9. preparation of cheese;
10. preparation of pickle, mixed pickle;
11. Preparation of dried fruit;
12. Preparation of potato wafers
13. Preparation of dehydrated vegetables.

Suggested Readings

1. Barret DM, Somogyi LP & Ramaswamy H. 2005. *Processing of Fruits*. CRC Press
FAO. 2007.
2. *Handling and Preservation of Fruits and Vegetables by Combined Methods for Rural Areas- Technical Manual*. FAO Agr. Ser. Bull., 149.
3. Fellows P. 2007. *Guidelines for Small-Scale Fruit and Vegetables Processors*. FAO Agr. Ser. Bull., 127.
4. Lal G, Siddappa GS & Tandon GL. 1998. *Preservation of Fruits and Vegetables*. ICAR.
5. Salunkhe DK & Kadam SS. 1995. *Handbook of Fruit Science & Technology: Production, Composition and Processing*. Marcel Dekker.
6. Salunkhe DK & Kadam SS. 1995. *Handbook of Vegetables Science & Technology: Production, Composition, Storage and Processing* Marcel Dekker.
7. Somogyi LP. et al. 1996. *Processing Fruits - Science and Technology*. Vols I, II. Technomic Publ.
8. Srivastava RP & Kumar S. 2003. *Fruit and Vegetable Preservation - Principles and Practices*. International Book Distributors.
9. Verma LR & Joshi VK. 2000. *Post Harvest Technology of Fruits and Vegetables*. Indus Publ.

Unit 1 Packaged drinking water

Introduction, Technology; abstraction and post abstraction treatments, quality assurance and control, chemical constituents of bottled water: Minerals and analysis, microbiology, types of microorganisms and public health.

Unit 2 Fruit juices and soft drinks

Introduction, Technology, Types, Processing, chemical constituents of water used in soft drinks,, chemistry: Chemistry of intense sweeteners, acidulants,colours,preservativesand antioxidants used in soft drinks ,. Fruit Juices, Processing, types, chemistry and microbiology, types of microorganisms and public health.

Unit 3 Cocoa, coffee, tea and chocolate based beverages

Introduction, technology of cocoa, technology, cocoa based beverages: coca, instant cocoa powder, drinking chocolate, chocolate crumb, added value products, ready to drink cocoa beverages, cocoa substitutes, biological activity of cocoa and chemistry: chemical changes during processing of cocoa. Microbiology, types of microorganisms and public health. Types of Tea and Coffee, Technology of coffee and Tea, Processing of various types of tea and coffee, Biological activity and chemistry of various types of Coffee and Tea.

Unit 4 Alcoholic beverages

Introduction, Microorganisms involved, microbiology, types of microorganisms and public health.Technology of Brewing and wine making, Chemistry of beer and wine, Microbiological hazards associated with beer and wine.

Practicals:

- 1) Determination of presence of E.Coli in water
- 2) Determination of TSS, acidity, pH, color of various beverages
- 3) Estimation of sugars in various beverages
- 4) To study the Rheological behavior of chocolate
- 5) Preparation of wine

Suggested Readings

- 1) Beverages: Technology, chemistry, and microbiology by Varnam A, Sutherland,J.M Vol. 2
- 2) Book on alcoholic and non-alcoholic beverages 2008 NPCS board of consultant and engineers

UNIT I

Present status of milk & milk products in India and abroad, estimates of milk production, and per capita availability, Indian and exotic breeds of dairy animals, systems of breeding and selection methods of dairy animals., housing systems of dairy and maintenance of hygiene and sanitation at dairy farm premises, feed resources for milk production and nutritive values, market milk- Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments, milk cold chain, Special milks such as flavored, sterilized, recombined & reconstituted toned & double toned.

UNIT II

Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder.

UNIT III

Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter, spreads .

UNIT IV

Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream and technology aspects of softy manufacture.

Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese, infant formulation, probiotic milk products

Practical

1. Study on basics of reception of milk at the plant;
2. Platform tests in milk; estimation and fat and SNF in milk;
3. Operation of LTLT & HTST Pasteurization;
4. Preparation of special milks; Cream separation & standardization of milk;
5. Visit to dairy plants.

