

ANNEXURE-I

SEMESTERWISE COURSE DISTRIBUTION OF M. Sc. FOOD TECHNOLOGY

FIRST SEMESTER

Course Code	Course Title	L-T-P	Total Credits	Total Marks
MFT-101	Principles of Food processing	3-0-1	4	100
MFT-102	Food Microbiology	2-0-1	3	100
MFT-103	Food Chemistry	2-0-1	3	100
MFT-104	Enzymes in food processing	3-0-1	4	100
MFT-105	Food Packaging Technology	3-0-1	4	100
MFT-106	Practical based on MFT - 101 and MFT-102			100
MFT-107	Practical based on MFT - 103, MFT-104 and MFT-105			100
Total		13-0-5	18	700

SECOND SEMESTER

Course Code	Course Title	L-T-P	Total Credits	Total Marks
MFT-201	Post harvest management of fruits and vegetables	3-0-1	4	100
MFT-202	Cereal, legume and pulses technology	2-0-1	3	100
MFT-203	Principles of Food Engineering	4-0-0	4	100
MFT-204	Beverage Technology	2-0-1	3	100
MFT-205	Food quality systems and management	2-0-1	3	100
MFT-206	Practical based on MFT - 201 and MFT-202			100
MFT-207	Practical based on MFT - 203, MFT-204 and MFT-205			100
Total		12-0-4	17	700

THIRD SEMESTER

Course Code	Course Title	L-T-P	Total Credits	Total Marks
MFT-301	Technology of Milk and Milk Products	3-0-1	4	100
MFT-302	Food additives, contaminants and toxicology	2-0-1	3	100
MFT-303	Principles of food analysis and sensory evaluation	2-0-1	3	100
MFT-304	Nutraceuticals and functional foods	3-0-1	4	100
MFT-306	Practical 1 based on MFT - 301 and MFT-302			100
MFT-307	Practical 1 based on MFT - 203 and MFT-304			100
Total		10-0-4	14	600

FOURTH SEMESTER

Course Code	Course Title	L	T	P	Total Credits	Total Marks
MFT-401	Seminar	0	0	2	02	100
MFT-402	Thesis/project	0	0	15	15	Satisfactory/Unsatisfactory
Total					17	100

Total credits: 65

SUMMARY OF MARKS

S. No.	Semester	Semester Total
1.	First	700
2.	Second	700
3.	Third	600
4.	Fourth	100
Total for M.Sc. Food Technology		2100

M. Sc. FOOD TECHNOLOGY

SEMESTER I

Course Code	Course Title	L-T-P	Total Credits
MFT-101	Principles of Food processing	3-0-1	4
MFT-102	Food Microbiology	2-0-1	3
MFT-103	Food Chemistry	2-0-1	3
MFT-104	Enzymes in food processing	3-0-1	4
MFT-105	Food Packaging Technology	3-0-1	4
MFT-106	Practical based on MFT -101 and MFT-102		
MFT-107	Practical based on MFT -103, MFT-104 and MFT-105		
Total		13-0-5	18

SEMESTER II

Course Code	Course Title	L-T-P	Total Credits
MFT-201	Post harvest management of fruits and vegetables	3-0-1	4
MFT-202	Cereal, legume and pulses technology	2-0-1	3
MFT-203	Principles of Food Engineering	4-0-0	4
MFT-204	Beverage Technology	2-0-1	3
MFT-205	Food quality systems and management	2-0-1	3
MFT-206	Practical based on MFT -201 and MFT-202		
MFT-207	Practical based on MFT -203, MFT-204 and MFT-205		
Total		13-0-4	17

SEMESTER III

Course Code	Course Title	L-T-P	Total Credits
MFT-301	Technology of Milk and Milk Products	3-0-1	4
MFT-302	Food additives, contaminants and toxicology	2-0-1	3
MFT-303	Principles of food analysis and sensory evaluation	2-0-1	3
MFT-304	Nutraceuticals and functional foods	3-0-1	4
MFT-306	Practical based on MFT -301 and MFT-302		
MFT-307	Practical based on MFT -203 and MFT-304		
Total		10-0-4	14

SEMESTER IV

Subject No.	Subject Name	L-T-P	Total Credits
MFT-401	Seminar	0-0-2	02
MFT-401	Thesis/project	0-0-15	15
Total			17

Total credits: 65

SEMESTER I

Course Code	Course Title	Total Credits
MFT-101	Principles of Food processing	4
MFT-102	Food Microbiology	3
MFT-103	Food Chemistry	3
MFT-104	Enzymes in food processing	4
MFT-105	Food Packaging Technology	4
MFT-106	Practical based on MFT -101 and MFT-102	
MFT-107	Practical based on MFT -103, MFT-104 and MFT-105	
Total		18

PRINCIPLES OF FOOD PROCESSING

Course Code: MFT 101

Credits 4(3-0-1)

Theory

UNIT I

Definition and scope of food processing; historical developments; national and international perspectives, causes of spoilage and general principles of food processing and preservation.

UNIT II

High temperature preservation, Principles of thermal processing Effect of temperature on microorganisms; use of different temperatures for processing of food. Basic steps in thermal processing. Canning, aseptic canning.

Method of calculation of process time; different time- temperature combination, TDT curve and TDR curve, 12 D value.

UNIT III

Preservation by water removal. Concept of water activity and its effect on physico-chemical and microbial changes in food. Drying: Mechanism of drying, factors affecting drying rate, effect of drying on product quality; types of dryers and their suitability for different food products; Intermediate moisture foods.

Processing and preservation by concentration, evaporation, ultra- filtration and reverse osmosis.

UNIT IV

Low-temperature food preservation. Mechanism of freezing of water in foods, effect of freezing on quality of foods; methods of freezing, storage and thawing of frozen foods. refrigeration, freezing, CA, MA, and dehydro-freezing.

UNIT V

Non-thermal preservation: Hydrostatic pressure, dielectric heating, microwave processing, high pressure, pulsed electric field, hurdle technology, membrane technology, irradiation of foods.

Use and application of enzymes and microorganisms in processing and preservation of foods; food fermentations, pickling, smoking etc;

Practical

Seaming and testing of cans; Tin coating measurement and tests for sulphide stain and crystal size of tinplates; Determination of thermal inactivation time of enzymes; Thermal processing of foods; Dehydration of foods; Refrigeration Freezing of foods; Concentration of foods; Use of chemicals in preservation of foods; Fermented food products; Extrusion cooking of foods; Visit to a food processing plant.

Suggested Readings:

Food Science Norman N.Potter

Food Processing technology P. Fellows.

Technology of Food Preservation Desosier & Desosier

Unit operations in Food Processing R. K. Singh & Sahai

Food Packaging Khetrapaul & Pania

Food Dehydration. Arsdel WB, Copley MJ & Morgan AI. 1973. 2nd Ed. Vols. I, II. AVI Publ.

Technology of Food Preservation. Desrosier NW & James N.1977. 4th Ed. AVI. Publ.

Food Processing Technology: Principle and Practice. Fellows PJ. 2005.2nd Ed. CRC.

Introduction to Food Processing. Jelen P. 1985. Prentice Hall.

Food Science. Potter NN & Hotchkiss 1997.5th Ed. CBS.

Food Processing. Potty VH & Mulky MJ. 1993. Oxford & IBH.

Food Processing: Principles and Applications. Ramaswamy H & Marcotte M. 2006. Taylor & Francis.

FOOD MICROBIOLOGY

Course Code: MFT-102

Credits 3(2-0-1)

Theory

UNIT I

Types of micro-organism normally associated with food spoilage- mold, yeast, and bacteria. Factors influencing growth and survival of microorganisms in foods.

UNIT II

Biochemical changes caused by micro-organisms. Physical and chemical methods to control microorganisms.

UNIT III

Food Spoilage: spoilage of fresh and processed products: fruits and vegetables; meat, poultry and fish, egg and poultry, grains and oilseeds, milk and milk products.

Spoilage of canned foods. Antagonism and synergism in microorganisms.

UNIT IV

Food Fermentations and microbes in food fermentation. Traditional fermented foods of India and other Asian countries. Probiotics and prebiotics. Fermented foods based on milk, meat and vegetables; Fermented beverages.

Unit V

Food hygiene and sanitation: Contamination during handling and processing and its control; indicator organisms; Rapid methods in detection of microorganisms.

Food poisoning (Staphylococcus, Bacillus, Listeria, Salmonella) and microbial toxins, Food-borne infections and intoxicants. Microbial toxins and mycotoxins

Practical

Microscopic examination of bacteria, and yeast and molds; Standard plate count; Yeast and mould count; Spore count; Detection and enumeration of pathogenic and indicator organisms in food; MPN of coli forms; Enumeration of physiological groups- psychrophile, thermotolerants, osmophiles and halophiles. Evaluation of microbiological quality of commonly consumed street foods.

Suggested Readings

Banawart GJ. 1989. *Basic Food Microbiology*. 2nd Ed. AVI Publ.

Frazier J & Westhoff DC. 1988. *Food Microbiology*. 4th Ed. McGraw Hill.

Garbutt J. 1997. *Essentials of Food Microbiology*. Arnold Heinemann.

Jay JM, Loessner MJ & Golden DA. 2005. *Modern Food Microbiology*. 7th Ed. Springer.

Ray B. 2004. *Fundamentals of Food Microbiology*. 3rd Ed. CRC.

Robinson RK. (Ed.). 1983. *Dairy Microbiology*. Applied Science.

Steinkraus KS. 1996. *Handbook of Indigenous Fermented Foods*. Marcel Dekker.

Branen A.L. and Davidson, P.M. 1983. *Antimicrobials in Foods*. Marcel Dekker, New York.

Jay J.M. 1986. *Modern Food Microbiology*. 3rd Edn. VNR, New York.

Robinson, R.K. Ed. 1983. *Dairy Microbiology*. Applied Science, London.

FOOD CHEMISTRY

Course Code: MFT-103

Credits 3(2-0-1)

Theory

UNIT I

Food chemistry-definition and importance, major food constituents and their physico-chemical properties.

Carbohydrate: -chemical reactions, functional properties of sugars and polysaccharides in foods. Applications and preparations of sugars and polysaccharides.

UNIT II

Protein and amino acids: structure, classifications, sources, denaturation and functional properties of proteins. Changes in milk and muscle protein during processing. protein quality evaluation.

Lipids and fatty acids: classification and use of lipids in foods, physical and chemical properties. Auto-oxidation of lipids and rancidity, different groups of fats and oils; effects of processing on functional properties of oil.