Suggested Readings

1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ.
2. De S.1980. *Outlines of Dairy Technology*. Oxford Univ. Press. Henderson JL. 1971. *Fluid Milk Industry*. AVI Publ. Rathore NS et al. 2008. *Fundamentals of Dairy Technology - Theory & Practices*. Himanshu Publ
3. Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.
4. Walstra P. 1999. *Dairy Technology*. Marcel Dekker.
5. Walstra P. (Ed.). 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.
6. Web BH, Johnson AH & Lford JA. 1987. *Fundamental of Dairy Chemistry*. 3rd Ed. AVI Publ.

UNIT I

Introduction: Livestock and poultry population in India; Development of meat and poultry industry in India and its need in nation's economy. Glossary of live market terms for animals and birds. Effect of feed, breed and environment on production of meat, animals and their quality. Slaughter, inspection and grading; Antemortem examination of meat animals. Slaughter of cattle, buffalo, sheep goat and pigs, dressing of carcasses. Postmortem examinations of meat. Retail and wholesale cuts, grading.

UNIT II

Preparing poultry for consumption, ready-to-cook chicken. Quality factors in meat and meat foods: Factors influencing the quality of fresh meat. Factors influencing the quality of cured meat. Preservation: Refrigeration and freezing, thermal processing, dehydration, irradiation, chemicals and antibiotics. Meat curing: Bacon, ham, corned meat, salami etc, sausage products. Packaging, transport and marketing. The nutritive value of meat and meat products (including poultry), effect of processing thereon. Methods of analysis of meat and meat products: Chemical, physical, panel, microscope, bacteriological.

UNIT III

By-products: Meat fats, feeds, hides, skins, natural casings and feathers, miscellaneous by-products.

Egg and egg products: The egg factory, its techniques of working, structure, composition and nutritive value of its product.

Preservation of eggs by different methods:

- a) Refrigeration and freezing
- b) Thermal processing
- c) Dehydration
- d) Coating.

Post-mortem changes in meat..

Factors affecting the quality of fresh meat.

UNIT IV**Fish and Fish products**

1. Introduction, fisheries resources of the world.
2. Canning, freezing, drying, dehydration, curing and pickling of fish.
3. Fish oils.
4. Fish protein concentration.
5. Quality control of fresh fish, fish products, food standards.

Practicals

1. Meat cutting and handling.
2. Dressing of poultry.
3. Evaluation of the quality of meat and poultry.
4. Analysis of meat and poultry products.
5. Canning.
6. Freezing.
7. Dehydration.
8. Measures of egg quality,
9. Production of egg powder.
10. Evaluation of quality of fish for processing-Physio-chemical indices of quality.
11. Analysis of fish and fish products.
12. Quality evaluation of processed products
13. pickling of fish and meat;
14. preservation of shell eggs
15. Visit to local meat preservation units.

Suggested literature:

1. Forrest JC. 1975. *Principles of Meat Science*. Freeman.
2. Govindan TK. 1985. *Fish Processing Technology*. Oxford & IBH.
3. Hui YH. 2001. *Meat Science and Applications*. Marcel Dekker.
4. Kerry J. *et al.* 2002. *Meat Processing*. Woodhead Publ. CRC Press.
5. Levie A. 1984. *Meat Hand Book*. 4th Ed. AVI Publ.
6. Mead M. 2004. *Poultry Meat Processing and Quality*. Woodhead Publ.
7. Mead GC. 1989. *Processing of Poultry*. Elsevier.
8. Pearson AM & Gillett TA. 1996. *Processed Meat*. 3rd Ed. Chapman & Hall.
9. Stadelman WJ & Cotterill OJ. 2002. *Egg Science and Technology*. 4th Ed. CBS.

UNIT I

General introduction and production and utilization trends; Structure and Composition of common cereals, pulses and oilseeds.

UNIT II

Wheat: Types and physicochemical characteristics; wheat milling - products and by products; factors affecting quality parameters; physical, chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents; manufacture of bakery products, pasta products and various processed cereal-based foods; manufacture of whole wheat *atta*, blended flour and fortified flour.

UNIT III

Rice: Classification, physicochemical characteristics; cooking quality; rice milling technology; by- products of rice milling and their utilization; Parboiling of rice- technology and effect on quality characteristics; aging of rice - quality changes; processed products based on rice.

UNIT IV

Corn: Types and nutritive value; dry and wet milling, manufacture of value-added products; processing of barley, oats, sorghum and millets.

Legumes and oilseeds: composition, anti-nutritional factors, processing and storage; processing for production of edible oil, meal, flour, protein concentrates and isolates; extrusion cooking technology; snack foods; development of low cost protein foods.

Practical

1. Physical-tests on wheat and rice; Physicochemical and rheological properties;
2. Determination of gluten content in wheat flour; Conditioning of wheat;
3. Milling of wheat and rice by laboratory mill; Parboiling of rice; Quality tests of rice; Amylose content determination in rice;
4. Malting of barley; puffing and popping of grains; experimental parboiling and assessment of degree of polishing;
5. Preparation of protein concentrates and isolates and their evaluation for protein content and solubility;
6. Extraction of oil using expeller and solvent extraction methods;
7. Experimental baking-bread, biscuits, cakes and pastries;
8. Visit to related processing industries.

Suggested Readings

1. Chakrabarty MM. 2003. *Chemistry and Technology of Oils and Fats*. Prentice Hall.
2. Dendy DAV & Dobraszczyk BJ. 2001. *Cereal and Cereal Products*. Aspen.
3. Hamilton RJ & Bhati A. 1980. *Fats and Oils - Chemistry and Technology*. App. Sci. Publ.

4. Hosney RS. 1994. *Principles of Cereal Science and Technology*. 2nd Ed. AACCC.
5. Kay DE. 1979. *Food Legumes*. Tropical Products Institute.
6. Kent NL. 1983. *Technology of Cereals*. 4th Ed. Pergamon Press.
7. Kulp K & Ponte GJ. 2000. *Handbook of Cereal Science and Technology*. 2nd Ed. Marcel Dekker.
8. Lorenz KL. 1991. *Handbook of Cereal Science and Technology*. Marcel Dekker.
9. Marshall WE & Wadsworth JI. 1994. *Rice Science and Technology*. Marcel Dekker.
10. Mathews RH. 1989. *Legumes Chemistry, Technology and Human Nutrition*. Marcel Dekker.
11. Matz SA. 1969. *Cereal Science*. AVI Publ.
12. Paquot C. 1979. *Standard Methods of Analysis of Oils, Fats and Derivatives*. Pergamon Press.
13. Pomeranz Y. 1987. *Modern Cereal Science & Technology*. VCH Publ.
14. Salunkhe DK. 1992. *World Oilseeds: Chemistry, Technology and Utilization*. VNR.
15. Swern D. 1964. *Bailey's Industrial Oil and Fat Products*. InterSci. Publ. 28
16. Watson SA & Ramstad PE. 1987. *Corn; Chemistry and Technology*. AACCC.
17. Dubey SC. 2002. *Basic Baking*. The Society of Indian Bakers, New Delhi.
18. Francis FJ. 2000. *Wiley Encyclopedia of Food Science & Technology*. John Wiley & Sons.
19. Manley D. 2000. *Technology of Biscuits, Crackers & Cookies*. 2nd Ed. CRC Press.
20. Pyler EJ. *Bakery Science & Technology*. 3rd Ed. Vols. I, II. Sosland Publ.
21. Qarooni J. 1996. *Flat Bread Technology*. Chapman & Hall.

3rd SEMESTER

MFT-301P

Analytical Techniques

Credits: 0-6 (3)

Unit I Chromatographic Techniques

Classification of chromatographic techniques, adsorption and partition, theory of chromatographic separation, distribution coefficient, retention, adsorption, efficiency and resolution, Types of chromatographic techniques: paper, TLC and HPTLC. Types of chromatographic techniques: HPLC, column, ion exchange, size exclusion and droplet counter current -instrumentation: columns, pumps, detectors, techniques and applications.

Unit II Gas chromatography

Instrumentation, types of columns, retention time, volume, capacity ratio, partition coefficient, theoretical plate & number, separation efficiency, resolution and applications.