UNIT III

Properties of minerals, vitamins, anti-oxidants, allergens, toxins and anti-nutritional factors in foods. Effect of processing on vitamins and minerals; Browning reactions in foods. Enzymatic and non-enzymatic browning in foods and industrial applications of enzymes.

Water: Role of water in food. Concept of water activity. water activity and shelf life of food.

UNIT IV

Natural food flavours, extraction methods and characterization. Flavor delivery systems, flavor modifiers Pigments in food and their industrial applications.

UNIT V

Food and energy: PEV and GEV of food constituents, Bomb calorimeter and its functioning. Essential nutrients- sources, functions, deficiency diseases.

Practical

Proximate analysis of foods; calorific value of foods; TSS; pH; acidity; estimation of browning intensity; determination of vitamin C and beta-carotene, sugars; estimation of calcium, phosphorus and iron; anti-nutritional factors in foods.

Suggested Readings

Aurand, L.W. and Woods, A.E. 1973. Food Chemistry. AVI, Westport.

Bamji MS, Rao NA & Reddy V. 2003. *Textbook of Human Nutrition*. Oxford & IBH.

Belity & Grosch. Food chemistry.

Belitz HD.1999. *Food Chemistry*. Springer Verlag.

Birch, G.G., Cameron, A.G. and Spencer, M. 1986. Food Science, 3rd Ed. Pergamon Dekker, New York.

DeMan JM. 1976. *Principles of Food Chemistry*. AVI.

Fenemma. Fundamentals of food chemistry .

Fennema O.R.1996. *Food Chemistry*. Marcel Dekker.

Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel

Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi.

Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport. Press, New York.

Swaminathan M. 1974. *Essentials of Foods and Nutrition*. Vol. II. Ganesh & Co.

W.S.Wang .Mechanism and theory in food chemistry.

ENZYMES IN FOOD PROCESSING

Course Code: MFT-104

Credits 4(3-0-1)

Theory

UNIT I

Enzymes– classification, properties, characterization, kinetics and immobilization; fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry.

UNIT II

Enzymes for production of protein hydrolysates and bioactive peptides, maltodextrins and corn syrup solids (liquefaction, saccharification, dextrinization, isomerization for production of high fructose-corn-syrup), fructose and fructo-oligosaccharides.

UNIT III

Role of enzymes in cheese making and whey processing; fruit juices (cell wall degrading enzymes for liquefaction, clarification, peeling, debittering, decolourization of very dark coloured juices such as anthocyanases); baking (fungal α -amylase for bread making; maltogenic α -amylases for anti-staling; xylanases and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes); meat and meat processing (meat tenderization); egg processing.

UNIT IV

Enzyme processing for flavours (enzyme-aided extraction of plant materials for production of flavours, production of flavour enhancers such as nucleotides; flavours from hydrolyzed vegetable/animal protein); enzymatic approach to tailor- made fats.

Practical

Assay of enzymes for activity, specific activity, kinetics, stability (temperature, pH and storage); Extraction and clarification of juices using enzymes; Applications of enzymes in baking, starch and protein hydrolysis, meat tenderization, cheese making.

Suggested Readings Suggested Readings

Flickinger MC & Drew SW. 1999. *Encyclopedia of Bioprocess Technology*. A Wiley- Inter Science Publ.

Kruger JE. *et al.* 1987. *Enzymes and their Role in Cereal Technology*. American Association of Cereal Chemists Inc.

Nagodawithana T & Reed G. 1993. *Enzymes in Food Processing*. Academic Press.

Tucker GA & Woods LFJ. 1991. *Enzymes in Food Processing*.

Whitehurst R & Law B. 2002. *Enzymes in Food Technology*. Blackwell Publ.

FOOD PACKAGING TECHNOLOGY

Course Code: MFT-105

Credits 4(3-0-1)

Theory

UNIT I

Definitions, objectives and functions of packaging and packaging materials; Packaging requirements and selection of packaging materials. Packaging requirements and selection of packaging materials; Types of packaging materials: Paper; Glass; Metals: Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminium containers, lacquers; Plastics: types of plastic films, laminated plastic materials, co-extrusion, edible films, bio-degradable 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, semi-rigid, 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; Shrink packaging, aseptic packaging systems ; aseptic and retortable pauches; bottling machines; carton making machines. Flexible and laminated pouches, aluminium as packaging material. Bio-degradable packaging. Active packaging. Modified atmosphere packaging.

UNIT V

Evaluation of packaging, and package performance, packaging equipment, package standards and regulation, Bar-coding material.

Practical

Identification and testing of packaging materials; Determination of wax from wax paper; Testing of lacquered tin plate sheets; Measurement of tin coating weight by Clarke's method; To perform sulphide stain test; To conduct ferricyanide paper test for porosity; Determination of equilibrium moisture content; Grading of glass bottles for alkalinity; Determination of water vapour transmission rate of packaging material; To perform vacuum packaging of food sample and carry out its storage study; Testing the compression strength of the boxes; Packaging the food material in seal and shrink packaging machine and study its shelf life; Testing the strength of glass containers by thermal shock test; Testing the strength of filled pouches by drop tester.

Suggested Readings

- Painy, F.A. and Painy, H.Y. 1983. *A Handbook of Food Packaging*. Leonard Hill, Glasgow, UK.
Scicharow, S. and Griffin, R.C. 1970. *Food Packaging*. AVI, Westport.
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.