Unit III Spectroscopy

The nature of electronic excitation-Use of UV spectra-Instrumentation-Effects of solvent-Effect of conjugation-Presentation of UV spectra

FTIR Spectroscopy-electromagnetic radiation - origin of molecular vibrations - principles of vibrational spectroscopy - normal mode of molecular vibrations – infrared activity. fourier transform infrared spectroscopy - working principles – sample preparation and measurement - applications. Fluorescence Spectroscopy- Fundamentals of fluorescence spectroscopy – selection of filters – selection of fluorophores , optical detectors. fluorescence quenching and fluorescence resonance energy transfer. confocal imaging and detection - laser scanning confocal microscopy – principles and applications.

Unit IV Textural and rheometry techniques

Textural analysis-Instrumentation, calibration of texture analyzer, measurement of textural property, types of probes, load cells, TPA, presentation of texture analysis graphs, suitability of food material for textural analysis, factors affecting the texture analysis Rheometry-Instrumentation, calibration of rheometer, measurement systems, flow curves, frequency sweep, gap setting, parameter settings. Viscometry-instrumentation, principle, calibration, measurement of parameter from viscometry.

Books Recommended

1. Introduction to Spectroscopy by Pavia, Lampman and Kriz
2. Introduction to Modern Liquid Chromatography by Lloyd R. Snyder., Joseph J. Kirkland & John W. Dolan

UNIT I Food Safety and Quality Assurance

Quality control of raw materials, in –process food control, quality control of finished products, quality assurance of therapeutic, functional, nutraceutical and novel foods. Food Quality Indices: Meat and meat products, fish and fish products, milk and dairy products, vegetables , fruits and their products, grain , pulses and oil seeds, coffee, tea and spices.

UNIT II Food adulteration and sampling

Common adulterants, simple tests for detection of adulteration. Food additives- classification, functional role and safety issues, types of adulteration and recent trends in food adulteration. Principal aspects of sampling of food: Importance of sample collection, sampling tools and containers, sample collection techniques, quantity of sample to be collected, packaging and sealing of sample, dispatch of sample, documentation and commodity specific sampling procedure. Codex Alimentarius Commission (CODEX): Introduction, standards, codex of practice, guidelines and recommendations, applying codex standards.

UNIT III Food factory auditing

Food surveillance: International and national practices, procedure and protocols, food alerts, traceability and food product recall. Risk analysis: risk assessment, management and communication. Food standards and Specification: need for auditing, increasing importance of HACCP based Codex Standards.

Unit IV International trade requirements

Export and import of food in India: Introduction, import and export policies, FDA import policy, export-import policy, export control systems. Import intelligence and alert systems, packaging and labeling, specifications and certifications. case studies and judicial pronouncements, procedure for investigations and filing of cases by food safety regulator as per FSS act. Inspection of food establishments, manufacturing units: Food regulatory enforcement and compliance through inspection. Inspectional requirements for food business operators: general inspection procedures, biological inspection of establishments.

Books Recommended

1. Guide to quality management system for food industry. Blackie, Academic and Professional, London by Early, R.
2. American Society for Quality. 2nd Edn. Quality Press
3. The training manual for food safety regulators. Vol II-Food safety regulations and food safety management. Food safety and standards authority of India, New Delhi

Unit I Building design principles

Design concepts, site selection and plant layout, water supply and waste disposal, landscaping and surrounding area, roof areas, loading bays, entry and exit points, external and internal lighting, future trends.

Unit II Improving zoning within food processing plants

Introduction, barriers 1: Site, Barrier 2: factory building, barrier 3: high care/risk areas, finished products enclosure. Improving the design of floors, walls and closed equipment- Introduction, what are floors made of?, requirement of flooring material, test methods, construction of floors, future trends

Unit III improving the hygienic design of electrical equipments

Introduction, hygienic zoning, hygienic electrical design principles, installation requirements for medium-hygienic areas, installation requirements for high-hygienic areas, general requirements for construction materials, future trends

Unit IV Testing food industry clean ability

Introduction, microorganisms, hygienic surfaces, organic soil, future trends. Improving surface sampling and detection of contamination-introduction, microbiological surface sampling, non-microbiological surface sampling, monitoring/sampling protocols and strategies, future trends

Suggested Readings:

- 1) Hygienic design of food factories edited by J.Holah & H.L.M. lelieveld
- 2) Essentials of food safety and sanitation 4th edition, David McSwane, Richard Linton, Nancy R.Rue
- 3) Principles of food sanitation. Fifth edition Norman.G.Marriott and Robert.B.Gravani.