SEMESTER II

Course Code	Course Title	Total Credits
MFT-201	Post harvest management of fruits and vegetables	4
MFT-202	Cereal, legume and pulses technology	3
MFT-203	Principles of Food Engineering	4
MFT-204	Beverage Technology	3
MFT-205	Food quality systems and management	3
MFT-206	Practical based on MFT -201 and MFT-202	
MFT-207	Practical based on MFT -203, MFT-204 and MFT-205	
Total		17

POST HARVEST MANAGEMENT OF FRUITS AND VEGETABLES

Course Code: MFT-201

Credits 4(3-0-1)

Theory

UNIT I

Importance and scope of post harvest management of fruits and vegetables in Indian economy. Principles and methods of fruit and vegetable preservation.

UNIT II

Morphology, structure and composition of fruits and vegetables; maturity indices and standards for selected fruits and vegetables; methods of maturity determinations.

UNIT III

Harvesting and handling of important fruits and vegetables, Harvesting tools and their design aspects; Field heat of fruits and vegetables and primary processing for sorting and grading at farm and cluster level; factors affecting post harvest losses; Standards and specifications for fresh fruits and vegetable.

UNIT IV

Post-harvest physiological and biochemical changes in fruits and vegetables; ripening of climacteric and non-climacteric fruits; regulations, methods; Storage practices: CA and MA, hypobaric storage, pre-cooling and cold storage, Zero energy cool chamber; Commodity pretreatments - chemicals, wax coating, prepackaging, VHT and irradiation.

UNIT V

Physiological post harvest disorders - chilling injury and disease; prevention of post harvest diseases and infestation; Handling and packaging of fruits and vegetables; Post Harvest handling system for fruits and vegetables of regional importance such as citrus, mango, banana, pomegranate, tomato, papaya and carrot etc., packaging house operations; principles of transport and commercial transport operations.

Practical

Studies of maturing indices; Studies on pre- treatments on selected fruits; Studies on use of chemicals for ripening and enhancing shelf life of fruits and vegetables; Studies on various storage systems and structures; Studies on pre-packaging of fruits and vegetables; Studies on physiological disorders-chilling injury of banana and custard apple; Canning of fruits; fruit marmalade; fruit preserve and candy; fruit RTS, squash, syrup and candy; preparation of grape raisin, dried fig and dried banana; Processing of tomato products; preparation of papain /guava cheese; preparation of pickle, mixed pickle. Visit to commercial storage structures- Onion, garlic and potato.

Suggested Readings

Bose, T.K. Ed. 1985. Fruits of India: Tropical and Sub-tropical. Naya Prokash, Calcutta.

Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.

Hamson, L.P. 1975. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.

Jagtiani J., Chan, H.T. and Sakal, W.S. Ed. 1988. Tropical Fruit Processing Academic Press, London.

Kadar, A. A. 1992. Postharvest Technology of Horticultural Crops. 2nd Ed. University of California.

Lai, G., Siddappa, G. and Tondon G.L. 1986. Preservation of Fruits and Vegetables, Indian Council of Agril. Research, New Delhi.

- Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker, New York.
- Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Vegetable Science and Technology. Production, Composition, Storage and processing Marcel Dekker, New York.
- Seymour, G.B., Taylor, J.E. and Tucker, G.A. Ed. 1993. Biochemistry of Fruit Ripening. Chapman and Hall, London.
- Srivastava, R.P. and Kumar, S. 1998. Fruit and Vegetable Preservation: Principles and Practices. 2nd Ed. International Book Distributing Co. Lucknow.
- Ting, S.V. and Roussett, R.L. 1986. Citrus Fruits and Their Products. Marcel Dekker, New York.
- Thurme S. Ed. 1991. Food Irradiation. Elsevier Applied Science, London.
- Wills, R.B.H., McGlasson, W.B., Graham, W.B., Lee, T.H. and Hall, E.G. 1981. Post-harvest: An Introduction to the Physiology and Handling of Fruits and Vegetables. Granada, U.K.

TECHNOLOGY OF CEREALS, LEGUMES AND OILSEEDS

Course Code: MFT-202

Credits 3(2-0-1)

Theory

UNIT I

Commercial edible oil sources. Processing of crude oils - oil extraction/expression and solvent extraction. Refining of crude oil- degumming, bleaching, deodourization. Hydrogenation and interesterification,

Imitation dairy products - peanut butter and vegetable ghee. Chemical adjuncts lecithins, GMS. Packing and storage of fats and oils, Cocoa butter, fat substitutes and low-calorie foods.

UNIT II

Wheat: Types and physicochemical characteristics; wheat milling -products and byproducts; 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.

Technology of bread, biscuits, cakes, durum wheat, extruded products (pasta and noodles).

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.

UNIT V

Legumes: 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.

Preparation of protein concentrates and isolates and their use in high protein foods.

Practicals

Physical-tests on wheat and rice; Physicochemical and rheological properties; Determination of gluten content in wheat flour; Conditioning of wheat; Milling of wheat and rice by laboratory mill; Parboiling of rice; Quality tests of rice; Amylose content determination in rice; Malting of barley; puffing and popping of grains; experimental parboiling and assessment of degree of polishing; Preparation of protein concentrates and isolates and their evaluation for protein content and solubility; Extraction of oil using expeller and solvent extraction methods; visit to related processing industries.

Suggested Readings

Baking. Royal Society of Chemistry, London.

Blanshard J.M.V., Frazier, P.J. and Galliard, T. Ed. 1986. Chemistry and Physics of
Chakrabarty MM. 2003. *Chemistry and Technology of Oils and Fats*. Prentice Hall.

Chakraverty, A. 1988. Postharvest Technology of Cereals, Pulses and oilseeds. Chemistry, Technology and Utilization. VNR, New York.

Dendy DAV & Dobraszczyk BJ. 2001. *Cereal and Cereal Products*. Aspen.

Durbey, S.C. 1979. Basic Baking: Science and Craft. Gujarat Agricultural University,

Hamilton RJ & Bhati A. 1980. *Fats and Oils - Chemistry and Technology*. App. Sci. Publ.

Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology.

- Hoseney RS. 1994. *Principles of Cereal Science and Technology*. 2nd Ed. AACC.
- Kay DE. 1979. *Food Legumes*. Tropical Products Institute.
- Kent NL. 1983. *Technology of Cereals*. 4th Ed. Pergamon Press.
- Kent, N.L. 1983. *Technology of Cereals*. 3rd Edn. Pergamon Press, Oxford, UK.
- Kulp K & Ponte GJ. 2000. *Handbook of Cereal Science and Technology*. 2nd Ed. Marcel Dekker.
- Lorenz KL. 1991. *Handbook of Cereal Science and Technology*. Marcel Dekker. Marcel Dekker, New York.
- Marshall WE & Wadsworth JI. 1994. *Rice Science and Technology*. Marcel Dekker.
- Mathews RH. 1989. *Legumes Chemistry, Technology and Human Nutrition*. Marcel Dekker.
- Mathews, R.H. Ed. 1989. *Legumes: Chemistry, Technology and Human Nutrition*.
- Matz SA. 1969. *Cereal Science*. AVI Publ.
- Paquot C. 1979. *Standard Methods of Analysis of Oils, Fats and Derivatives*. Pergamon Press.
- Pomeranz, Y. 1987. *Modern Cereal Science and Technology*. VCH Pub., New York.
- Pomeranz, Y. Ed. 1978. *Wheat: Chemistry and Technology*. Am. Assoc. of Cereal Processing and Utilization, (3 vol. set). CRC Press, Florida.
- Salunkhe, D.K., Kadam, S.S. and Austin A. Ed. 1986. *Quality of Wheat and Wheat*
- Watson SA & Ramstad PE. 1987. *Corn; Chemistry and Technology*. AACC.
- Wolf, I.A. Ed. 1983. *Handbook of Processing and Utilization in Agriculture*. (2 vol. set).

Principles of Food Engineering

Course Code: MFT-203

Credits 4(4-0-0)

Theory

UNIT I

Introduction to food engineering; material and energy balances: basic principles, process flow diagrams, total mass balance, component mass balance, material balance problems involved in dilution, concentration and dehydration; heat balance calculations.

UNIT II

Kinetics of biological reactions - kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction; quality changes during storage of foods; application of Arrhenius equation to biological reactions.

UNIT III

Method for thermal process evaluation - Commercial sterility, pasteurization and sterilization methods based on slowest heating region; determination of the process time based on region of greatest temperature lag; the process equivalence in terms of minutes at 121.1°C.

UNIT IV

Food chilling and freezing – Precooling and cold storage; CA and MA; Properties of frozen foods; freezing point depression; general introduction to enthalpy change during freezing; Plank's equation for predicting rates of product freezing; Cryogenic freezing and IQF; design of food freezing equipment such as air blast freezers, plate freezers and immersion freezers.

UNIT V

Mechanical separation-filtration, membrane concentration, sieving, centrifugation, sedimentation, Mechanical handling-conveying and elevation. Size reduction and classification-mixing, kneading, blending.

Suggested Readings

Aeldmam & Lunde Hand book of Food Engineering

Batty, J.C. and Folkman, S.L. 1983. Food Engineering Fundamentals. John Wiley and Sons, New York.

Fennema O.R. Ed. 1985, Principles of Food Science: Part-II Physical Principles of food.

Harper, J.C. 1975. Elements of Food Engineering. AVI, Westport.

Heldman, D.R. and Lund, D.B. Ed. 1992. Handbood of Food Engineering Marcel Dekker, New York.

R.P. Singh Hand book of food Engineering.

T.Toledo .Fundamentals of Food Process Engineering

BEVERAGES TECHNOLOGY

Course Code: MFT-204

Credits 3(2-0-1)

Theory

UNIT I

Types of beverages and their importance; status of beverage industry in India; Manufacturing technology for juice-based beverages; synthetic beverages; technology of still, carbonated, low-calorie and dry beverages; isotonic and sports drinks; role of various ingredients of soft drinks, carbonation of soft drinks.

UNIT II

Specialty beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy and imitation dairy-based beverages.

UNIT III

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipments used for brewing and distillation, wine and related beverages, distilled spirits.

UNIT IV

Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, BIS quality standards of bottled water; mineral water, natural spring water, flavoured water, carbonated water.

Practical

Chemical and microbiological analysis of raw water quality; Preparation of regional fruit juices; Preparation of whey-based beverages; preparation of iced and flavoured tea beverage; Preparation of carbonated and non-carbonated soft drinks; Preparation of wine and beer; Preparation of soy milk, fruit milkshakes, herbal beverages; visit to relevant processing units.