UNIT I

Definitions, objectives and functions of packaging and packaging materials; Packaging requirements and selection of packaging materials; Types of packaging materials: Paper: pulping, fibrillation and beating, types of papers and their testing methods; Glass: composition, properties, types of closures, methods of bottle making; Metals: Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminum containers, lacquers; Plastics: types of plastic films, laminated plastic materials, co-extrusion, edible films, biodegradable plastics.

UNIT II

Properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation; Barrier properties of packaging materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods, selection and design of packaging material for different foods.

UNIT III

Food packaging systems: Different forms of packaging such as rigid, semirigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.

UNIT IV

Packaging equipment and machinery: Vacuum, CA and MA packaging machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machines; carton making machines. Package standards and regulations.

Practical

1. Identification and testing of packaging materials;
2. Determination of wax from wax paper;
3. Testing of lacquered tin plate sheets;
4. Measurement of tin coating weight by Clarke's method;
5. To perform sulphide stain test;
6. To conduct ferricyanide paper test for porosity;
7. Determination of equilibrium moisture content;
8. Determination of water vapour transmission rate of packaging material
9. To perform vacuum packaging of food sample
10. Testing the compression strength of the boxes
11. Packaging the food material in seal and shrink packaging machine and study its shelf life
12. Testing the strength of glass containers by thermal shock test
13. Testing the strength of filled pouches by drop tester.

Suggested Readings

Crosby NT.1981. *Food Packaging: Aspects of Analysis and Migration Contaminants*. App. Sci. Publ.

Kadoya T. (Ed). 1990. *Food Packaging*. Academic Press.

Mahadeviah M & Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw Hill.

Palling SJ. (Ed). 1980. *Developments in Food Packaging*. App. Sci. Publ.

Painy FA. 1992. *A Handbook of Food Packaging*. Blackie Academic.

Sacharow S & Griffin RC. 1980. *Principles of Food Packaging*. AVI Publ.

Stanley S & Roger CG.1970. *Food Packaging*. AVI Publ.

Unit I Hazards in food processing environments

Introduction, different types of contamination analyses, *listeria monocytogenes* contamination in food processing environments, psychrotropic lactic acid bacterium contamination in meat processing environments, applying knowledge from contamination analysis to improve hygienic food manufacturing, future trends

Unit II Hygienic design of valves, pipes, pumps and sensors

Introduction, valve types, hygienic aspects of valve design, current guidelines and standards. piping design-materials of construction, product recovery, microbial growth in piping system, plant design. Pumps-components used in pumps, types of pumps used in food industry, clean ability, surface finish and other requirements, materials and motor design. Sensors-sensor types, common industrial applications and future trends

Unit III Improving the hygienic design of heating equipment

Introduction, heat exchanger design, development in heat exchanger design, future, trends

Unit IV Improving the hygienic design of equipment in dry handling materials

Introduction: principles of hygienic design, dry particulate material and hygienic processing, cleaning regimes, design principles, types of equipments in dry material handling areas

Suggested Readings:

- 1) Hygienic design of food factories edited by J.Holah & H.L.M. Ielieveld
- 2) Essentials of food safety and sanitation 4th edition, David McSwane, Richard Linton, Nancy R. Rue
- 3) Principles of food sanitation. Fifth edition Norman.G.Marriott and Robert.B.Gravani.

MFT-313P Research: Assignment of topic for Dissertation

Credits: 0-10 (5)

The students will be allotted a supervisor who will assign a research problem to the student. The student thesis will be evaluated by an external examiner. The supervisor should ensure that the submitted dissertation does meet the requirements of thesis and should also certify that the thesis has been properly checked for scientific/technical/language requirements.

4th SEMESTER

MFT-411P Research Project

Credits: 0-40 (20)