Suggested Readings

Hardwick WA. 1995. *Handbook of Brewing*. Marcel Dekker.

Hui YH. *et al* 2004. *Handbook of Food and Beverage Fermentation Technology*. Marcel Dekker.

Priest FG & Stewart GG. 2006. *Handbook of Brewing*. 2nd Ed. CRC.

Richard P Vine. 1981. *Commercial Wine Making - Processing and Controls*. AVI Publ.

Varnam AH & Sutherland JP. 1994. *Beverages: Technology, Chemistry and Microbiology*. Chapman & Hall.

Woodroof JG & Phillips GF. 1974. *Beverages: Carbonated and Non-Carbonated*. AVI Publ.

SEMESTER III

Course Code	Course Title	Total Credits
MFT-301	Technology of Milk and Milk Products	4
MFT-302	Food additives, contaminants and toxicology	3
MFT-303	Principles of food analysis and sensory evaluation	3
MFT-304	Nutraceuticals and functional foods	4
MFT-306	Practical based on MFT -301 and MFT-302	
MFT-307	Practical based on MFT -203 and MFT-304	
Total		14

FOOD QUALITY SYSTEMS AND MANAGEMENT

Course Code: MFT-205

Credits 3(2-0-1)

Theory

UNIT I

Concept of quality: Quality attributes- physical, chemical, nutritional, microbial, and sensory; their measurement and evaluation; Sensory *vis-à-vis* instrumental methods for testing quality.

UNIT II

Concepts of quality management: Objectives, importance and functions of quality control; Quality management systems in India; Sampling procedures and plans; Food Safety and Standards Act, 2006; Domestic regulations; Global Food Safety Initiative.

Various organizations dealing with inspection, traceability and authentication, certification and quality assurance (PFA, FPO, MMPO, MPO, AGMARK, BIS); Labeling issues; International scenario, International food standards.

Unit III

Quality assurance, Total Quality Management; GMP/GHP; GLP, GAP; Sanitary and hygienic practices; Quality manuals, documentation and audits; Indian & International quality systems and standards; Laboratory quality procedures and assessment of laboratory performance; Applications in different food industries; Food adulteration and food safety. IPR and Patent.

UNIT IV

Sampling and specification of raw materials and finished products, Concept of Codex Alimentarius/ /USFDA/ISO 9000 series , rules and regulations for waste disposals. Food adulteration and food safety. HACCP,.

Practical

Testing and evaluation of quality attributes of raw and processed foods; Detection and estimation of food additives and adulterants; Quality assurance procedure, GMP, GAP documentation; Preparation of quality policy & documentation, Application of HACCP to products, Preparation of HACCP chart; Preparation of documentation & records, Visit to Units with ISO systems; Visit to Units with HACCP certification.

Suggested Readings

Amerine MA *et al* 1965. *Principles of Sensory Evaluation of Food*. Academic Press.

Early R.1995. *Guide to Quality Management Systems for Food Industries*. Blackie Academic.

Furia TE.1980. *Regulatory Status of Direct Food Additives*. CRC Press.

Jellinek G. 1985. *Sensory Evaluation of Food - Theory and Practice*. Ellis Horwood.

Krammer A & Twigg BA.1973. *Quality Control in Food Industry*. Vol. I, II. AVI Publ.

Macrae R. *et al*.1994. *Encyclopedia of Food Science & Technology & Nutrition*. Vol. XVI. Academic Press.

Piggot JR. 1984. *Sensory Evaluation of Foods*. Elbview Applied Science.

Ranganna S. 2001. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw-Hill.

Technology of Milk and Milk Products

Course Code: MFT-301

Credits 3(2-0-1)

Theory

Unit-1

Sources, and composition of milk, processing of market milk, standardization, toning of milk, homogenization, pasteurization, sterilization, storage, transportation and distribution of milk.

Technology of fluid milk: collection, chilling, transportation, cream separation, standardization, pasteurization, sterilization, homogenization, packaging, storage and distribution of fluid milk, flavoured milk, enriched milk.

Unit-2

Milk product processing-cream, butter, condensed milk, evaporated milk, whole and skimmed milk powder.

Unit-3

Instantization of milk and milk products, ice cream, khoa, channa, paneer, milk sweets. Judging and grading of milk and its products.

Unit-4

Technology of fermented milk: principles and practices of manufacture, packaging, storage and marketing of dahi, cultured butter milk, acidophilus milk, yoghurt, shrikhand. Technology of cheese: standards of manufacture of hard, semi hard, soft and processed cheeses. Storage and marketing of cheese. Cheese defects and their control. Dairy equipments and sanitization.

Unit V

Technology of fat rich dairy products: manufacture, packaging, storage and marketing of butter and cream and butter defects and their control. Technology of frozen milk products: classification, standards manufacture, packaging, storage and marketing. Defects of frozen products and their control.

Technology of concentrated, evaporated and dried milk: standards manufacture, packaging. Storage, defects and their control.

Technology of Indigenous dairy products – Khoa (manufacture, classification and use) Paneer, Ghee. Technological aspects of casein manufacture; by- products utilization of dairy industry.

Practical

Study on basics of reception of milk at the plant; platform tests in milk; estimation of fat and SNF in milk; Operation of LTLT and HTST Pasteurization; Preparation of special milks; Cream separation & standardization of milk; Preparation and evaluation of table butter, ice-cream, cheese and indigenous milk product such as khoa, chhanna, paneer, ghee, rosogolla, gulab jamun, shrikhand, lassi, burfi etc.; Visit to dairy plants.

Suggested Readings

B.L.Herrington .Milk and Milk Processing

Considine, D.M. Ed. 1982. Foods and Food Production Encyclopaedia, VNR, New York.

Dey, S. 1994. Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.

Edgar Spreer .Milk and Dairy Technology

Fox Cheese – chemistry , physics & microbiology vol. I & II

Gregory D.Miller. Handbook of Dairy Foods and Nutrition.

MaCrae, R., Robinson, R.K. and Sadler, M.J. Ed. 1993. Encyclopaedia of Food Science, Food Technology and Nutrition Academic Press, London.

Robinson, R.K. (2 vol. set). 1986. Modern Dairy Technology Elsevier Applied Science, UK.

Rosenthal, I. 1991. Milk and Milk Products. VCH, New York.

Su Kumar De.Outlines of dairy technology.

Walastra, Geuts, Normen .Dairy Technology.

Warner, J.M. 1976. Principles of Dairy Processing. Wiley Eastern Ltd. New Delhi.

Yarpar, WJ. and Hall, C.W. 1975. Dairy Technology and Engineering AVI, Westport.

FOOD ADDITIVES, CONTAMINANTS AND TOXICOLOGY

Course Code: MFT-302

Credits 3(2-0-1)

Theory

UNIT I

Definition scope and general principles of food toxicology; manifestation of toxic effects; classification of food toxicants; factors affecting toxicity of compounds; methods used in safety evaluation-risk assessments.

UNIT II

Toxicants and allergens in foods derived from plants, animals, marine, algae & mushroom; Microbial toxins; Food Poisoning; Food borne infections and disease.

UNIT III

Food additives- definitions, classification and functions, Preservatives, antioxidants, colours and flavours (synthetic and natural), emulsifiers, sequesterants, humectants, hydrocolloids, sweeteners, acidulants, buffering salts, anti-caking agents, etc. - chemistry, food uses and functions in formulations; indirect food additives; toxicological evaluation of food additives.

UNIT IV

Toxicology and food additives; Toxicological aspects of nutrient supplements; Chemicals from processing such as fumigants, chlorinated solvents, auto-oxidation products, carcinogens in smoked foods and pyrolysis, agrochemicals; heavy metals; intentional and unintentional additives.

UNIT V

Derived Food toxicants- Processing & Packaging; Toxicants generated during food processing such as nitrosamines, acrylamide, benzene, dioxins and furans; persistent organic pollutants.

Practical

Estimation of preservatives, sweeteners, fibres, colours, antioxidants, flavour enhancers; Isolation, modification, and functional properties of native and modified proteins, starches and lipids; extraction of essential oil and oleoresins; applications of additives and ingredients in foods.

Protocol for detection and quantification of toxins in food, Detection of pesticide residues, antibiotic residues, hormones and veterinary drugs, & heavy metals; Analysis of microbial & plant toxins.

Suggested Readings

Branen A.L. and Davidson, P.M. 1983. Antimicrobials in Foods. Marcel Dekker, New York

Branen AL, Davidson PM & Salminen S. 2001. *Food Additives*. 2nd Ed. Marcel Dekker. New York.

Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker

Furia, T.E. 1980, Handbook of food additives, Vol I and Vol II.

George AB. 1996. *Encyclopedia of Food and Color Additives*. Vol. III. CRC Press.

George AB. 2004. *Fenaroli's Handbook of Flavor Ingredients*. 5th Ed. CRC Press.

Madhavi DL, Deshpande SS & Salunkhe DK. 1996. *Food Antioxidants: Technological, Toxicological and Health Perspective*. Marcel Dekker.

Morton ID & Macleod AJ .1990. *Food Flavours*. Part A, BC. Elsevier.

Nakai S & Modler HW. 2000. *Food Proteins. Processing Applications*. Wiley VCH.

Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport.

Stephen AM. (Ed.). 2006. *Food Polysaccharides and Their Applications*. Marcel Dekker. New York.

Principles of Food Analysis and Sensory Evaluation

Course Code: MFT-303

Credits 3(2-0-1)

Theory

UNIT I

Scope and importance of food evaluation in food industry. Importance of proximate composition analysis. Determination of different constituents in different food sample along with the principle involved in their estimation. Fractionation of ash and their importance in food analysis.

Principles and methods involved in the estimation of calcium, phosphorus and iron in food samples.

UNIT II

Principles and procedures involved in estimation of starch and sugars. Principles and procedures involved in estimation of vitamins: Vitamin A, C, Riboflavin and thiamin. Determination of enzymatic and non-enzymatic browning in food samples. Importance of rheological properties in food. Techniques and principles involved in their estimation.

UNIT III

Introduction to sensory analysis; general testing conditions, Requirements of sensory laboratory; organizing sensory evaluation programme. Selection of sensory panelists; Factors influencing sensory measurements; Sensory quality parameters -Size and shape, texture, aroma, taste, color and gloss; Detection, threshold and dilution tests.

Unit IV

Different tests for sensory evaluation— discrimination, descriptive, affective; Flavour profile and tests; Ranking tests; Methods of sensory evaluation of different food products. Computer-aided sensory evaluation of food & beverage, statistical analysis of sensory data.

Practical

Selection and training of sensory panel; Detection and threshold tests; Ranking tests for taste, aroma colour and texture; Sensory evaluation of various food products using different scales, score cards and tests; Estimation of color and texture; Relationship between objective and subjective methods.

Suggested Readings

Amerine MA, Pangborn RM & Rossles EB. 1965. *Principles of Sensory Evaluation of Food*. Academic Press.

Early R. 1995. *Guide to Quality Management Systems for Food Industries*. Blackie Academic.

Jellinek G. 1985. *Sensory Evaluation of Food - Theory and Practice*. Ellis Horwood.

Lawless HT & Klein BP. 1991. *Sensory Science Theory and Applications in Foods*. Marcel Dekker.

Macrae R, Rolonson Roles & Sadlu MJ. 1994. *Encyclopedia of Food Science & Technology & Nutrition*. Vol. XI. Academic Press.

Maslowitz H. 2000. *Applied Sensory Analysis of Foods*. Vols. I, II. CRC Press.

Piggot JR. 1984. *Sensory Evaluation of Foods*. Elbview Applied Science Publ.

Potter NN & Hotchleiss JH. 1997. *Food Science*. 5th ed. CBS.

Rai SC & Bhatia VK. 1988. *Sensory Evaluation of Agricultural Products*. Indian Agricultural Statistics Research Institute (ICAR).

Stone H & Sidel JL. 1985. *Sensory Evaluation Practices*. Academic Press.

Watts CM, Ylimaki CL, Jaffery LE & Elias LG. 1989. *Basic Sensory Methods for Food Evaluation*. Int. Dev. Res. Centre, Canada.

NUTRACEUTICALS AND FUNCTIONAL FOODS

Course Code: MFT-304

Credits 4(3-0-1)

Theory

UNIT I

Introduction to nutraceuticals: definitions, synonymous terms, basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticals including CODEX.

UNIT II

Concept of angiogenesis and the role of nutraceuticals/functional foods; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action, dosage levels, contraindications if any etc.

UNIT III

Manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids, prebiotics and probiotics, glucosamine, phytosterols etc.; formulation of functional foods containing nutraceuticals – stability and analytical issues, labelling issues.

UNIT IV

Clinical testing of nutraceuticals and health foods; interactions of prescription drugs and nutraceuticals; adverse effects and toxicity of nutraceuticals; nutrigenomics – an introduction and its relation to nutraceuticals.

Practical

Market survey of existing health foods; identification and estimation of selected nutraceuticals; production and quality evaluation of foods containing nutraceuticals; development of labels for health foods; visit to relevant processing Units.

Suggested Readings

Brigelius-Flohé, J & Joost HG. 2006. *Nutritional Genomics: Impact on Health and Disease*. Wiley VCH.

Cupp J & Tracy TS. 2003. *Dietary Supplements: Toxicology and Clinical Pharmacology*. Humana Press.

Gibson GR & William CM. 2000. *Functional Foods - Concept to Product*.

Goldberg I. 1994. *Functional Foods: Designer Foods, Pharma Foods*.

Losso JN. 2007. *Angi-angiogenic Functional and Medicinal Foods*. CRC Press.

Manson P. 2001. *Dietary Supplements*. 2nd Ed. Pharmaceutical Press.

Campbell JE & Summers JL. 2004. *Dietary Supplement Labeling Compliance*.

Neeser JR & German BJ. 2004. *Bioprocesses and Biotechnology for Nutraceuticals*. Chapman & Hall.

Robert EC. 2006. *Handbook of Nutraceuticals and Functional Foods*. 2nd Ed. Wildman.

Shi J. (Ed.). 2006. *Functional Food Ingredients and Nutraceuticals: Processing Technologies*. CRC Press.

Webb GP. 2006. *Dietary Supplements and Functional Foods*. Blackwell Publ.

SEMESTER IV

Subject No.	Subject Name	Total Credits
MFT-401	Seminar	02
MFT-401	Thesis/project	15
Total		17

THESIS/ PROJECT

Course Code: MFT-402

Credits 15 (0-0-15)

- I. Every student shall be required to conduct research on a topic selected in consultation with the Advisory Committee constituted for the purpose.
- II. The Advisory Committee for guiding the student's research shall be appointed by the HOD/Principal of the College and shall comprise of at least three members from the concerned and related departments.
- III. The students shall be required to submit the results of research in the form of a Thesis dissertation. The thesis shall be forwarded to the External examiner for evaluation at least twenty days before the date of the Viva-voce examination. The external examiner shall be appointed by the Kumaun University. If the examination report of the dissertation is satisfactory, the external examiner shall be invited to conduct viva- voce examination. The grading of the thesis shall be done satisfactory or unsatisfactory by the external examiner. In case the result of thesis dissertation is unsatisfactory, the thesis shall be revised as per recommendation of the external examiner and resubmitted within 30 days by concern student.
- IV. There will be an option for students to do project work in lieu of thesis research. Each student's project shall be guided by an advisory committee consisting of at least three members and the student will have to submit report on their project work. The evaluation of the project work shall consist of evaluation of the project report and viva- voce examination to be conducted by external examiner. The grading for the project and the viva-voce shall be satisfactory or unsatisfactory as in case of thesis dissertation.